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***TABLE OF CONTENTS***

1	<b><i>AIR FORCE.....</i></b>	<b>5</b>
2	<b><i>MANAGEMENT.....</i></b>	<b>122</b>
3	<b><i>SOCIO-HUMANITIES .....</i></b>	<b>369</b>
4	<b><i>ELECTRICAL AND ELECTRONICAL ENGINEERING.....</i></b>	<b>661</b>
5	<b><i>MECANICAL ENGINEERING.....</i></b>	<b>806</b>
6	<b><i>MATHEMATICS, COMPUTER SCIENCES AND INFORMATION TECHNOLOGY.....</i></b>	<b>1029</b>

## 1. AIR FORCE

„CONSIDERATIONS UPON THE CAVITATION PHENOMENON OCCURING AT THE NAVY PROPELLERS AND HYDROFOILS”, <b>Beazit ALI , Adriana SPORIȘ, Handeris ALI</b>	6
„OBTAINING THE CHARACTERISTICS OF SMALL AND VERY SMALL SPAN WINGS”, <b>Beazit ALI , Adriana SPORIȘ, Handeris ALI</b>	10
„THE ADAPTIVE CONTROL. THE SIMULATION OF THE ADAPTIVE SYSTEMS”, <b>Corneliu AXENTE, Silviu BALUȚĂ, Mircea BOȘCOIANU</b>	15
„THE COMMAND AND CONTROL STRUCTURE OF THE MOBILE SHORT RANGE AIR DEFENCE SYSTEMS”, <b>Silviu BĂLUȚĂ, Marian PEARSICA, Corneliu AXENTE</b>	19
„ROMANIA - THE SECURITY PROVIDER IN THE WIDER BLACK SEA REGION”, <b>Catalin CIOACA</b>	24
„HELICOPTER ANTITORQUE SYSTEM USING CIRCULATION CONTROL”, <b>Ionică CÎRCIU</b>	32
„MODERNIZATION OF THE AUDIO-VIDEO RECORDING AND DEBRIEFING SYSTEM FOR THE IAR 99 SOIM AIRCRAFT”, <b>Eugen DUMITRU</b>	35
„HIGH ACCURACY DETERMINATION OF FLIGHT PERFORMANCES OF AIRCRAFT”, <b>Marin FIRANESCU, Gheorghe MUNTEANU</b>	39
„INTEGRATION OF EMOTIONAL INTELLIGENCE IMPLICATIONS FOR MILITARY LEADERSHIP”, <b>Lavinia GAVRILĂ, Ionel ONICIUC – CORDUBAN</b>	45
„EVOLUTIONS AND TENDENCIES, IN THE COMMON EUROPEAN SECURITY STRATEGY IN THE CONTEXT OF GLOBALIZATION”, <b>Ovidiu MOȘOIU, Marian OANA</b>	50
„CRISIS MANAGEMENT - CIVIL AND MILITARY WAYS OF ACTION”, <b>Marian OANA, Ovidiu MOȘOIU</b>	60
„CORROSION DAMAGE OF ENTRANCE BUCKET”, <b>Sorin PAVEL</b>	68
„THE FUNCTION BEHAVIOR AT STATOR’S AND ROTOR’S TURBINE BLADES”, <b>Sorin PAVEL</b>	73
„TRANING IN CINCU RANGE ONLY BY SIMULATION?”, <b>Horia POPESCU, Adrian ALEXEI</b>	77
„THE IMPLICATIONS ISSUE OF THE INTEGRATION IN NATINEADS ON THE NATIONAL AIR DEFENCE SYSTEM”, <b>Marcel PREDA, Eugen BOAMBĂ</b>	83
„AERO DYNAMICAL STUDY ON RELIEVING ROPE”, <b>Georgică SLĂMNOIU, Gabriel VLADU, Adrian CIUCULIN, George SURDU, Viorel UDRESCU, Simona CIUREA, Camelia PASCU</b>	87
„ CONSIDERATIONS REGARDING THE FLYING CONDUCT OF THE CLOSE OBSERVATION SYSTEM SUPERVISOR COMBAT COMPONENT”, <b>Georgică SLĂMNOIU, Gabriel VLADU, Adrian CIUCULIN, George SURDU, Viorel UDRESCU, Simona CIUREA, Camelia PASCU</b>	90
„NEW METHODS IN EDUCATION OF AIR DEFENCE STUDENTS“, <b>Milan SOPÓCI</b>	94
„AIR FORCE ROLE, PLACE AND CONTRIBUTION AS SECURITY PROVIDER IN NATO AND EU”, <b>Ion Aurel STANCIU</b>	100
„INFORMATION ON GASEOUS DETONATIONS”, <b>Costin-Sebastian ZAGONEANU, Cristian ULEANU, Octavian ORBAN</b>	108
„COMPLEX ASPECTS OF DETONATIONS”, <b>Costin-Sebastian ZAGONEANU, Cristian ULEANU, Octavian ORBAN</b>	115

## CONSIDERATIONS UPON THE CAVITATION PHENOMENON OCCURING AT THE NAVY PROPELLERS AND HYDROFOILS

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*Abstract: This working research presents an original approach of the cavitation processes taking into consideration similar phenomena which are producing in nature. This new vision about cavitation phenomenon offers us other ways to study it, among these the similarity theory .In the working research are presented also the methods which can make possible the removing or the slowing down of cavitation process starts during the navy propeller and carrying wings function*

**Key words:** cavitation, bubbles, model

### 1. INTRODUCTION

There are situations when in different zones of a liquid's current the static pressure of the liquid falls below the evaporation pressure value, at the temperature of the respective environment. In these zones the process of water evaporation begins; the mass of current produced by liquid becomes discontinuous; at this stage bags of water and gas, which were previously present in water (dissolved in it and absorbed by it at high pressures) can appear. If these gas and liquid bags are carried by the liquid current towards other zones of the current, where the static pressure is bigger than the pressure at which the vapors were created, then a sudden condensation of water vapors takes place, thus generating vacuum pockets (in the space initially occupied by vapors) which absorb the surrounding liquid at extraordinary high speeds. As a result, the liquid hits the metallic surfaces, which delimited the space of the vapor bags with great force, thus provoking the detachment of metallic microparticles which belonged to the rigid walls that delimited the mass of the liquid current. Since the absorption

speed of the liquid towards the liquid bags can become extremely high there can be a possibility for the static pressure to fall again below the evaporation pressure value at the respective temperature, thus generating a new evaporation of the liquid that can be followed by a new condensation of vapors and by absorption of the surrounding liquid towards the space delimited by the respective metallic surfaces, with a new microparticle detachment. The repeated vaporization and condensation process, followed by pressure shocks with metallic microparticle detachment is called cavitation.

### 2. THEORETICAL CONSIDERATIONS ON CAVITATION

As it is known, the problems related to cavitation haven't been resolved theoretically, although much research and experiments have been, and is still being made. It appears curious that this important issue hasn't, at least, been inferred appropriately, according to the inner

structure of the phenomenon. Researchers in this domain seem not to have understood that the process of cavitation is similar, structurally, with the phenomenon of vapor condensation, present in the earth's atmosphere, that appear during rain seasons. It is logical then, to understand that the electric discharges during rain seasons can appear at a smaller scale, even in the process of cavitation.

The occurring of the electric sparks in the process of current cavitation should not appear surprising to anyone, nor should the bioelectromagnetism of the human body and other beings; they are subordinated to the same structural laws of universal electromagnetism. Probably, the phenomenon of electric spark occurrence can be more easily understood when it is compared with the pneumatic transportation of flour, used by whet mills. It is known that disastrous fires happened, many times, during the pneumatic transportation of flour; they were caused by electrostatic discharges within the pipes used for pneumatic transport. The same electrostatic discharges may appear when gasoline is transported in plastic containers.

We are hopeful that electromagnetism and electrostatic discharges, of which we have talked, will soon be known, reproduced and used for the benefit of humanity. Only then cavitation and rain phenomena will be mastered, and corresponding possibilities of generation and stopping will be created for them.

The electrostatic charge of water vapors that creates the clouds in the terrestrial atmosphere or in spaces where cavitation is generated – having as a consequence electric discharges (lightnings or electric sparks) – is a problem for the science of the future to be solved, with all the benefits that may come out of this.

The occurrence of cavitation is followed by an abnormal sound, and by the vibrations that lead to the decrease of efficiency, volume and charge of hydraulic installations.

Avoidance of cavitation requires that the static pressure of the flowing water should not

become equal or smaller than its evaporation pressure at the respective temperature.

The increase of ship speed has a great influence on the propellers functioning, because with the increase of the flow speed through the propellers' blades, the static pressure of the liquid decreases, sometimes below the value of the evaporation pressure, thus leading to the occurrence of cavitation.

The presence of certain gas or vapors bags disrupts the homogeneity of the current flow, this happening when the sector in which cavitation takes place is sufficiently big; in this case the hydrodynamic characteristics of the support profile.

At present there is not any theoretical formulation to state corresponding relations between the size of the cavitation region and the effect on the hydrodynamic profile characteristics.

The word "cavitation" comes from the Latin "cavitas", which means "empty" (inside). In reality the bags of fluid that generate cavitation are filled with a mixture of water vapors and gas.

Supposing the profile's section is moves at a speed  $v_0$ , in an ideal liquid, with density  $\rho$ .

If we note with  $p_A$  the pressure in a certain point on the surface of the profile, with  $v_A$  the local speed in this point, and with  $p_0$  the static pressure in the undisrupted liquid:

According to the BERNOULLI equation, we have:

$$p_A = p_0 - \frac{\rho}{2}(v_A^2 - v_0^2) \quad (01)$$

From the above relation we see that the local pressure on the surface of the profile decreases with the increase of the dynamic pressures

$\frac{\rho}{2}(v_A^2 - v_0^2)$ , and when this difference

becomes equal with the static pressure of the undisrupted environment of the local pressure

becomes invalid. The more the  $\frac{\rho}{2}(v_A^2 - v_0^2)$

increases, the smaller the pressure  $p_A$  becomes; this leads to the generation of the cavitation phenomenon, with liquid

detachment off the metallic surface that delimits its volume.

The occurrence of cavitation on the propeller's blades is followed by a release of air bubbles that spread into the water. If the revolution of the propeller is increased, at a certain moment, there can appear vapors and gas on the surface of the propeller, in zones with minimum pressure. These bubbles are moved by the water current. The release of vapors and gases, with

the condensation of vapors is responsible for the propeller's sound. As the propeller's revolution movement increases, there may be a possibility for the propeller to be surrounded by a pocket of vapors; the same can happen to the bearing wings of the winged crafts. In such cases as the density decreases the bearing force decreases and the ship 's hull falls into the water. The wings lose the vapor bags and as well as the sustaining force of the raised water current. Cavitation re-appears and there appears another phenomenon- ship's galloping.

We can infer from the above mentioned that cavitation can appear when the static pressure of the liquid becomes equal or smaller than the evaporation pressure at the respective temperature of the environment. The following relations can be written:

$$p = p_0 - c_{p_{\max}} \cdot p_d \leq p_v \quad (02)$$

where:

$p_0$  - the static pressure of the undisrupted liquid  
 $p$  - pressure in a point on the surface of the liquid

$p_v$  -the vaporization pressure of at the respective temperature of the environment

$$p_d = \frac{\rho v_0^2}{2} \text{ - dynamic pressure}$$

$$c_{p_{\max}} = \frac{p_0 - p_v}{\frac{\rho v_0^2}{2}} = c_p = K$$

$K$  - pressure coefficient or cavitation number

As we have already mentioned when the entire bearing wing is surrounded by a bag of water vapors, its sustaining force is 800 times

reduced because  $\rho_{\text{aer}}$  is approximately 800 times smaller than  $\rho_{\text{apa}}$ .

The values of propeller's pushing and efficiency depend at a great extent on number of cavitation  $K$ , which at its turn depends on the speed march.

The values of cavitation number span within the interval  $0,2 \leq K \leq 2$ . The small value refer to fast ships, and the big ones to the slow ships.

Up to the present there is no theory referring to the corresponding relations between the size of the cavitation region and the effect produced on the hydrodynamic characteristics of the propeller.

Experiments on mock-ups are made in cavitation tunnels in which variation of speeds and pressures can be controlled, which allows the making of an analysis of the dependence between the evolution of cavitation and that of the propeller's pushing capacity, and the propeller's momentum, as well as of moment in which cavitation becomes dangerous for the thruster's performances. By systematic experiments specialists drew the conclusion that the main criteria according to which the propellers should be modeled when they suffer the phenomenon of cavitation is the equality of cavitation numbers  $K_m = K_n$ , on the mock-up.

$$\frac{p_{0m} - p_{vm}}{0,5 \rho_m v_{0m}^2} = \frac{p_{0n} - p_{vn}}{0,5 \rho_n v_{0n}^2} \quad (03)$$

In which with  $m$  were noted the measurements related to the model, and with  $n$  those referring to the prototype.

In the evolution of the process of cavitation there are other similitude criteria, which assure the similitude between the phenomenon on the model, and the one on the prototype, namely: REYNOLDS, NEWTON and WEBER.

The FROUDE criteria can be left apart under appropriate immersing conditions, and for the REYNOLDS number, a value, small enough so that all the sectors of the blades be under the critical limits, should be provided. As to what the WEBER criteria is concerned (which modifies the forces of superficial tension) practically it is impossible to realize an



equality both on the model and on the prototype of this criteria; attention should be paid on the air content of the water in the basin, on which the evolution of the process of cavitation depends. The fact that the beginning of cavitation depends on the angle of attack  $\alpha$ , should not be neglected; the bigger the angle of attack, the sooner the process of cavitation begins.

### 3. CONCLUSIONS

If the positive angle of attack  $\alpha$  is big the process of cavitation appears on the back of the profile, beginning with the board of attack.

In case both the positive and negative angles of attack are smaller, cavitation appears on the exterior back of the profile, approximately on its middle part. In this case, at great speeds of the current of translation and when the thickness of the profile is big, cavitation can extend on the interior back, and in such a case the whole profile will be surrounded by a bag of air and gas.

In the case of big, negative angles of attack, cavitation can appear on the interior back of the profile beginning with the board of attack.

In order to stop the phenomenon of cavitation of the propeller, it is necessary to fit up, at a relatively small distance, a wing, named cavitation stopping wing. On the interior back of this wing, while the slip is underway, the pressure increases and thus the phenomenon of cavitation is stopped.

Experiments on propellers mock-ups, in cavitation models allow the set up of all the factors that produce cavitation. These are: the overloading of propellers, the big turning

speed of the propeller, the small stern draft, the ship's high speed, the low efficiency of the thruster, great sliding and small pitch, big number of propellers, poor polishing of the propellers' blades, the big thickness of the blades, blades with inappropriate hydrodynamic profiles.

As it was seen, all the factors that appear in a propeller's designing have influences on cavitation; however one can not set the priorities of the phenomena which generate cavitation.

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## OBTAINING THE CHARACTERISTICS OF SMALL AND VERY SMALL SPAN WINGS

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**Abstract:** This scientific work presents the way in which the small, and very small span wings can be obtained starting from the great span wings and using the two scales of the similarity theory. Basing on two scales model it can transcribe from model at nature the coefficients  $c_x$ ,  $c_y$  and lengthening  $\lambda$  of GOTTINGEN- 612 profile.

### 1.INTRODUCTION

In the following we will set out the coordinates (polars ) of wings of small and very small elongation, which can be obtained starting from the coordinates of the wings of big elongation, if the theory of similitude is used at two scales. In order to obtain this it is necessary to transcribe from model to nature the coefficients  $c_x$ ,  $c_y$  and elongation  $\lambda$ , according to the model at two scales of the wing.

### 2. TRANSCRIPTION OF THE COEFFICIENTS $c_x$ , $c_y$ AND $c_M$ ACCORDING TO THE MODEL AT TWO SCALES

In the case of the rectangular wing in a plane, having string  $c$  constant all along the span ( in this case the wing is called aerodynamically twisted with the angle of attack variable along the span) the surface of the wing is determined with the relation:

$$S = c \cdot l \quad (01)$$

The relative elongation of the wing is:

$$\lambda = \frac{l^2}{S} = \frac{l^2}{l \cdot c} = \frac{l}{c} \quad (02)$$

Since  $K_l = K_z$  și  $K_c = K_x$  the elongation scale is:

Since  $K_l = K_z$  și  $K_c = K_x$  the scale of the elongation is:

$$K_\lambda = \frac{K_l}{K_c} = \frac{K_z}{K_x} = \frac{\lambda_n}{\lambda_m} = K_1 \quad (03)$$

$$\lambda_n = K_1 \cdot \lambda_m ; K_1\text{-raport de distorsiune} \quad (04)$$

from which results the relation of elongation transcription:

$$\lambda_n = K_1 \cdot \lambda_m ; K_1\text{- distort ratio}$$

If we write the wing's bearing force like:

$$R_y = c_y \cdot S \cdot \frac{\rho \cdot v^2}{2} \quad (05)$$

We have:

$$K_R = K_{R_y} = K_{c_y} \cdot K_S \cdot K_\rho \cdot K_v^2 = K_{c_y} \cdot K_z \cdot K_x \cdot K_\rho \cdot K_v^2 \quad (06)$$

The scale of the forces can also be written like:

$$K_R = K_{R_y} = K_1^2 \cdot K_\rho \cdot K_v^2 \cdot K_x^2 = K_\rho \cdot K_z^2 \cdot K_v^2 \quad (07)$$

And by the equalization of the relations (06) și (07) we get:

$$K_{c_y} \cdot K_z \cdot K_x \cdot K_\rho \cdot K_v^2 = K_\rho \cdot K_z^2 \cdot K_v^2 \quad (08)$$

hence resulting the scale of the unitary coefficient of the bearing force:

$$K_{c_y} = \frac{c_{y_n}}{c_{y_m}} = \frac{K_z}{K_x} = K_1 \quad (09)$$

having thus:

$$c_{y_n} = K_1 \cdot c_{y_m} \quad (10)$$

The advance resistance being:

$$R_x = c_x \cdot S \cdot \frac{\rho v^2}{2} \quad (11)$$

and taking into account the relation (8), because the scale of forces is dependent on their nature we can write:

$$K_R = K_{R_x} = K_{c_x} \cdot K_z \cdot K_x \cdot K_\rho \cdot K_v^2 = K_\rho \cdot K_z^2 \cdot K_v^2 \quad (12)$$

from which result the relation:

$$K_{c_x} = \frac{c_{x_n}}{c_{x_m}} = \frac{K_z}{K_x} = K_1 \quad (13)$$

having:

$$c_{x_n} = K_1 \cdot c_{x_m} \quad (14)$$

As it is known for a given profile the coefficients  $c_x$ ,  $c_y$  and  $c_M$  are functions of the incidence angle  $\alpha$ , and the criteria of similitude Re, Fr, Sh și Eu; also, the covement conditions of the wing in the unlimited fluid or in the vicinity of a solid or fluid surface have a great influence.

Let's examine now the scale of  $c_M$  in conditions of similitude at two scales, with small angles of attack. In this case we can write the relation:

$$M = R_y \cdot e \quad (15)$$

In which e represents the distance from the pressure centre of the profile to its board of attack.

So, we can write:

$$K_M = K_R \cdot K_c = K_\rho \cdot K_v^2 \cdot K_z^2 \cdot K_x \quad (16)$$

and

$$K_M = K_{c_M} \cdot K_\rho \cdot K_z \cdot K_x \cdot K_v^2 \cdot K_x \quad (17)$$

Equalizing (16) cu (17) we get:

$$K_\rho \cdot K_v^2 \cdot K_z^2 \cdot K_x = K_{c_M} \cdot K_\rho \cdot K_z \cdot K_x^2 \cdot K_v^2 \quad (18)$$

From which results:

$$K_{c_M} = \frac{(c_M)_n}{(c_M)_m} = \frac{K_z}{K_x} = K_1 \quad (19)$$

Or:

$$(c_M)_n = K_1 (c_M)_m \quad (20)$$

By the help of the relations (03), (10), (14), and (20) it is possible to transcribe the nondimensional  $\lambda$ ,  $c_y$ ,  $c_x$  and  $c_M$  from the model to nature, which as seen, have in nature the values from the model multiplied by the distortion ratio  $K_1$ . Being nondimensional, these coefficients vary to the same extent when they shift from model to nature.

We should also say that in order to obtain the nature wing's hydrodynamic coefficients we can also use the following formula: If we write the speed on the model like:

$$v_m = \frac{Re_m \cdot v_m}{c_m} \quad (21)$$

And having known that between the speed of the nature wing and model wing is the following relation of similitude :

$$v_n = v_m \cdot \frac{K_x}{\sqrt{K_z}} \quad (22)$$

we get:

$$v_n = \frac{Re_m \cdot v_m}{c_m} \cdot \frac{c_n}{\sqrt{\lambda_m \cdot c_m}} \quad (23)$$

from which:

$$v_n = \frac{Re_m \cdot v_m \cdot c_n \cdot \sqrt{\lambda_m \cdot c_m}}{c_m^2 \sqrt{l_n}} \quad (24)$$

or:

$$\frac{\sqrt{c_m}}{c_m} = \frac{v_n \cdot \sqrt{l_n}}{Re_m \cdot v_m \cdot c_n} \quad (25)$$

$$c_m \sqrt{c_m} = \frac{Re_m \cdot v_m \cdot c_n \cdot \sqrt{\lambda_m}}{v_n \cdot \sqrt{l_n}} \quad (26)$$

obtaining in this way the relation of determination of the model's string's length  $c_m$ :

$$c_m = 3 \sqrt{\left( \frac{Re_m \cdot v_m \cdot c_n \cdot \sqrt{\lambda_m}}{v_n \cdot \sqrt{l_n}} \right)^2} \quad (27)$$

Using the definition relation of the relative elongation we can determine the span of the model wing:

$$l_m = \lambda_m \cdot c_m \quad (28)$$

We calculate the scale of the string  $K_c$  and the scale of the span  $K_l$ :

$$K_c = K_x = \frac{c_n}{c_m} \quad (29)$$

$$K_l = K_z = \frac{l_n}{l_m} \quad (30)$$

We determine the distortion ratio  $K_1$

$$K_1 = \frac{K_l}{K_c} = \frac{K_z}{K_x} \quad (31)$$

We state the scales of density, speed, and force.

$$K_\rho = \frac{\rho_n}{\rho_m} \quad (32)$$

$$K_v = \frac{K_x}{\sqrt{K_z}} = \frac{v_n}{v_m} \quad (33)$$

$$K_R = K_\rho \cdot K_x^2 \cdot K_z = \frac{R_{y_n}}{R_{y_m}} = \frac{R_{x_n}}{R_{x_m}} \quad (34)$$

Both the model and the real wing are rectangular in plan, and we can determine, with the known data the areas of the surfaces:  $S_m = l_m \cdot c_m$  (35)

$$S_n = l_n \cdot c_n \quad (36)$$

According to the law of the model we calculate the speed of the nature (real) wing:

$$v_n = v_m \cdot K_v = v_m \cdot \frac{K_x}{\sqrt{K_z}} \quad (37)$$

With the known data we can further determine the bearing force of the model wing:

$$R_{y_m} = c_{y_m} \cdot S_m \cdot \frac{\rho_m \cdot v_m^2}{2} \quad (38)$$

Using the law of model or the relation (07), we will calculate the bearing force of the real wing:

$$R_{y_n} = K_R \cdot R_{y_m} = K_x^2 \cdot K_z \cdot K_\rho \cdot R_{y_m} \quad (39)$$

From which the coefficient of the real wing bearing force:

$$c_{y_n} = \frac{R_{y_n}}{S_n \cdot \frac{\rho_n \cdot v_n^2}{2}} \quad (40)$$

We calculate the advance resistance of the model wing:

$$R_{x_m} = c_{x_m} \cdot S_m \cdot \frac{\rho_m \cdot v_m^2}{2} \quad (41)$$

and on the basis of the law of model we get the advance resistance of the real wing:

$$R_{x_n} = K_R \cdot R_{x_m} = K_\rho \cdot K_x^2 \cdot K_z \cdot R_{x_m} \quad (42)$$

From which the coefficient of advance resistance of the real wing is deduced:

$$c_{x_n} = \frac{R_{x_n}}{S_n \cdot \frac{\rho_n \cdot v_n^2}{2}} \quad (43)$$

In conclusion, taking into account what we have mentioned before, we can say that the values of the coefficients  $c_{y_n}$  și  $c_{x_n}$

of the real(nature) wing do not depend on the dimensions of the model wing; they depend only on the relative elongation of the wing, and for every single elongation of the wing only one polar is established.

It is true that if we extend the relations (10) and (14.) we get:

$$c_{y_n} = c_{y_m} \cdot \frac{K_z}{K_x} = c_{y_m} \cdot \frac{\frac{l_n}{l_m}}{\frac{c_n}{c_m}} = c_{y_m} \cdot \frac{\lambda_n}{\lambda_m} \quad (44)$$

$$c_{x_n} = c_{x_m} \cdot \frac{K_z}{K_x} = c_{x_m} \cdot \frac{\frac{l_n}{l_m}}{\frac{c_n}{c_m}} = c_{x_m} \cdot \frac{\lambda_n}{\lambda_m} \quad (45)$$

This is to confirm once more that within the relations between coefficients the dimensions of model wing do not interfere.

**3. TRACING THE GOTTINGEN – 612 PROFILE’S POLAR WITH RELATIVE ELONGATION  $\lambda = 3$ , KNOWING THE CORRESPONDING PROFILE’S POLAR CORRESPONDING TO THE RELATIVE ELONGATION  $\lambda = 5$**

The string’s length  $c_n = 0,3$  m and the ship’s speed  $v_n = 25$  m/s is considered for the nature wing. We also stress that the initial polar was drawn in the aerodynamic tunnel, an the small span wing under observation will function in water.

Cinematic viscosity values of the two fluids are:

$$v_{aer} = 0,0000143 \frac{m^2}{s} \quad v_{apa} = 1,191 \cdot 10^{-6} \frac{m^2}{s}$$

Table No. 1

$\alpha$	$c_{ym}$	$c_{xm}$
-10,4	-0,340	0,0796
-8,9	-0,250	0,0216
-6,0	-0,056	0,0096
-3,0	0,141	0,0109
-0,1	0,322	0,0159
2,8	0,526	0,0261
5,8	0,723	0,0437
8,7	0,900	0,067
11,6	1,044	0,0941
14,6	1,073	0,135
17,7	0,952	0,260

The distortion ratios for the three elongations

$$\lambda_{n_1} = 3; \lambda_{n_2} = 2 \text{ și } \lambda_{n_3} = 1$$

will be:

$$K_1' = \frac{\lambda_{n_1}}{\lambda_m} = \frac{3}{5} = 0,6 \quad (47)$$

$$K'' = \frac{\lambda_{n_2}}{\lambda_m} = \frac{2}{5} = 0,4 \quad (48)$$

$$K''' = \frac{\lambda_{n_3}}{\lambda_m} = \frac{1}{5} = 0,2 \quad (49)$$

Using the equations obtained through the theory of similitude (10) and (14) we can draw up the table 2 for the nature wing with elongation  $\lambda_{n_1} = 3$ :

$$\lambda_{n_1} = 3; K_1' = 0,6; Re_n = 6.300.000.$$

TABLE No. 2.

Thus, for the  $c_n = 0,3m$ ,  $v_n = 25 \frac{m}{s}$  and

$$v_{apa} = 1,191 \cdot 10^{-6} \frac{m^2}{s} \text{ there results:}$$

$$Re_n = \frac{v_n \cdot c_n}{v_{apa}} = \frac{25 \cdot 0,3}{1,191 \cdot 10^{-6}} = 6,27 \cdot 10^6 \quad (46)$$

$$Re_n = 6.300.000.$$

The GOTTINGEN-612 profile is characterized by:  $\lambda_m = 5$  and  $Re_n = 420.000$ . The following data are to be found in the specialty literature (see table 1)

Table No. 2

$\alpha$	$c_{ym}$	$c_{xm}$
-10,4	-0,204	0,0477
-8,9	-0,15	0,0129
-6,0	-0,033	0,00576
-3,0	0,091	0,0065
-0,1	0,1932	0,0095
2,8	0,3156	0,0156
5,8	0,434	0,0262
8,7	0,54	0,0402
11,6	0,626	0,0564
14,6	0,644	0,081
17,7	0,5712	0,156

**4. CONCLUSIONS**

Going on in the same manner, that is starting from the polars of big span wings and using the theory of similitude at two scales, the polars of other profiles ( of small and very small span), which were analysed, can be built; for example: GOTTINGEN-439, GOTTINGEN- 480, NACA- 4409, CLARK Y, RAF- 32, GOTTINGEN- 565, GOTTINGEN- 670, GOTTINGEN- 682, GOTTINGEN- 507, and NACA- 6412, (for  $\lambda=3$ ,  $\lambda=2$  and  $\lambda=1$ ).

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## THE ADAPTIVE CONTROL. THE SIMULATION OF THE ADAPTIVE SYSTEMS.

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**Abstract:** In order to simulate the adaptive systems, we've chosen to simulate the adaptive control with reference model, also known as Model Reference Adaptive Control – MRAC. The general idea behind Model Reference Adaptive Control (MRAC, also know as an MRAS or Model Reference Adaptive System) is to create a closed loop controller with parameters that can be updated to change the response of the system. The output of the system is compared to a desired response from a reference model. The control parameters are update based on this error. The goal is for the parameters to converge to ideal values that cause the plant response to match the response of the reference model.

*Key words:* MIT rule, adaptive control

### 1. THEORETICAL CONSIDERATIONS

Again, the idea behind Model Reference Adaptive Control is to create a closed loop controller with parameters that can be updated to change the response of the system to match a desired model. There are many different methods for designing such a controller. This tutorial will cover design using the MIT rule in continuous time. When designing an MRAC using the MIT rule, the designer chooses: the reference model, the controller structure and the tuning gains for the adjustment mechanism. MRAC begins by defining the tracking error,  $e$ . This is simply the difference between the plant output and the reference model output:

$$e = y_{sistem} - y_{model} \quad (1)$$

From this error a cost function of theta ( $J(\theta)$ ) can be formed.  $J$  is given as a function of theta, with theta being the parameter that will be adapted inside the controller. The choice of this cost function will later determine how the parameters are updated. Below, a typical cost function is displayed.

$$J(\theta) = \frac{1}{2} e^2(\theta) \quad (2)$$

To find out how to update the parameter theta, an equation needs to be formed for the change in theta. If the goal is to minimize this cost related to the error, it is sensible to move in the direction of the negative gradient of  $J$ . This change in  $J$  is assumed to be proportional to the change in theta. Thus, the derivative of theta is equal to the negative change in  $J$ . The result for the cost function chosen above is:

$$\frac{d\theta}{dt} = -\gamma \frac{\delta J}{\delta \theta} = -\gamma e \frac{\delta e}{\delta \theta} \quad (3)$$

This relationship between the change in theta and the cost function is known as the MIT rule. The MIT rule is central to adaptive nature of the controller. Note the term pointed out in the equation above labeled „sensitivity derivative”. This term is the partial derivative of the error with respect to theta. This determines how the parameter theta will be updated. A controller may contain several different parameters that require updating. Some may be acting n the input. Others may be acting on the output. The sensitivity derivative would need to be calculated for

each of these parameters. The choice above results in all of the sensitivity derivatives being multiplied by the error.

Another example is shown below to contrast the effect of the choice of cost function:

$$J(\theta) = |e(\theta)|$$

$$\frac{d\theta}{dt} = -\gamma \frac{\delta e}{\delta \theta} \text{sign}(e) \quad (4)$$

$$\text{where, } \text{sign}(e) = \begin{cases} 1, & e > 0 \\ 0, & e = 0 \\ -1, & e < 0 \end{cases}$$

To see how the MIT rule can be used to form an adaptive controller, consider a system with an adaptive feed forward gain. The block diagram is given below.

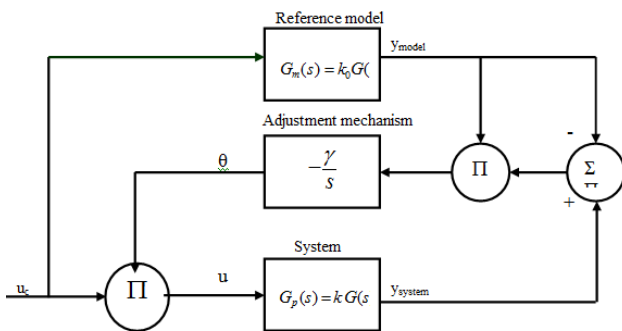


Fig. 1 MIT The system model for the adaptive control according to the MIT rule

$$\frac{Y(s)}{U(s)} = kG(s) \quad (5)$$

The constant k for this plant is unknown. However, a reference model can be formed with a desired value of k, and through adaptation of a feed forward gain, the response of the plant can be made to match this model. The reference model is therefore chosen as the plant multiplied by a desired constant k<sub>0</sub>:

$$\frac{Y(s)}{U_c(s)} = k_0 G(s) \quad (6)$$

The constant k for this plant is unknown. However, a reference model can be formed with a desired value of k, and through adaptation of a feed forward gain, the response of the plant can be made to match this model.

The reference model is therefore chosen as the plant multiplied by a desired constant k<sub>0</sub>:

$$\frac{Y(s)}{U_c(s)} = k_0 G(s) \quad (7)$$

The same cost function as above is chosen and the derivative is shown:

$$J(\theta) = \frac{1}{2} e^2(\theta) \longrightarrow \frac{d\theta}{dt} = -\gamma e \frac{\delta e}{\delta \theta} \quad (8)$$

The error is then restated in terms of the transfer functions multiplied by their inputs.

$$e = y - y_m = kGU - G_m U_c = kG\theta U_c - k_0 G U_c \quad (9)$$

As can be seen, this expression for the error contains the parameter theta which is to be updated. To determine the update rule, the sensitivity derivative is calculated and restated in terms of the model output:

$$\frac{\delta e}{\delta \theta} = kG U_c = \frac{k}{k_0} y_m \quad (10)$$

Finally, the MIT rule is applied to give an expression for updating theta. The constants k and k<sub>0</sub> are combined into gamma.

$$\frac{d\theta}{dt} = -\gamma' \frac{k}{k_0} y_m e = -\gamma y_m e \quad (11)$$

The block diagram for this system is the same as the diagram given at the beginning of this example. To tune this system, the values of k<sub>0</sub> and gamma can be varied.

## 2. OBTAINED RESULTS

In order to study the adaptive control, the following longitudinal dynamics was considered as a reference system:

$$G_m(s) = \frac{3.476(s + 0.0292)(s + 0.883)}{(s^2 + 0.019s + 0.01)(s^2 + 0.841s + 5.29)}$$

To analyze the behavior of the adaptive control the following model was designed in Matlab/Simulink:



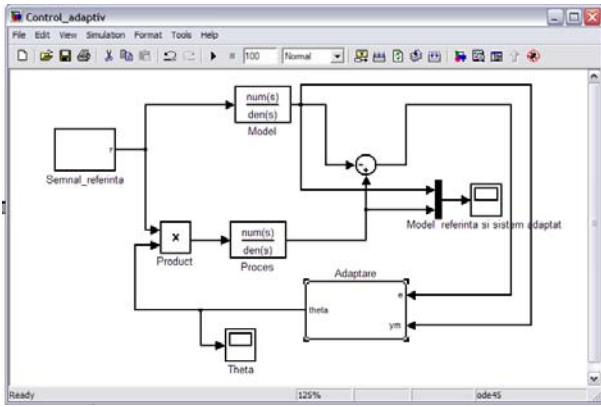


Fig. 2 The implemented model in Simulink

The reference signal is a sine wave, which has the amplitude  $A=1$  and the frequency  $f=0.5\text{Hz}$ , with an initial offset equal with 0 for  $k_0=0.5$  and  $k=1$ . The *Adaptare* model does the operation

$$\frac{d\theta}{dt} = -\gamma \frac{k}{k_0} y_m e = -\gamma y_m e.$$

The system response and theta  $\theta$  will be analyzed for different amplitude and offset values of the reference signal and  $\gamma$ .

a) offset = 0,  $\gamma = 1$ ,  $A = 1$

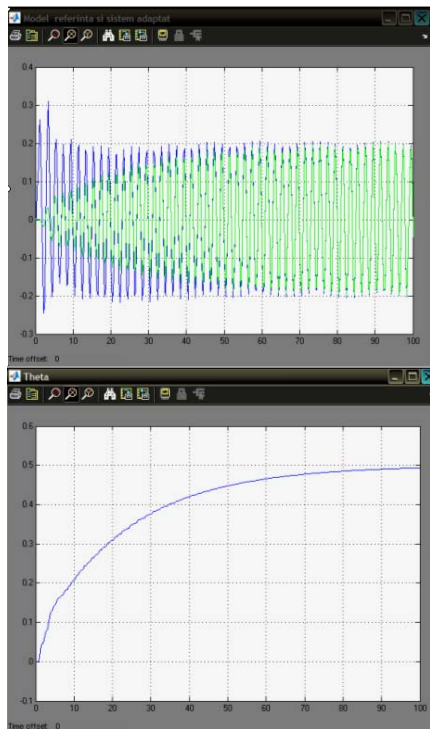


Fig. 3 The response for the reference model and adapted system and the evolution of the theta parameter

The response of the adapted system (green) becomes identical with response of the reference model (blue). The same interval of time is required for the theta parameter to stabilize itself around the value of 0.5.

b) offset=0,  $\gamma=5$ ,  $A=1$

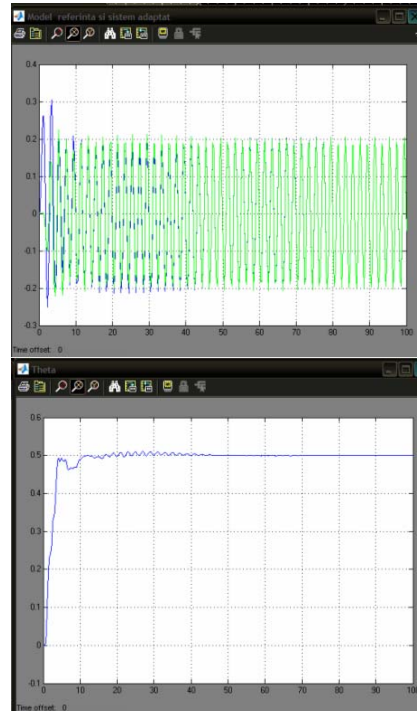


Fig. 4 The response for the reference model and adapted system and the evolution of the theta parameter

The period for stabilization is decreased if the  $\gamma$  parameter is increased.

c) offset=0.5,  $\gamma=5$ ,  $A=1$

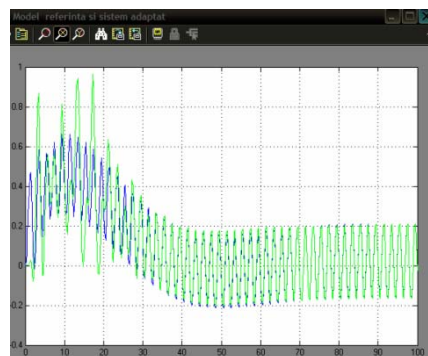


Fig. 5 The response for the reference model and adapted system and the evolution of the theta parameter

As the offset value is increased, some transitory conditions appear for a period of 40 seconds. Arbitrary oscillations which lead to instability are expected for values greater than 1 of the offset.

d) offset=0,  $\gamma=5$ ,  $A=0.5$

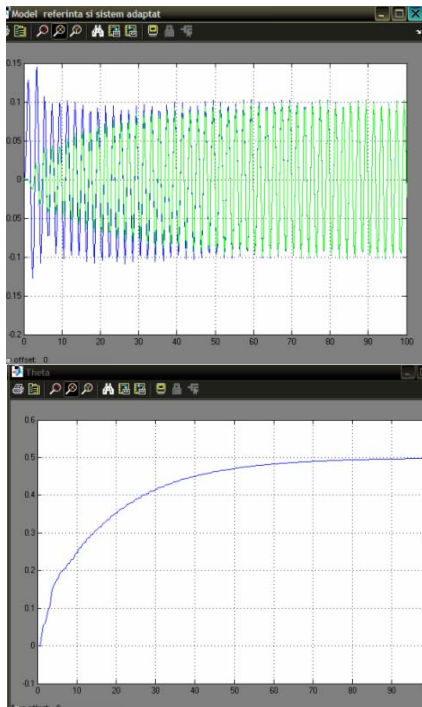


Fig. 6 The response for the reference model and adapted system and the evolution of the theta parameter

Decreasing amplitude leads to the increase of the transition period, as can be seen from the figure above. The case for amplitude greater than 1 is left to be analyzed.

e) offset=0,  $\gamma=5$ ,  $A=2.5$

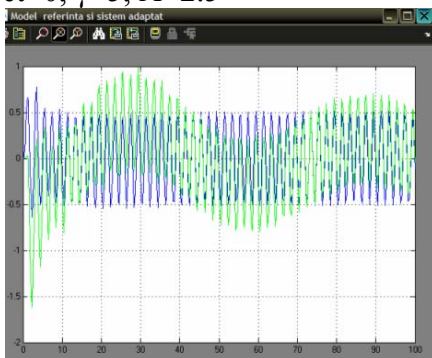


Fig.7 The response for the reference model and adapted system and the evolution of the theta parameter

It can be seen that the adaptive system response doesn't follow anymore the reference system, the oscillations of the *theta* parameter have a slow damping period, but the adaptation is not done in useful time, so the system behavior is unsatisfactory.

### 3. CONCLUSIONS

The MIT rule by itself does not guarantee convergence or stability. An MRAC designed using the MIT rule is very sensitive to the amplitudes of the signals. For the studied model, the MIT rule provides satisfactory results for signal amplitudes which are in the  $[-1,1]$  domain. Divergence is obtained for negative values of *gamma*, and instability is obtained for values greater than 5. This parameter has to have small values. For greater values in absolute value of the offset leads also to instability.

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## THE COMMAND AND CONTROL STRUCTURE OF THE MOBILE SHORT RANGE AIR DEFENCE SYSTEMS

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**Abstract:** *The continued evolution of aerial threats has conduct to the emergence of a new generation of ground based air defence (GBAD) systems. Many of these GBAD systems are in fact mobile short range air defence (SHORAD) systems, designed to assure the combat of aerial threats which evolve at low-level altitude and at short distance from the defended assets. In this paper are presented some aspects regarding the command and control structure that may be considered the operational heart of a SHORAD system.*

**Keywords:** *air defence, command and control, SHORAD, weapon system.*

### 1. INTRODUCTION

The purpose of the *Ground Based Air Defence (GBAD) systems* -at Battalion level, is early and reliable detection of low flying aircraft, both fixed wing and helicopters, to do threat evaluation, identification and classification on the detected targets and to allocate target parameters to surface-to-air weapon systems. The objectives of the system can be summarized as follows:

- to provide early warning of weapon operator against approaching aircraft. This serves to reduce the alert level of the operators.
- to provide cueing data to weapon operator. Visual contact is achieved earlier and the operator gets more time for engagement.
- to provide airspace control in order to protect own aircraft against own fire.

- to provide emission control of radars and radios.
- to deliver status reports to Higher Echelon.
- to deliver engagement summary to Higher Echelon.

A system is composed of various sites and elements, each of them covering parts of the total system capabilities. The Air Defence Battalion is equipped with a self-propelled systems-of –systems, comprised of:

- Battalion Command Post (BCP);
- 4÷6 Battery Command Posts (BtCP);
- Weapon system (guns and missiles) with/without dedicated sensors.

The basic functional elements which are assured by a GBAD system are presented in the following figure.

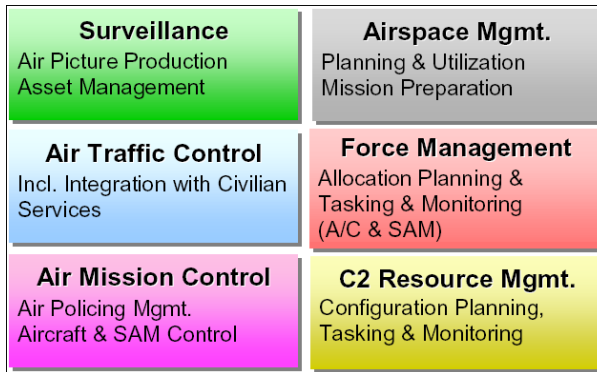


Fig. 1. Functions assured by a typical GBAD system

The Battalion Command Post is the command and control structure (C2) of the battalion and integrated weapons and sensors; this structure can be considered as the operational heart of a ground based air defence system. All systems are modular in design and shall, in their turn, be made up of various subsystems. The BCP will provide air space data exchange with higher echelons, subordinate and/or

adjacent Air Defence units. This requires use of standard interfaces in order to communicate within the internal environment, as well as with the external environment. It will have the capability to combine the RAP and LAP (Recognized Air Picture and Local Air Picture) in a Single Integrated Air Picture (SIAP).

The BCP site consists of a Radar, a Command and Control Shelter and a Vehicle. The BCP control a number of BtCP's which are connected in a Battalion radio net. The BtCP site consists of a Command and Control Shelter and a Vehicle.

The BtCP collects a Local Air Picture based on input from Radars on the weapons. The BtCP controls a number of WT's (weapon terminals) which are connected in Radio net. The WT receives commands and target information from the Battery radio net and integrates the weapons and sensors on the weapon platforms.

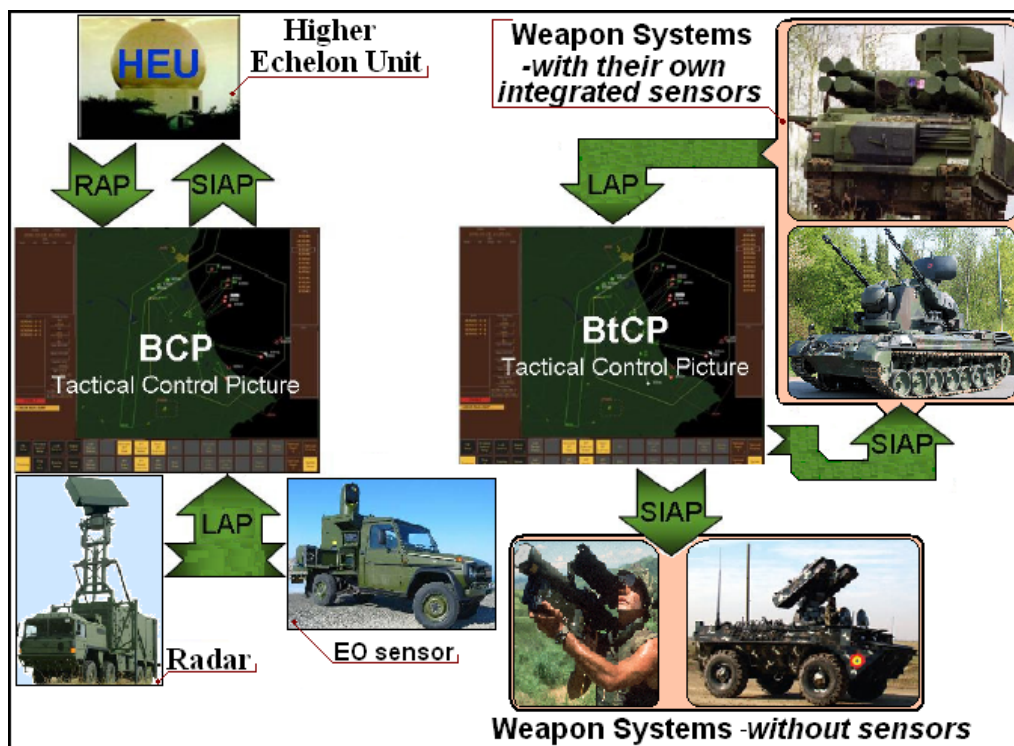


Fig.2. Single Integrated Air Picture (SIAP) based on multiple correlated inputs

## 2. THE MAIN FUNCTIONS

There are three basic functions which are assured by the command and control structure: mission planning, airspace surveillance and combat management.

### a) Mission Planning

The mission planning consists in four sequences: mission definition, terrain analysis, deployment proposal, coverage assessment. This software module is used to *optimize surveillance and firing units location* in the operational theatre. The optimisation takes into account system constraints and environment such as terrain, Forward Line of Own Troops, Forbidden Area, available firing units.

### b) Airspace Surveillance

The airspace management is a permanent function of a BCP. BCP will process the complex environment and mission data to provide operators with all necessary operational information.

### c) Combat Management

The Combat Management function is responsible of optimal engagements in order to counter air strikes with high level of efficiency. Taking into account the tactical and natural environments, the BCP will engage incoming targets with the appropriate weapons, avoiding over or under-kill.

The combat situation is displayed on the Fire Officer console. In order to reduce reaction time, even in a complex situation, the **Man Machine Interface (MMI)** is intuitive and easy to operate

A real-time algorithm named **TEWA** (Threat Evaluation & Weapon Assignment) is at the base of the Combat Management function. This algorithm assures the following functional elements:

- *Threat Evaluation*: track behavior, location of defended assets, engagement rules;
- *Engagement computation*: fire authorization, engagement status, coordination with other BCPs;
- *Fire Units engageability*: firing unit availability, weapon firing domain, reaction time;
- *Engagement control monitoring*: select the appropriate firing unit to engage a target, optimizes the kill probability.

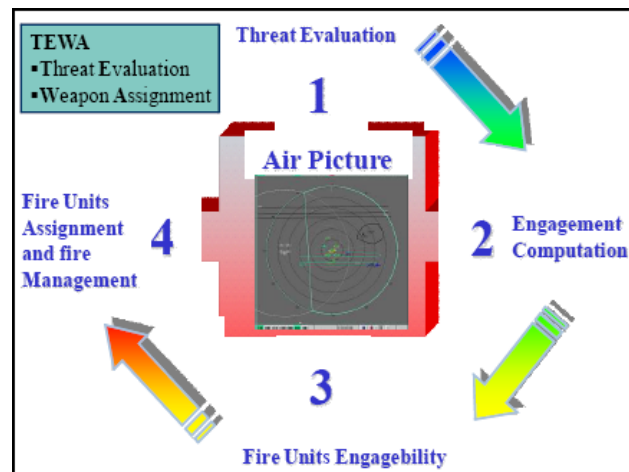
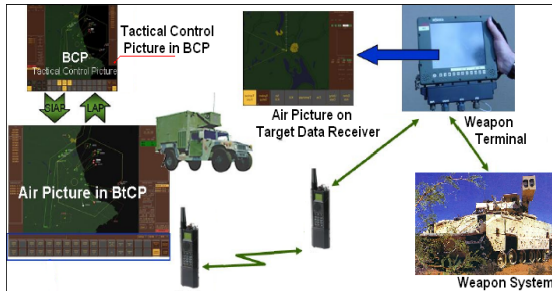


Fig. 3. A schematic representation of the TEWA algorithm

## 3. THE INTERFACE WITH THE WEAPON SYSTEMS

The Weapon Terminal (WT) is the most flexible and effective solution to integrate on the spot any kind of weapon systems in an air defence network. When used with a Command & Control station, WT will improve firing units effectiveness. The Weapon



Terminal is hand-held, lightweight, compact and robust.

Fig. 4. The interface between BCP and a weapon system - realized by a WT

The WT main benefits are:

- Firing unit integration in air defence system network;
- Reduced reaction time from target assignment by CCS (Command & Control Structure) to target acquisition by firing unit;
- Reduced operator workload and stress by improved designation accuracy;
- Multi-purpose “toolbox” to support operators for: mobility and deployment, firing unit configuration, status report, target engagement, training.

A WT operator at the weapon platform level can perform accurate engagement

operations with the timely information presented on the terminal. The situational awareness is improved at the weapon platform as battle management orders, air picture and commands are received and displayed on the Weapon Terminal.

Usually, a WT is part of a standardized control package with other two items:

- A Weapons Clip on Device with Headset;
- A Combat Net Radio

Also, the WT is integrated with a Global Positioning System (GPS) and the two-way integrated data link for data connection between the weapon platform and the BtCP.

The 3D targeting data is used by the WT and translated into synthetic voice commands/ guidance signals for the MANPAD operator or slew-to-cue data if the weapon system holds automatic slew capability.

#### 4. A TYPICAL ARCHITECTURE OF A C2 STRUCTURE AT BATTALION LEVEL

In the following picture is presented a typical architecture of a Command & Control Structure designed to assure the appropriate functions for an air defence battalion.

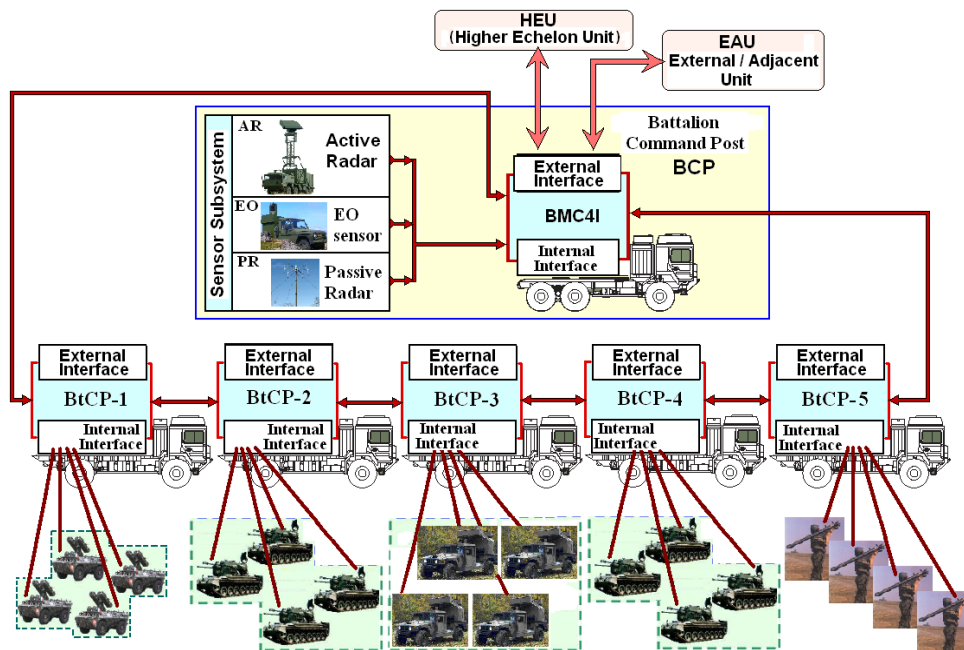


Fig. 4. A typical C2 architecture at battalion level

The basic component subsystems of such architecture are the following:

- The sensor subsystem;
- The vehicle subsystem;
- The BMC4I structure (Battle Management Command, Control, Communications, Computers & Intelligence).
- The weapon systems.

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## ROMANIA - THE SECURITY PROVIDER IN THE WIDER BLACK SEA REGION

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**Abstract :** *The global security environment is very dynamic, fluid and represents the background on which the regional security environment, take shape and develop in accordance with the threats and security needs.*

*In the last two decades the Black Sea region has become a major point of interest for the Eurasian security. NATO's and EU's expansion has transformed this region into the border of the Western security space.*

*Nowadays the international context is characterized by the multipolar tendencies, by the economic and financial crisis and by the varied risks, so Romania can become one of the pillars of the new regional buildings. Also, Romania can offer the integrated and adapted answers to the challenges that are generated by the complex risks, including the decline that affects the economic growth.*

**Key words:** *Regional Security, The Wider Black Sea Region, Regional risk, Security provider, Frozen conflicts, Regional co-operation.*

### 1. THE WIDER BLACK SEA REGION - REALITIES AND TENDENCIES

The Wider Black Sea Region (WBSR) includes, in a complex and seeming contradictory variety, the maritime and terrestrial spaces from the East and South-East Europe, from the Caucasian space and the from the Near East (Fig.1 The geographical limit of the Wider Black Sea Region).

The end of the Cold War, the breakdown of the global geostrategical balance along with the disappearance of the bipolar administration system, the alert transformation and the extension of the North Atlantic Treaty and the European Union, “the fight” for energetical resources, the world economic crisis - are just some of the factors that transformed the Black Sea from a space of regional interests into an intermediary area between different world, a space submitted to the laborious and attentive process of the European and Euroatlantic integration.

The strategical interests regarding WBSR are determined, supported and promoted by the four global actors: USA, The Russian



Fig.1 The geographical limit of the Wider Black Sea Region

**USA**, regarding this space, promoted a policy that meant to promote its rigorous interests, pleading for the opening of this area, the stability of the democratic systems, the development of the regional co-operation, the



guarantee of the free access to the energetical resources of the region, the negotiated settlement of local conflicts, the war against terrorism and transnational organized crime, the strengthened military presence, the opening of the alternative energetic routes.

In spite of a relatively limited opening to the Black Sea, **The Russian Federation** conferred it's self an important role in the WBSR, based on it's huge military capacity and the neighbourhood proximity procedures<sup>1</sup>, as well as the support of republics such as Transnistria, Abhasia, Southern Osetia. But the most important reality that determines the decisive geopolitical conduct of the Russian Federation is the proximity with NATO and EU. This shows the obvious change regarding the power equation from the economical, political, technological and demographic point of view, and therefore the influences exerted on the WBSR by the West.

In the last decade, the North Atlantic Treaty strengthened the strategic device in the South East of Europe and on the western and southern seaside of the Black Sea. This organization concluded separate partnerships with the Russian Federation and Ukraine, without concealing the intention to continue the extension process. Although the will of Ukraine, Georgia and Adzerbaidjan to join NATO were taken into account, this was realised in a prudent manner.

Beginning with the year 2007, the European Union saw the Black Sea basin as a vital center for it's promotion as a global actor and the WBSR region as a possibility to reassert some values: the civilized conduct, the democracy statute or the prosperity argument.

The four global actors together divided the responsibility for this region that lies from the Baltic Sea to the Black Sea.

The unilateral attempts from anyone of these powers to solve the crisis from this region were destined to fail. Now there is a great challenge: the development of a common pattern of development in the ex-soviet space. The common interests to preserve a stable

environment based on the peaceful terms of transformation will have a positive effect on the economical and political development of this region<sup>2</sup>.

For a better understanding of the security characteristics in the WBSR, on one side from the beligerant protention and on the other hand from the prospect of the chronicall sensibility of the same states from the region, should emphasize and illustrate the next aspects : the vulnerabilities ( the different level of reorganization and economical development; the different levels of the socio-political achievements of the states from the region ; the features of the political systems); the local crisis and conflicts (Transnistria, the conflicts from the caucasian space, the situation from the Nagorno-Karabakh, the conflict from Cecenia, the tensions from Daghestan, the crisis from Georgia); the threats (the mentioned conflicts, the external pressure, the international terrorism, the muslim fundamentalism, the organized crime, the illegal migration); the power distribution in the region (the economic superiority of the EU and the military superiority of NATO, Russia has an important military instrument in the region and the most rich mineral resources from the world) as well as the friend-enemy relations (the democratization of the states, the respect of the human rights, the assuming of the european democratic values).

At a closer look, the region appears rather as a homogenous region. Because of the almost similar socio-economical structure the states from the Black Sea region have to face , at different levels of intensity, same challenges: the strengthening of democracy processes, the economical integration, the energetical dependency, the ensurance of security as a pre-condition for the development.

The extension of NATO and EU remained a very popular idea in this region. The local desire in favour of introducing the european social and political values, but creating a space with a government at european standards will be very difficult to achieve without the

<sup>1</sup> Bugajski, J., *The Cold Peace*, Casa Radio Publishing House, Bucharest, 2005, p. 265

<sup>2</sup> The International Conference Report, *The Black Sea region – towards a partnership of the 21<sup>st</sup> century*, Ovidiu Sincai Institute, Bucharest, 10-12 June 2007

involvement of the previously mentioned global actors and without an increase of the regional co-operation.

The tendencies that manifest in the region have multiple determinations: the indistinct aspiration of the states from the ex-sovietic empire regarding the strategic, political, social and economic options; the strategic interests of two communities (the euro-atlantic and the CSI); the importance of the region for global security and stability.

In a geopolitical plan, an attempt to classify the tendency conditions specific to the WBSR [1] could show in this way:

- tendencies of manifestation of an obvious regional role (Ukraine, Turkey, Romania and Bulgaria);
- tendencies of including the geopolitical and geostrategic potential of the region within the projects of global reassertion (EU, NATO, USA and the Federation of Russia);
- the survival and state strengthened tendencies (Moldavia, Georgia and Azerbaijan);
- the tendencies to "freeze" local conflicts (Transnistria, The Northern Caucasian region, Nagorno-Karabakh, Georgia);
- the tendencies to solve on the long term these conflicts (EU and NATO).

From this point of view it is obvious that the USA and EU developed real integration strategies of these states within a space of stability, security and global cooperation. In fact, for the USA and the EU the geostrategic interest is highly influenced by the interest for the energetic resources of the region with the purpose to ensure their own energetic security. Once the energetic issue is solved, the actions of the global actors in the region will try to stop the instability export from this area through demilitarisation, decriminalisation and democratisation.

**The Federation of Russia**, the most important state in the region, demonstrates a geopolitical conduct that follows the next objectives: to counteract any influences exerted by other important global actors; to minimize the role of The Organization for Democracy

and Economic Development (GUAM)<sup>3</sup> and to struggle against the spirit of the "orange revolutions" from the Ukraine and Georgia; to involve in the solution of the local conflicts, not including the UNO, EU and USA and the proximity states from the Black Sea; the exploitation of all contradictions between the states from the region but also from the inside of these; to exert the economic, political and military pressure on the Republic of Moldavia, Ukraine and Georgia; to assume the right to combat the terrorist groups in any part of the globe; maintaining a positive relationship with EU especially because of the dependence to the proper energetic resources.

**Ukraine**, one of the important states from the region, will have to act in the geopolitical plan between the stake of joining the European and Euroatlantic values and the economic dependence to the Russian Federation. Ukraine wants to go out from Russia's shadow cone and along with the adhesion to the NATO to preserve its independence from Russia.

**Romania and Bulgaria** "pushed" the eastern frontier of the EU until the western seaside of the Black Sea, becoming the main providers of security in the region. The future of these states relies upon the continuation of the assumed mission as stability factors and regional leaders in the war against the transnational threats. Both states are aware that their active involvement in the Black Sea region could help their development.

**Turkey** is aware that for the West it represents an important political and military piece as well as in the WBSR and also in the strategy of the alternative energetic routes. In an external plan, the geopolitical effort of Turkey will be influenced by the administration and the assurance of the energetic transit from East to West and on the other hand by the ability to deal positively with Armenia, Syria, Iraq and Greece. Also Turkey exerts a dynamical influence in the

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<sup>3</sup> GUAM has turned up in October 1997 by Georgia, Ukraine, Azerbaijan and Moldavia. The organization included Uzbekistan in 1999, but this state decided to leave 6 years later.

The source: <http://ro.wikipedia.org/GUAM>

muslim environment from Krimea and Northern Caucasian Area.

**The Republic of Moldavia** is and will be marked in its evolution, on one hand, by the energetical addiction of the Russian Federation, and on the other hand by the secession of the “republic” of Transnistria. The option to join the euro-atlantic structures can dim the export of the instability in the area and in the EU.

First **Georgia** has to solve its security issues that result from the integrity of this state. The demands of the separatist republics of Abhasia and South Osetia to be integrated in the Russian Federation, the maintaining of the Russian military equipments in order to pretext of peacekeeping, as well as the postponement of MAP agreement by NATO – are still reasons of concern regarding the security of this state.

For **Armenia** the main political issue is related to the extension of the crisis from Nagorno-Karabakh, a territory from Adzerbaidjan that is managed by armenian secessionist forces.

**Adzerbaidjan** plays the gate role of the west to the Central of Assia. In order to consolidate its regional position is vital to use the important energetical and mineral resources available in order to achieve a real opening to NATO, EU and USA. The geostrategic tendencies that manifest in the WBSR are generated by the interests of the present actors, mediated or not, in this area. The general tendency to orientate towards the euro-atlantic system of values conveys a certain international credibility with implications in the geopolitical and geostrategical plan.

Deriving from the globalization, the regional instability can seriously affect the national security. Therefore the states support the stabilization and democratization processes in the neighbour spaces, the development of a coherent politic that is meant to minimalise the conflicts and to warn the growth of them, as well as the achievement of an efficient cooperation, of some regional partnerships.

## **2. ROMANIA AND THE REGIONAL SECURITY**

The globalization is considered the phenomenon with the most impact on the international system and the parameters of this. So, Romania must act in order to reaffirm the role as a stability factor and to promote the values and principles of the democracy, peace and security, on the regional level, as well as on the international level.

In present the regional community that includes Romania has many problems that become sharper and more pressing. The solution can be a common commitment from the states of the region, states that are in full process of european and euro-atlantic integration.

Romania, is appreciated as an important actor of the region, in its capacity as a NATO and EU member, and demonstrated, by its actions, that could constitute in a solid pillar of stability.

After the achievement of the european and euro-atlantic integration, Romania proposed them as a main objective to intensify the co-operation actions at the regional level in order to grow the stability in this area. So, many politic, economic, security or cultural problems were efficiently solved relating to a relatively homogeneous environment with a certain degree of cohesion [2].

The contribution of our country to the stability of the Wider Black Sea Region is motivated by the fact that the Black Sea is the north border of the south flank of NATO, it is situated in the “hot” proximity area of the Near and Middle East, it assures the exit to the Planetary Ocean for Romania, Bulgaria, Ukraine and the transcaucasian states and for the Federation of Russia to the “hot seas”, it comprises varried transport routes of the hidrocarbons from the Caspic Sea and Central of Asia regions to the West of Europe, it is the main corridor for the drugs traffic from the Middle East and Asia to the West of Europe, it has the important economic resources and offers the vast possibilities of economic and tourism co-operation.

The political feature of region is that to build a new security architecture by the

involvement of the states from this area in different partnership forms: euro-atlantic (The Partnership for Peace, The Organization for Security and Cooperation in Europe Council, The Council of Europe) or regional (The Black Sea Economic Cooperation, The Organization for Democracy and Economic Development, The Common Security Treaty Organization, BlackSeaFor). The local actors realised that in order to ensure a lasting development and stability of the Wider Black Sea Region the improvement of the forms of regional co-operation is necessary<sup>4</sup>.

Within the Black Sea Economic Cooperation (BSEC), Romania supported the necessity to tie the co-operation between the organization and the EU, in the favourable context of “the European Proximity Policy”. It initiated the involvement process of BSEC in the security and stability dimension in the Black Sea region, leading to the elaboration of a viable concept in this matter and the identification of the means in order to increase the organization’s contribution in this field [3].

As a co-ordinating country of the working group against organised crime, Romania contributed in a substantial way to the conclusion of an Additional Protocol with a particular accent upon the war against terrorism.

Also our country promoted the actions in order to support the efforts of the states from the East of Europe and Caucasians to strengthen the democracy processes and reforms that are required by the transition to the market economy along with the identification of a safe and attractive business environment.

At the last meeting of BSEC<sup>5</sup>, Romania was appreciated for the promotion manner, the examination supplying and the financial support for some far-reaching projects (the launching of the study “Black Sea and Central Asian Economic Outlook” at Bucharest; the

realisation of the two co-operation projects regarding the war against human traffic and the migration in the Black Sea area). Romania showed the intention to contribute in addition to the BSEC Project of the Development Fund with the transfer of assistance development funds in order to achieve some common projects into the Black Sea Sinergy (the maritime way, the ring highway).

Romania was actively involved in the operational buildup process of the European Security and Defence Policy (PESA). The used means were: periodical meetings on the theme of the European security, the involvement in elaborating decisions regarding the administration of the military and civil aspects of crisis; the involvement in the current activities of the EU’s institutions that function in the security domain; the involvement in exercises and operations led by the EU. In this way Romania was an active presence from the launch of the first operations led by the EU: CONCORDIA (3 staff officers), ALTHEA (85 soldiers), PROXIMA (3 police officers) or EUBAM (4 police officers).

Today, Romania could constitute an important pillar of PESA in the central and south-east part of the European continent. This thing is demonstrated by its participation to the South-East Europe Multinational Peace Force (SEEMPF), to the Brigade Task with High Combat Capability of the United Nations Forces (SHIRBRIG), to the establishment of a peacekeeping brigade in the states from the Central Europe (CENCOOP) and another mixed military units (one peacekeeping Romanian – Hungarian battalion; one Romanian – Hungarian – Slovakian engineering unit and one Romanian – Moldavian battalion). By the offer of contribution with forces and means (3500 soldiers, warships and airships) to the Rapid Intervention Force of EU, Romania contributes in an efficient manner to the achievement of “Headline Goal”, as well as the “joint capacity objectives” and by all these to the strengthening of its position as a security provider and as a stability factor in region.

As part of approaching the security by co-operation, Romania made efforts to increase the role of the European Cooperation and Security Organization (OSCE) by: enlarging

<sup>4</sup> Mihai NEAGU, *The prospect of the security environment in the Black Sea area*, The session of science research of the National Defence University “Carol I”, Bucharest, 2007

<sup>5</sup> The XIX<sup>th</sup> meeting of the BSEC External Affairs Ministers Council was organized at Tirana in 23 October 2008

the consulting process in conditions of transparence and respect for the interests of all participante states, the development of the operational capacity of the organization, it's reassertion as an active instrument of prevention and administration of the conflicts, the post-conflict reconstruction, the increase of the efficiency of activities and curent operations of institutions and it's instruments, as well as the development of the co-operation with other euro-atlantic institutions.

As a state with complete rights in NATO, the responsibility of Romania is not limited to the national defence or preventive diplomacy, but at the politics that promote in an offensive way the national interests and support the global stability in any region when NATO asks missions. Romania contributes at all Alliance missions, including the missions from outside the euro-atlantic space. The purpose of these missions is to combat the terrorist treats and to support the democracy.

The placing of the military bases on the territory of Romania is useful for the national interests and, in the same time, it contributes to the acceleration of the NATO transformation in a designing instrument of security in the Near East and the Black Sea area [4].

The contact area between Europe and Asia, West and East, Christianity and Muslem, the Wider Black Sea Region reflects, on a reduced scale, the mutations, evolutions and tendencies from the economic, politic and social life that are manifested on the international level. In this context, Romania holds an active role in solving the problems from the region that concern today EU and NATO: the economic and social differences; the ethnical religious conflicts; the terrorism, the weapons of mass destruction and the organized crime; the weapons, drugs and human traffic; the corruption and the human rights.

The economic-financial crisis accelerated the necessity to intensify the co-operation in the economic domain and to identify the combat solutions of these effects.

In the gobal economic crisis ages, Romania tries to establish the priorities [5] on the external level (Tab.1 The priorities of the Romanian external policy in 2009), like that:

Europe, the regional policy, the strenghtening of partnerships at the global level, the international security and the promovation of the multilateral method.

<b>Europe</b>	<b>The Regional Policy</b>	<b>The international security</b>
<b>Joining to the Shengen Space in the year 2011</b>	<b>The achievement of the Black Sea objectives</b>	<b>The contribution to the elaboration of NATO's new strategic concept</b>
<b>The consolidation of the national profile through the substantial participation to PESA</b>	<b>The achievement of realistic political projects together with the regional partners</b>	<b>The participation to international alliance missions</b>
<b>A common energetical policy</b>	<b>Creating new prospects regarding the relationship with the Russian Federation</b>	<b>The cooperation in the non-proliferation domain</b>
<b>The development of diferent bilateral relationships on sectorial communication levels</b>	<b>Supporting Ukraine during the NATO and EU integration process</b>	<b>The fulfillment of the commitment in the war against terrorism</b>

Tab.1 The priorities of the Romanian external policy in 2009

This table can be completed by: the strenghtening of the strategic partnership with the USA, mainly regarding an economical co-operation and cultural exchanges; the consolidation of Romania's energetical security through the development of a strategic partnership with Adzerbaidjan; the contribution to the elaboration of NATO's new strategic concept; the participation to international alliance missions; the cooperation in the non-proliferation domain; the fulfillment of the commitment in the war against terrorism; the strenghtening of the influences and capacities of the regional and international organizations; the development of solid

bilateral relationships with global covering; the promoting of the cooperation between ONU and regional organizations.

Romania, in respect of its regional weight because of the strategic position, the territory, the population, the political and military potential, is an important factor for the improvement of the bilateral relations, facilitating the communication between the states from the region and the identification of lasting solutions in order to solve the potential strain situation.

Today, Romania continues to be an active and ferme lawyer of the partnership development with the Republic of Moldavia, it joins Ukraine in the effort to support the democratic evolutions and the achievement of the euro-atlantic aspirations, it offers the technical assistance to the states from the Balcanic Peninsula that aspire to the NATO member capacity, it provides at the NATO's disposal the army forces from all categories to ensure a stability climate on the long term in region, proving that by implication and community support it is a real stability and security factor.

### **3. SOME CONCLUSIONS**

- The transformation of the Black Sea region in a politic stability and economic development pillar with the purpose of the peace and security climate extension represents a priority for the states from the proximity of the Black Sea, an also for NATO and EU.
- In a world more and more independent, it is proved that any serious shock has a repercussion from a region to another and this can amplify and extend to the whole planet. Therefore, more than ever, the states should give evidence and transparence, prudence and strictness, to strenghten the democracy and to promote the security by co-operation.
- The regional policy will have an important pragmatic character, that will be based on the benefits that can be obtained by realistic political projects, on the long and middle term, that will be builded together with the regional partners.

- "Frozen conflicts" from the Republic of Moldavia, Georgia, Cecenia and Nagorno-Karabakh, the dictatorship from Belarus, the poverty from Ukraine and Moldavia, the energetical dependence of Europe on the Caucasian ressources, the ethnical problems from Turkey, the transit of the hydrocarbons from East to west are many preoccupation of the specialists in the security of the Black Sea region.

- The attention of EU and USA will be directed in the next time on the situation from the Black Sea region. They work already with the posibility to realize some new regional co-operation structures with more efficiency, as well as solving the conflicts that are considered "frozen". These conflicts can become the cause of some major military confrontations.

- The Black Sea region is an area of the strategic interest. The Georgian conflict from august 2008 demonstrated once again both the risks that are created by the instability of the region, as well as the importance of the European implication in the stability and development process.

- In the complex strategic area in wich Romania is situated, a multirealist vision that is centred upon the strengthening influence and capacity of the regional and international organizations to solve the major problems that are in connection with the system stability and the international security represent the most efficient strategy.

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# HELICOPTER ANTITORQUE SYSTEM USING CIRCULATION CONTROL

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**Abstract** :The NOTAR system operates by forcing moving air out of slots located on the tail boom. The interaction of this air flow with the downwash of the main rotor is such that it creates a force that opposes the torque of the main rotor. The airflow exits the slot in a direction tangential to the external surface and generally parallel with the external flow, resulting in deflection of the external flow and generating lift.

**Key words** (keywords):. Coanda effect, tail boom, jet thruster, lift, slots.

## 1. INTRODUCTION

**NOTAR**, an acronym for NO Tail Rotor, is a helicopter stabilization process developed by McDonnell Douglas Helicopter Systems which eliminates the use of tail rotors on helicopters, yielding quieter and safer operation. NOTAR rotorcraft utilize the Coanda Effect, ducting downdraft from the main rotor blades into the tailboom.

A variable pitch fan is enclosed in the aft fuselage section immediately forward of the tail boom and driven by the main rotor transmission.

Anti-torque control is effected using this low pressure, high volume air ducted through the tail boom. There are currently three helicopters that take advantage of NOTAR technology, all produced by MD Helicopters:

The Coanda effect is the tendency of a stream of fluid to stay attached to a convex surface, rather than follow a straight line in its original direction.

The Coanda effect is the tendency of a stream of fluid to stay attached to a convex surface, rather than follow a straight line in its original direction.

The principle was named after Romanian inventor Henri Coandă, who was the first to

understand the practical importance of the phenomenon for aircraft development.

He made the discovery during experiments with his Coanda-1910 aircraft, which is the first aircraft based on a jet engine. It has important applications in various high-lift devices on aircraft, where air moving over the wing can be "bent down" towards the ground using flaps.

It was first implemented in a practical sense during the U.S. Air Force's AMST project. Several aircraft, notably the Boeing YC-14, have been built to take advantage of this effect by mounting jet engines on the top of wing to provide high-speed air even at low flying speeds, but to date only one aircraft has gone into production using this system, the Antonov An-72 'Coaler'.

The McDonnell Douglas YC-15 and its successor, the Boeing C-17 Globemaster III also employ the effect, though to a less substantial degree.

An aircraft is any machine capable of atmospheric flight.

## 2. DEVELOPMENT

The use of directed air to provide anti-torque control had been tested as early as 1945 in the



British Cierva W.9. Development of the NOTAR system dates back to 1975 when engineers at Hughes Helicopters began concept development work. In December 1981 Hughes flew a OH-6A fitted with NOTAR for the first time. The OH-6A helicopter (Serial number 65-12917) was supplied by the U.S. Army for Hughes to develop the NOTAR technology and was the second OH-6 built by Hughes for the U.S. Army.

A more heavily modified version of the prototype demonstrator first flew in March 1986 (by which time McDonnell Douglas had acquired Hughes Helicopters).

The original prototype last flew in June 1986 and is now at the U.S. Army Aviation Museum in Fort Rucker, Alabama.

A production model NOTAR 520N (N520NT) was later produced and first flew on May 1, 1990.

It later crashed on September 27, 1994 when it collided with an AH-64D while flying as a chase aircraft for the Apache.

### 3.CONCEPT

Although the concept, which uses the Coandă effect, took some time to refine, the NOTAR system is simple in theory and works to provide directional control the same way a wing develops lift.

A variable pitch fan is enclosed in the aft fuselage section immediately forward of the tail boom and driven by the main rotor transmission.

This fan forces low pressure air through two slots on the right side of the tailboom, causing the downwash from the main rotor to hug the tailboom, producing lift, and thus a measure of directional control.

This is augmented by a direct jet thruster and vertical stabilisers.

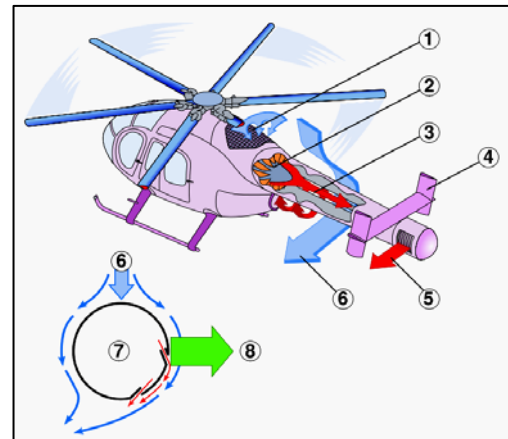


Fig.1 System NOTAR

1. Air intake ;
2. Variable pitch fan
3. Tail boom with Coanda Slots
4. Vertical stabilizers
5. Direct jet thruster
6. Downwash
7. Circulation control tailboom cross-section
8. Anti-torque lift

To operate the NOTAR system draws air in through an intake located at the top of the airframe to the rear of the main rotor shaft. A variable pitch fan pressurises the tailboom to a relatively constant 0.5 psi. The air is then fed to three places- two slots located at 70 and 140 degrees around the tail and a "thruster". The slots generate lift through the Coanda effect.

Stability equations :

$$\frac{d}{dt} \{H\} = [m] \{a\} = [m] \{\dot{V}\} + [m][\Omega] \quad (01)$$

$$\{V\} = \{F\}$$

$$\frac{d}{dt} \{K\} = [I] \{\varepsilon\} + [\Omega][I][\Omega] = \{M_0\} \quad (02)$$

:  $\{H\} = \{H_x H_y H_z\}^T$  matrix represents

impulses,

$$[m] = \begin{bmatrix} m & 0 & 0 \\ 0 & m & 0 \\ 0 & 0 & m \end{bmatrix} \text{ mass matrix is,} \quad (03)$$

$$\{a\} = \{a_x a_y a_z\}^T \text{ acceleration matrix,} \quad (04)$$

#### 4. USE

There are three production helicopters that utilize the NOTAR system, all produced by MD Helicopters:

MD Helicopters 520N NOTAR

MD 520N - a NOTAR variant of the Hughes/MD500 series helicopter is seen in the movie *Mission: Impossible*

MD 600N - a larger version of the MD 520N, is seen in the James Bond film *Die Another Day*

MD Explorer - a twin-engine, 8-seat light helicopter.

A 520N NOTAR helicopter (N599DB) can also be seen in the 1994 action film, *Speed*. The helicopter was owned by Rainbow Helicopters and was later used for tours over the Niagara Falls. Their reduced operational noise means that they are well suited to urban use, and along with the increased safety and the ability to get close to buildings, they are becoming increasingly popular for law enforcement and air ambulance use. Note that the claim of lesser "control-ability" at higher speeds is inaccurate, in that the Tail rudders of the empennage maintain a controlled flight at higher speeds.

#### 5. CONCLUSION

The disadvantages of implementing the NOTAR system can be seen in higher necessary power of the powerplant, thus increasing the fuel consumption and reducing the helicopter flight range, and in somewhat more complex design compared to the one of the classical tail rotor, may have problems operating in high cross winds. Furthermore, the cost, complexity, and less mature technology make the NOTAR less desirable

than the conventional or fan-in-fin configurations. The NOTAR anti-torque system eliminates all of the mechanical disadvantages of a tail rotor, including long drive shafts, hanger bearings, intermediate gearboxes and ninety-degree gearboxes. In spite of this, due to a number of advantages that result from the implementation of this system in the helicopter design we may expect in the future an increase in the number of helicopters being equipped with such a system. The number of accidents dropped from 30 per 100,000 flight hours in 1970 to slightly over 9 in 2002.

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## **Modernization of the audio-video recording and debriefing system for the IAR 99 SOIM aircraft**

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*Audio-video data provides by the avionics systems of IAR 99 SOIM and MIG 21 Lancer is recorded by the TEAC V-80AB-F, AVTR that has the data storage a Hi-8 mm cassette. In order to record much information the avionics system provides the video signal divided in fields, each field containing coded information (VITC- Vertical Interval Time Code) about this division. The technological progress allows the replacement of Hi-8mm data storage recorder with portable data storage digital systems. The paper identifies a hardware replacement of data storage without modification of the existing avionics systems and presents the possibility of development a system for decoding the recorded data. This system has the same facilities like the systems that are in endowment of SMFA. It is presented in details the possibility of realization of such system using a general PC with application software designed in Visual Studio IDE.*

*Key Words: VITC, avionics systems, digital systems, application software*

### **1. INTRODUCTION**

The paper presents the results of a research project that has two main objectives: identifying a portable data storage digital system and developing application software to decode the recorded data. The digital system must do not involve any modification in avionics system.

### **2. AVTR REPLACEMENT**

The MDR-80 has been designed to meet a broad spectrum of applications, from a form-fit-function upgrade for the TEAC V-80AB-F Hi-8mm AVTR to more demanding video and data recording requirements, without requiring re-design and re-qualification. Three internal User Application Card (UAC) slots are available to customize the MDR-80 configuration to the user's needs. Two slots can be configured to record NTSC/CCIR video sources using MPEG-2 digital video compression. All three slots can be configured with optional TEAC developed to record MIL-STD-1553B data busses, rangeless ACMI data, as well as image capture transceiver cards.

Data is recorded by the MDR-80 on a Removable Memory Module (RMM). Digital storage options are available using solid state PCMCIA memory designed to survive the most rugged applications as well as lower cost/higher capacity hard disk drive for more benign environments. The RMM is designed using industry standard IDE computer interfaces to enable easy connection to commercial PC's for ground playback debriefing.

The MDR-80 is more complex than existing AVTR and must be analyzed that the using of such system is compatible with the existing avionics systems.

The avionics systems, by the means of MMRC, monitor the status of following AVTR signals:

- ◆ EOT(End Of Tape)
- ◆ REC(Recording)
- ◆ DEW(Dew)

The input-output of these systems is identical except the functions that are obsolete for MDR-80, EOT and DEW. The output of obsolete status signals is open collector with the following logical levels:

Table no.1 AVTR output status

Status	Level output status
EOT	0V- End of tape detection
	30V max. –Not End of tape detection
DEW	0V- Dew detection
	30V max. – Not Dew detection

In the AVTR command and signal connector, the MMRC puts this signals to high level and the AVTR assign these signals to low level in the case of malfunction. The MDR has no connections for EOT and DEW and the corresponding signals to MMRC remains in high level that means that malfunction was not detected.

### 3. APPLICATION SOFTWARE DEVELOPMENT FOR DEBRIEFING

The VITC information consists in vertical bands on the first three lines of image. When information contains more sources each field contains this VITC information. In the old system with 640x480 format for each VITC byte 6 pixels is allocated. For the NTSC MPEG-2 format each VITC byte 7 pixels is allocated.



Fig. no.1 Example of image with VITC lines

Each VITC line conveys 90 bits as 9 serialized bytes, each preceded by a 2-bit sync code (one, zero). The first 8 bytes contain the time code information bits.

The ninth byte contains a cyclic redundancy check (CRC) code that may be

used for error detection (and possibly correction). CRC is computed as  $G(x) = x^8 + 1$  across the 64 information bits and the 18 VITC sync bits. A CRC can be independently computed by the receiver from the information and sync bits; if the computed CRC does not match the transmitted CRC, and then an error is known to have occurred.

The avionics system of IAR 99 SOIM and MIG 21 LANCER uses the general VITC format and use the user bits for transmitting the system sources and armament events.

For visualization of recorded data the ground station decodes this information and recomposes the fields. The VITC information contains information about the system sources, recording time and also the events from armament systems. The presence of time and the events from armament system allows the positioning the recorded data, based on the user selection.

To prove the possibility to realize of decoding system for data recorded with MDR-80 it was realized demonstrative application software that realize the following functions:

- ◆ Programmatic creation of multifunctional multimedia graph to permit the rendering of audio-video information
- ◆ Sequential acquisition of video data in format bitmap
- ◆ Extract the VITC information from acquired bitmap
- ◆ Decode the extracted VITC information
- ◆ Reconstruction and rendering the original video information based on VITC decoded data
- ◆ Seek the recorded data on user selected time( relative or absolute)
- ◆ Seek the recorded data on user selected event( relative or absolute)

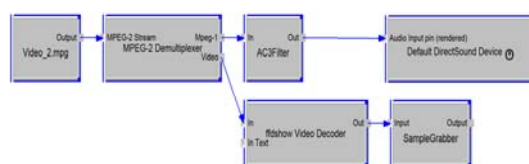


Fig. no.2 Application multimedia graph

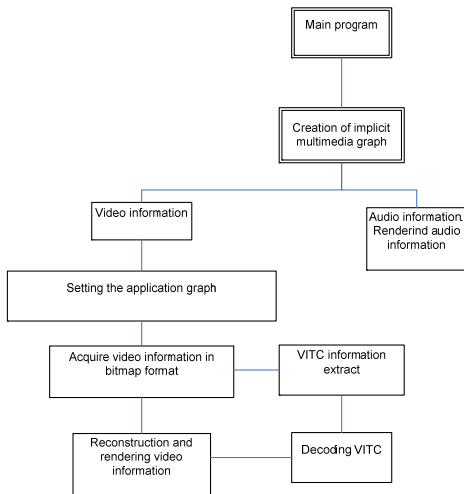


Fig. no.3 Application software

The demo application was developed in Visual Studio IDE using the DirectX technology.

First the application creates the implicit multimedia graph to render the selected file.

Programmatic, in the file graph, are made the replacement of video renderer with a Sample Grabber filter. If the implicit graph does not support this operation, by the means of DirectX tools, the implicit configuration are replaced by the one that permit the insertion of Sample Grabber filter. This is the only configuration for the computer that run this application. The rendering of audio information remains unchanged.

The insertion of Sample Grabber filter permits the acquisition of video data field by field.

The VITC information is extracted from the first three line of the acquired field.

Converting the region used in monochrome image and using the edge filter, the VITC information are transformed in two state: black and white.

Because the region allocated for each VITC byte does not respect the assumption that seven pixels are used, it was develop a module to decode correct the information.

The VITC information used by the avionics system of IAR 99 and MIG 21 Lancer respect the standard, but contains additional information about the system sources and armament event, in the positions dedicates for user options.

When in information are present HUD fields and MFCD fields, the data are acquired in the following order: HUD, MFCD-R, HUD, MFCD-G, HUD, MFCD-B. In this situation each component for MFCD and HUD image are replace in place with the original speed.

In the case of HUD and MFD, the images are also replaced in place with original speed.

The situation with single source is the simple case and the HUD is displayed color.

The application filter graph permits also the positioning of recording on time or events select by the user.

#### 4. RESULTS OBTAINED

We present two examples of decoded information and media player display.

When more sources are present in recorded data, in the HUD display window is inserted test supplementary information: the result of decoding information process (true or false) and the time extract from VITC data.

The result of decoding process is about the verification of CRC (Cyclic Redundancy Check)

This visualization is made in order to obtain the information about the quality of decoding process and is necessarily in the development phase of application software.

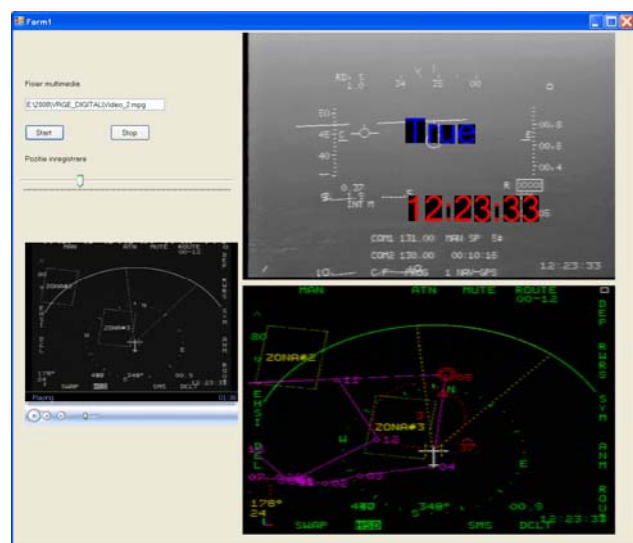


Fig. no.4 Rendering HUD and MFCD

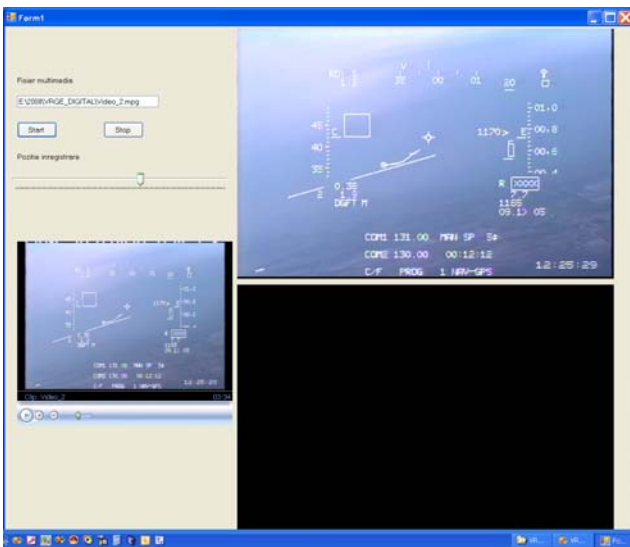


Fig. no.5 Rendering single color source (HUD)

## 5. CONCLUSIONS

The recording equipment that is proposed, MDR-80, is compatible with IAR 99 SOIM because the geometrical dimension and electrical connections are the same and is also compatible with avionics system.

The digital video recorder is accompanied with application software to decode all the data recorded.

For multiple sources the recorder uses separate file for each audio-video source.

The using of this software to decode the audio-video information, on IAR 99 SOIM, involves the necessity to upgrade this software to increase this capability. This upgrade is probably with expensive cost.

The paper presents the possibility of decoding information according with data codification of audio-video information implemented by the existing avionics system. This solution can realize all the functions of debriefing system for analog solution that are in endowment of SMFA.

The advantage of using the presented software solution is that is open and can be developed for the users requests and does not implies supplementary cost, that the cost of the digital video recorder proposed.

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## HIGH ACCURACY DETERMINATION OF FLIGHT PERFORMANCES OF AIRCRAFT

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**Abstract:** This paper present the determination of the flight performances of aircraft with high accuracy, using a modern method for flight testing, like DGPS technique. The method is illustrated on some practical examples which use data obtained from a few flight tests performed with IAR-99 ȘOIM aircraft.

**Key words:** flight, tests, performances, aircraft, instrumentation, data acquisition

### 1. INTRODUCTION

Taking in account of the special features [3] of the DGPS (Differential Global Positioning System) system in mode RTK (Real Time Kinematic), regarding very high accuracy level (centimeter values) provided in real time determination of the position of a motion vehicles and its kinematic values, it was developed, for the first time in Romania, a ground and flight test program for using a such system on a military aircraft, to study the possibilities to rise the accuracy of the main parameters measured in flight (position on trajectory, speed, acceleration, altitude, etc.) and to evaluate the flight performances of the aircraft. The DGPS system was mounted on IAR-99 ȘOIM aircraft no.718.

$k C_L^2$	– induced drag coefficient ;
$M$	– Mach number ;
$m$	– aircraft mass;
$N$	– engine speed ;
$N_z$	– normal factor;
$p$	– atmospheric pressure ;
$S$	– wing surface ;
$s$	– distance ;
$t$	– time ;
$T$	– atmospheric temperature ;
$t_{urcare}$	– minimum climb time;
$V$	– true air speed;
$V_0$	– corrected true air speed with altitude deviations;
$\varepsilon_s$	– distance measure error ;
$\varepsilon_t$	– time measure error;
$\rho$	– atmospheric density.

### 2. NOTATIONS

$a_1, \dots, a_9$	– coefficients of the fit polynom ;
$C_{D0}$	– drag coefficient to $C_L=0$ ;
$C_L$	– $mg / \left( \frac{\rho V^2}{2} S \right)$ , lift coefficient ;
$D$	– drag;
$F$	– thrust;
$g$	– gravity acceleration;
$H$	– current altitude;
$H_0$	– reference altitude;

### 3. USING DGPS SYSTEM FOR FLIGHT TESTING

The GPS system represents a space technique based radionavigation system which can identify a global position through reception of signals from satellites. In order to get a current position the GPS receivers use a synchronization signals provided by minimum four satellites. Using a such system a horizontal accuracy between 10÷30m can be achieved. In order to rise the accuracy in the current determination of the current position it was developed a more performant GPS

system, named DGPS (Differential GPS), which basically involves the cooperation of two GPS receivers, one stationary and other in motion. The stationary receiver, named base station or reference station, which is placed in a very precise determined position in order to perform a local reference point, calculates all the time the corrections of position, like the difference between its known coordinates and the coordinates resulting from the analyze of the received signals from satellites, embeds these corrections in an output serial message, according with RTCM-SC104 (Radio Technical Commission for Marine) standard, and transmits this message via a radio data link to the mobile receiver, named rover. The rover receives the corrections from the base station and applies them to its own coordinates, obtained after the analyse of the received signals from satellites, and determines with high accuracy its current position. (fig.1). Basically a DGPS system can be used in flight testing for determination of kinematic elements (speed and acceleration) and trajectory elements (current position), with an accuracy level (centimetric values) higher than the accuracy level obtained with the inertial systems and one single GPS.

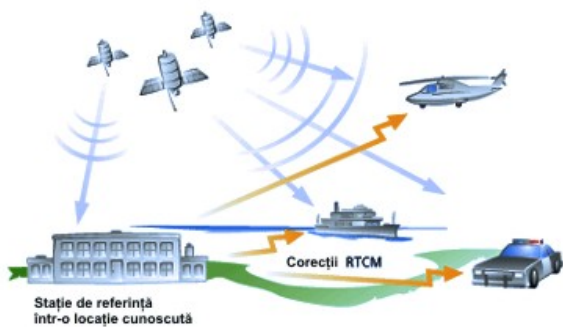


Fig. 1. Principle of using DGPS

#### 4. INSTRUMENTATION SYSTEM

For the instrumentation system it was selected a solution which was focused to provide the information of interest from four different, time synchronized, data sources: avionics mux-bus 1553, ACRA-KAM500 data acquisition system, DGPS/RTK system (on aircraft) and video system (on ground). The

main electric diagram is presented in fig.2. In this way it was realized an onboard distributed instrumentation system, which contains many complementary sub-systems, with the main part, like measurement, signal conditioning, acquisition, telemetry, recording and DGPS sub-systems, is placed on a special mechanical rack, that was mounted in the aft-cockpit of the IAR99-SOIM aircraft, replacing the ejection seat.

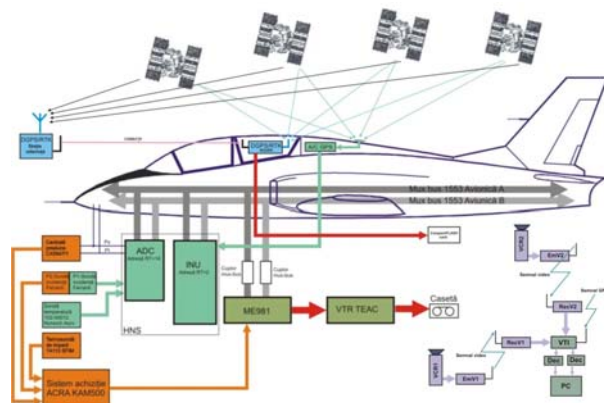


Fig. 2. The main electric diagram used for DGPS/RTK system

It was used, for both reference unit and mobile unit, a very powerful DGPS, type Leica 1230GG, which supports GLONASS and GALILEO systems and has a ultra precise measure engine to be able to offer a very high computing power in a very harsh environmental conditions: temperature  $-40^{\circ}\text{C} \div 60^{\circ}\text{C}$ , rain, salt humidity, sand, dust, vibrations, shocks, etc. This solution of instrumentation of the IAR-99 SOIM aircraft is presented in fig.3

#### 5. EVALUATION OF FLIGHT PERFORMANCE OF AIRCRAFT

Two of most important aspects which must be keep in consideration in the flight performances evaluation of aircraft are represented by the measure errors of the equipments involved in tests process and the errors of the methods involved in data processing. These parameters can influence the accuracy in determination of flight performance. Obvious, in case of using of the same method for data processing, the



difference in the accuracy level, regarding the evaluation process of flight performances of aircraft, will be done by the equipments used in the testing process.



Fig. 3. The solution of instrumentation with DGPS/RTK on IAR99SOIM aircraft

In the following stage, we will demonstrate in a practical way, starting from the flight data (position) recorded by the DGPS device mounted on aircraft, the evaluation of the maximum speed, climb speed and the normal factor in a steady turn of a subsonic jet aircraft, like IAR-99 SOIM. In order to gain this purpose were used the atmospheric and engine speed parameters, recorded with other data acquisition sub-systems of the instrumentation system of the aircraft: ACRA KAM-500, mux-bus 1553 avionics. The test procedure is based on the specific excess power [1], [2] and consist in the execution of an acceleration process, from a minimum speed to a maximum speed, at a constant altitude of flight, maintaining a constant regime of engine speed. In this way on can realize the extraction of a lot of information from the flight recorded data, with a minimum fuel consumption.

### 5.1. MAXIMUM SPEED EVALUATION

The maximum speed evaluation process has as start point the motion equation of the

aircraft, in case of stationary flight regime (flight level):

$$m \frac{dV}{dt} = F - D, \quad (1)$$

Writing the drag expression:

$$D = \frac{\rho V^2}{2} S (C_{D0} + k C_L^2), \quad (2)$$

and the thrust expression:

$$F = p \left[ a_1 + a_2 M + a_3 \frac{N}{\sqrt{T}} + a_4 M \cdot \frac{N}{\sqrt{T}} + a_5 \left( \frac{N}{\sqrt{T}} \right)^2 + a_6 M^2 \cdot \frac{N}{\sqrt{T}} + a_7 M \cdot \left( \frac{N}{\sqrt{T}} \right) + a_8 M^3 + a_9 \left( \frac{N}{\sqrt{T}} \right)^3 \right] \quad (3)$$

and introducing the expressions (2) and (3) in expresoin (1), on obtain the equation of acceleration with unknown parameters  $C_{D0}$ ,  $k$  and  $a_1, \dots, a_9$ , which must be determined from the values of speed during the acceleration period, calculated from the current position of the aircraft, supplied by the DGPS device.

An accurate evaluation of speed during the acceleration period, involves its correction with the smal deviations from the flight level regime during test performing [2]. The necessary correction can be obtained using the kinetic energy theorem between the current altitude and the reference<sup>1</sup> altitude of the flight level. On obtain an expresion which does a reversible conversion between speed and altitude,

$$V_0 = \sqrt{V^2 - 2g(H_0 - H)} \quad (4)$$

After correction of speed, the parameters  $C_{D0}$ ,  $k$  and  $a_1, \dots, a_9$  can be estimated, using the least-squares method, processing simultaneously the accelerations performed at all altitudes.

Since the coefficients  $C_{D0}$ ,  $k$  and  $a_1, \dots, a_9$  were determined, on can integrate the motion equation for a big enough period of time, at

<sup>1</sup> Taken equal with mean altitude calculated for the integral time period of acceleration.

different altitudes, in order to obtain the maximum speed.

The characteristic of acceleration (speed function of time) at a few representative altitude is represented in figure 4 and the characteristic of maximum horizontal speed function of altitude is represented in figure 5.

In this point it will be performed an evaluation of estimation error of speed, obtained with a calculus of a small finite differences (variation of space unit in the time unit) made with a recorded coordinates:

$$V = \frac{ds}{dt} \cong \frac{\Delta s}{\Delta t} = \frac{s_2 - s_1}{t_2 - t_1} \quad (5)$$

Example:  $t_1 = 2,95$  m;  $s_1 = 15,7$  m;  $t_2 = 3,15$  m;  $s_2 = 45,7$  m; it results:  $V = 150,0$  m/s

Case I. Absolute values of measure errors of DGPS:  $\varepsilon_t = 0,000001$  s;  $\varepsilon_s = 0,02$  m;

$$V_{\varepsilon I} = \frac{s_2 - s_1 + 2\varepsilon_s}{t_2 - t_1 - 2\varepsilon_t} = 150,2 \text{ m/s } \text{și} \quad (6)$$

$$V_{\varepsilon I} = \frac{s_2 - s_1 - 2\varepsilon_s}{t_2 - t_1 + 2\varepsilon_t} = 149,8 \text{ m/s} \quad (7)$$

It results a relative error:

$$\varepsilon_{V_I} = \frac{0,2}{150} = 0,13\% . \quad (8)$$

Case II. Absolute values of measure errors of GPS:  $\varepsilon_t = 0,000001$  s;  $\varepsilon_s = 2$  m;

$$V_{\varepsilon I} = \frac{s_2 - s_1 + 2\varepsilon_s}{t_2 - t_1 - 2\varepsilon_t} = 170,0 \text{ m/s } \text{și} \quad (9)$$

$$V_{\varepsilon I} = \frac{s_2 - s_1 - 2\varepsilon_s}{t_2 - t_1 + 2\varepsilon_t} = 130,0 \text{ m/s} \quad (10)$$

It results a relative error:

$$\varepsilon_{V_{II}} = \frac{20}{150} = 13\% . \quad (11)$$

Comparing the values of relative error (being in a ratio of 1:100) obtained in above cases, it can ascertain easily that the accuracy

of speed, evaluated from DGPS recorded data, is clerly higher than the accuracy determined from GPS data. Keeping in account of the error propagation in calculus, this conclusion remains valable in case of flight performance evaluation.

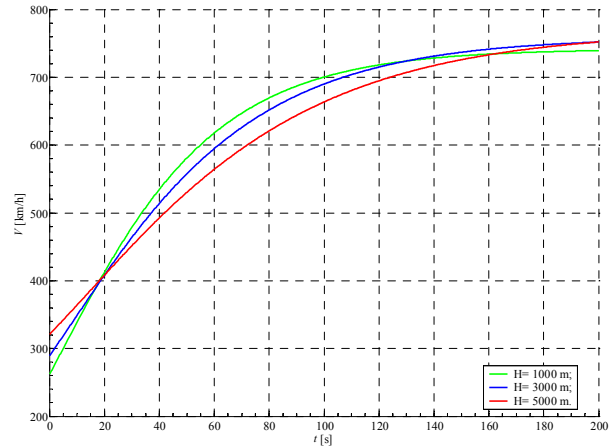


Fig. 4. Acceleration characteristic at flight level for IAR-99 SOIM aircraft, function of time, at three value of altitude

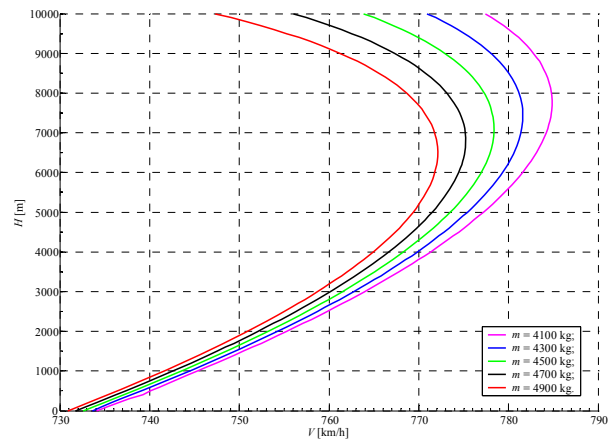


Fig. 5. Maximum speed characteristic at flight level for IAR-99 SOIM aircraft, function of mass and altitude

## 5.2. CLIMB SPEED EVALUATION

Climb speed evaluation is fundamental for the energy-climb correlation, wich is established based on the specific excess power concept:

$$w = \frac{d}{dt} \left( H + \frac{V^2}{2g} \right) = \frac{dH}{dt} + \frac{V}{g} \cdot \frac{dV}{dt} \quad (12)$$

At a flight level:

$$w = \frac{V}{g} \cdot \frac{dV}{dt}, \quad (13)$$

while at a climb with constant speed:

$$w = \frac{dH}{dt} \quad (14)$$

Therefore, the specific excess power at a constant altitude is equal with the vertical speed performed in a climb flight with a trajectory constant speed. This consideration (which is presented here in a simplified mode) is used to determine the vertical climb speed.

From expressions (13) and (1) result the specific excess power:

$$w = \frac{V}{g} \cdot \frac{F - D}{m}, \quad (15)$$

which can be evaluated using the results for  $F$  and  $D$ , obtained in 5.1.

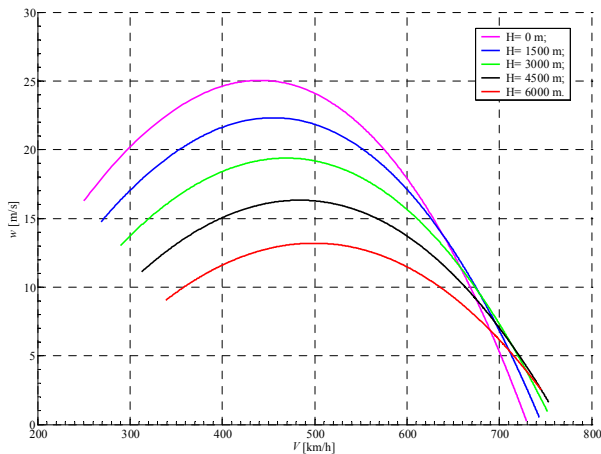


Fig. 6. Climb speed characteristics of IAR-99 SOIM aircraft, function of speed and altitude.

Having the variation of the vertical speed with altitude (fig. 6) can be establish the law of the

optimum climb<sup>2</sup> (fig. 7) and the time variation according with this law (fig. 8).

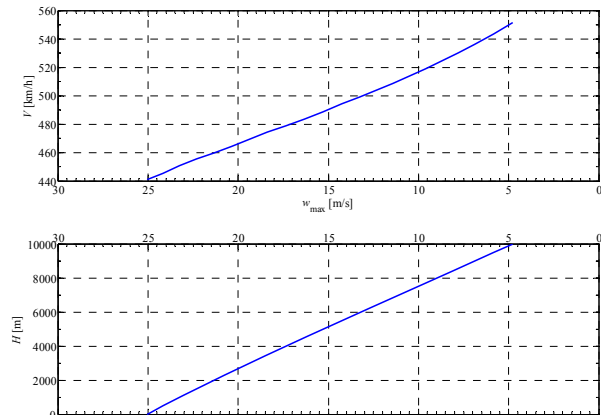


Fig. 7. Trajectory true air speed characteristic of IAR-99 SOIM aircraft, according with maximum vertical speed, on different altitudes

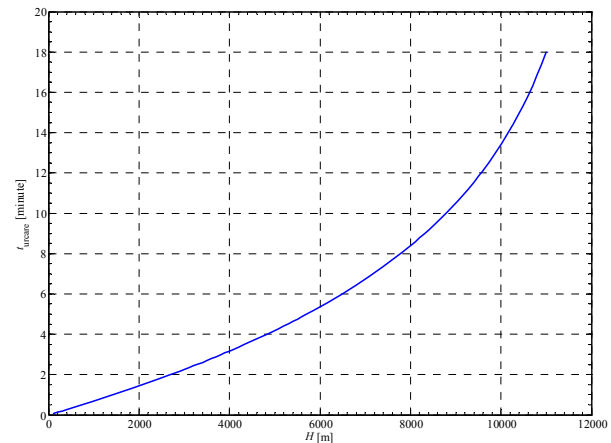


Fig. 8. Minimum climb time characteristic of IAR-99 SOIM aircraft, function of altitude

### 5.3. EVALUATION OF THE NORMAL FACTOR IN A STEADY TURN

The evaluation of the normal factor in a steady turn is made using the results (coefficient  $k$  and, respectively,  $w$ ) obtained in 5.1 and 5.2, with expression [2]:

$$N_z = \sqrt{\frac{\rho V^2}{2} S \cdot \frac{1}{mgk} \cdot \frac{w}{V} + 1}. \quad (16)$$

<sup>2</sup> In minimum time.

In figure 9 is represented the variation of the normal factor at five altitudes, function of

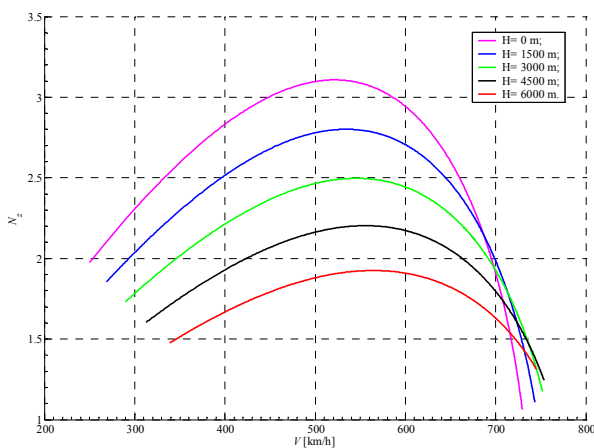


Fig. 9. The normal factor characteristic of IAR-99 SOIM aircraft, function of speed and altitude

## 6. CONCLUSIONS

During the flight tests it was monitored and recorded the global accuracy of the DGPS/RTK system. On can appreciate that the DGPS/RTK system represents a reliable and powerful tool for very high precision navigation and flight tests activities. Using the

speed.

position parameters provided by the DGPS/RTK system and, also, the other parameters supplied by the complementary data acquisition systems mounted on the aircraft, which are necessary in flight data processing and analyzing, on can determine with high accuracy the flight performance of aircraft.

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## INTEGRATION OF EMOTIONAL INTELLIGENCE IMPLICATIONS FOR MILITARY LEADERSHIP

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**Abstract:** *Emotional intelligence has become increasingly popular as a measure for identifying potentially effective leaders, as a tool for developing effective leadership skills and illustrates how technical and emotional factors work effective together in the roles and functions of military leadership.*

Leadership can be define as a process by which a person influences others to accomplish an objective and directs an organization in a way that makes it more cohesive and coherent by applying their leadership attributes, such as values, ethics, knowledge, skills, character, and beliefs.

Military leadership and leaders have their sources definitions in deep-values of strength and professional competence that influence the leader's character and professional development, instilling a desire to acquire the essential knowledge to lead.

Leaders apply this knowledge within a spectrum of established competencies to achieve successful mission accomplishment. The roles and functions of military leaders apply to the three interconnected levels of leadership: direct, organizational, and strategic. Within these levels of leadership, cohesive teams can achieve collective excellence when leadership levels interact effectively. Leaders have to build teams and organizations through direct interaction, resource management, and providing for future capabilities.

The most important keys to effective leadership are trust, confidence and effective communication, by providing purpose, direction, and motivation - while operating to accomplish the mission and improving the organization."

Developing an organization, involves three competencies: creating a positive

environment in which the organization can flourish, preparing oneself, and developing other leaders. The environment is shaped by leaders taking actions to foster working together, encouraging initiative and personal acknowledgment of responsibility, setting and maintaining realistic expectations, and demonstrating care for people—the number one resource of leaders.

Preparing self involves getting set for mission accomplishment, expanding and maintaining knowledge in dynamic topic areas as cultural and geopolitical affairs, and being self-aware. Developing others is a directed responsibility of commanders.

Leaders develop others through coaching, counseling, and mentoring—each with a different set of implied processes. During social interactions, verbal and nonverbal emotional expressions convey information about thoughts, intentions, and behaviors.

Intelligent processing and effective management of emotional information are necessary to navigate into the social world.

Managing emotions effectively is critical to optimal social functioning as this skill enables one to express socially appropriate emotions and behave in socially acceptable ways. Emotions contain information about a person's relationship with the environment and can be triggered when the person–environment relationship changes.

One of the most complaints about the leader's attitude is the lack of empathy. They are outstanding individual performances, being a solo achiever. This type of leaders needs guidance, a specific plan to manage emotional perceptions and resources, to handle different situations, and they can develop emotional intelligence skills.

When military leaders unfamiliar with Emotional Intelligence first hear about it, they are generally unreceptive. Emotional Intelligence (EI) in the context of leadership is seen as a leader's ability to manage personal emotions and the relationships present with others.

At the military career beginning, is the time for young officers, to learn about effective leadership, to understand how they can develop leadership skills, how they need to prepare themselves to discover their strengths and their weaknesses and, with time and attention, how to transform their weaknesses into strengths.

Emotional abilities, including the ability to perceive, use, understand, and manage emotion, contribute to optimal social functioning for building better quality relationships. From the researches in ability-testing of EI, studies and real-world experience, which has accompanied the scientific theory, these abilities within each dimension are expected to develop with experience and age.

From a scientific point of view, emotional intelligence is referring at the ability to accurately perceive your own and others emotions, to understand the signals that emotions send about relationships and to manage situations in a right manner.

Emotional Intelligence (EI) theory, which explicates the cognitive and emotional mechanisms that process emotional information, provides a unified framework to study the role of emotional abilities in social functioning.

Mayer and Salovey's model of EI identifies four interrelated emotional abilities, including the perception, use, understanding, and management of emotion.

The four branch models of emotional intelligence was described by Mayer and Salovey in 1997, and use four areas of

capacities or skills that collectively describe many of areas of emotional intelligence.

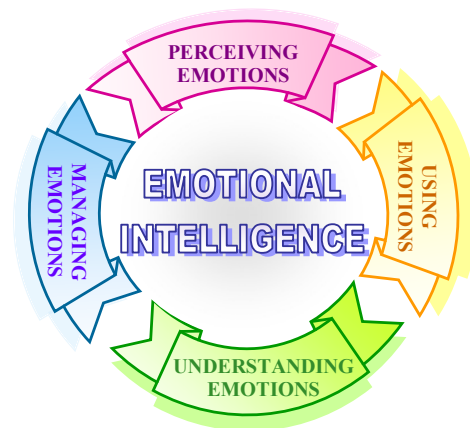


Fig. 2 The four branch model of Emotional intelligence

This model defines emotional intelligence as involving the abilities to:

- accurately perceive emotions in oneself and others;
- use emotions to facilitate thinking;
- understand emotional meanings;
- Manage emotions.

1. PERCEIVING EMOTIONS - the most basic area that has to do with the nonverbal reception and expression of emotion.

Emotions researchers, evolutionary biologists, specialists in nonverbal behavior, and others, have made studies into understanding how human beings recognize and express emotions. The capacity to accurately perceive emotions in the face or voice of others provides a crucial starting point for more advanced understanding of emotions.

2. USING EMOTIONS TO FACILITATE THOUGHT - the second area appeared as basic as the first and has to do with the capacity of the emotions to enter into and guide the cognitive system and promote thinking.

Cognitive scientists pointed out that emotions prioritize thinking. In other words: something we respond to emotionally, is something that grabs our attention. Having a good system of emotional input should helped direct thinking toward matters that are important. As a second example, a number of researchers have suggested that emotions are important for certain kinds of creativity.

3. UNDERSTANDING EMOTIONS - the central point of this group of emotionally intelligent skills is to understand emotional messages and to take actions associated with them. Emotions convey information, each emotion conveys its own pattern of possible messages, and actions associated with those messages.

Fully understanding emotions, in other words, involves the comprehension of the meaning of emotions, coupled with the capacity to reason about those meanings.

4. MANAGING EMOTIONS - a person needs to understand emotions because emotions convey information and often can be managed.

Under the voluntary control, a person may want to remain open to emotional signals so long as they are not too painful, and to block out those that are overwhelming. Within the person's emotional comfort zone, it becomes possible to regulate and manage one's own and others' emotions so as to promote one's own and others' personal and social goals.

An individual may be predisposed to a certain level of emotional reactivity and intensity, but emotion management skills determine how the person's emotions are dealt with once activated.

EI involves the accurate processing of emotion relevant information (e.g., facial expressions) and the ability to use emotions in reasoning in order to solve problems.

The third area, Understanding Emotions, involves knowing how emotions change, in and of themselves, as well as how they will change people and their behaviors over time.

The fourth area, Emotional Management, focuses on how to integrate logic and emotion for effective decision-making. These four skill areas are related to one another, but they are functionally distinct as well.

The third and fourth areas of EI skills are termed "strategic EI" because they pertain to calculating and planning with information about emotions.

When considers EI in light of these domains, it becomes obvious that the field represents a set of comprehensive, interpersonal abilities rather than hardwired native skills, as such, it can be learned. EI

could well be called "affective effectiveness". The affective domain consists of mind, will, and emotions, "heart knowledge", it contrasts with linguistic, logical, mathematical, and spatial intelligences, the cognitive domain of "head" knowledge.

Leaders who are high in EI capabilities may be better equipped to develop stronger teams, and to communicate more effectively with others. Leaders high in EI will build real social fabric within an organization, and between an organization and those it serves, whereas those low in EI may tend to create problems for the organization through their individual behavior. Emotional intelligence is one useful tool, a core competency for leadership effectiveness that there is more than one way to lead, and that certain situations call for EI more (or less) than others.

Leaders that effectively use EI consider decisions that are also sensitive to emotions. Elements of EI, categorized by Daniel Goleman, include self-awareness, self-management, social awareness, and relationship management. Goleman contends that there is a high correlation between performance and emotional intelligence. Emotional intelligence may come naturally to a leader, but Goleman also states that it can be learned and greatly improved upon.

**Self-awareness** describes the ability to understand personal emotions and recognize how they impact other people. A self-aware leader would be able to accurately gauge personal assets and openly handle emotions that could influence decision-making and relationships with others.

**Self-management** describes the ability to control strong emotions that can upset the efforts of subordinates. Attributes of self-management include trustworthiness, adaptability and conscientiousness.

**Social Awareness** describes the ability to understand the emotional state of other people and how it will impact the organization. Social awareness can bridge many cultural differences and protocols. Empathy can allow a much better level of customer service and the ability to

understand the aggravation experienced by employees.

**Relationship Management** comprises the ability to converse, persuade, collaborate and work effectively with colleagues. An understanding of relationship management is needed for inspirational leadership, managing change, encouraging teamwork, and building bonds across organizations.

Goleman and many other researchers in this field make a point that these competencies are not necessarily innate skills, but rather alternative forms of intelligence that can be learned if there is sufficient motivation. Quantifying the skills involved with EI can be valuable as potential selection tools for screening future leaders and developing training programs to improve or enhance current leaders.

## CONCLUSIONS

Education, training, and experience are indispensable components of the military profession, critical to the successful accomplishment of the mission, and the tools of performance and leadership development. Education and training processes are not distinct and separate activities, but they are integrated endeavors on a single learning continuum.

Military organization is a lifelong learning organization. A learning organization is one that promotes and values individual competitive effort and accomplishment teamwork and group success. The result is an environment that has a creative and flexible atmosphere, challenges the conventional, and develops people who are comfortable working with uncertainty. Today's transformational leader must understand a wide variety of complex subjects and be able to integrate them toward a common purpose. The universal and occupational competencies of the transformational leader are best internalized through the teaching process.

As leaders intuitively appreciate, the better they know/understand and manage themselves and the better they know/understand and manage others, the more likely they are to get the results they

want. The EI's values to military leaders consist in how individuals can improve their emotional intelligence, and what impact it has on the effectiveness of military leaders.

As Leaders, establish and continue to maintain your own personal learning agenda. This means a continuing exploration of your limitations and insecurities. Goleman makes it clear that self awareness means facing fears and insecurities on an emotional level.

In an interview conducted in 1996, Dr. Howard Gardner cited linguistic and personal intelligence as the sine qua non of leadership: "It doesn't mean that all leaders have to start with having well developed variants of both of them, but if they're not a particularly good speaker or they don't have a particularly good understanding of other people, that's got to be a top priority for them."

The field of study emotional intelligence has high importance in leadership-sensitive organizations. A cluster of skills and competencies that has great effect on leader effectiveness, EI can be learned, developed, and improved. While researchers continue to refine the field, the two key relational domains - interpersonal and intrapersonal - remain unchanged. The assumption behind EI studies, confirmed by research, maintains that leaders must understand and manage their own emotional makeup before attempting to understand and manage other people.

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## EVOLUTIONS AND TENDENCIES, IN THE COMMON EUROPEAN SECURITY STRATEGY IN THE CONTEXT OF GLOBALIZATION

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**Abstract:** *The security represented one of the most important highlights after which Europe guided itself along history. The security guarantees a favorable climate for the economic and social development. At the beginning of the millennium, in a Europe in full economic and social ascension, security becomes extremely important, leading to the visible intensification of the preoccupations regarding the upgrading of the different security systems and of the quick reaction forces.*

**Keywords:** *Security, strategy, defense, military, policy, capabilities.*

### 1. THE INTERNATIONAL SECURITY ENVIRONMENT

Because of the changing international strategical security environment, states are interested in their security and defense, as a consequence of the complex interaction and interdependence of the phenomenon and of social, economic, military, demographic and ecological processes in the world.

The main influence upon the contemporary security environment is represented by the globalization. A general definition, widely accepted describes the globalization as being “a growing connectivity process, where the ideas, the capital, the goods, the services, the information and the people are transferred nearly in real time throughout the national borders”.

The leadings of the states search for adequate solutions to their problems caused by globalization, risks, and security threatens.

In the last decades of the XXth century, the globalization created defeaters and defeated. A global economy and a global culture in seed phase are to develop, but this will not be in the universal benefit.

The poverty, diseases and inequality remain the major problems for a big part of the people, and the global economy is seen as favoring the Occident, meanwhile making weaker the nations which are to develop. The development

of the global culture is perceived as a form of the Anglo-Saxon culture expansion, affecting the religious beliefs, the structure of the traditional societies, this leading to social, spiritual and cultural disorganization. This created a class of actors – mainly non-state actors – who oppose to globalization and its beneficiaries. The globalization created enemies of the Occident and gave them never used instruments for the future cause.

The globalized mass-media, the communication satellites, in and intercontinental moves, international commerce and internet facilitate the coordination of the moves who oppose to the Occident domination. The free circulation of the budget, persons and ideas permit the expansion of the opposing moves and ensure them means for later development.

The multinational corporations, the transnational organizations and non-governmental actors are the main players in globalization.

Because of its economic and technologic superiority, partly resulted from globalization, the USA has a major influence in the conventional military power domain. All the actors in the international security environment, states or non-state actors, whether they wish for the good or for the bad of the USA, they have to take in consideration this military power which turns

the USA into an invincible power, in case of a conventional military confrontation force to force. The military domination of the USA led to a behavior of asymmetric avoidance from the part of its opponents.

Actors as Al Qa'eda adopted an asymmetric strategy in which they search for manners, others than the conventional military operations, in the confrontation with the USA.

As well, they adopted an asymmetric strategy at the level of the operation theatre where they try to attract the Occident in a growing, exhausting, long-term confrontation, particularly with the Islamic world.

The terrorist attacks on the 11<sup>th</sup> of September 2001, as well as the actions of the same fact which took place then in Europe and in other regions in the world, prove that the terrorist threat is unpredictable and everywhere directed, thus convincing the other states, which fairly consider themselves possible targets of the terrorist attack, to modify their own security and defense strategies and to pursue the achievement of a greater synergy of efforts at international level.

From Romania's perspective, terrorism, generally, and the international terrorism, structured in a out of borders network, especially, represent the most pressing menace to people's life and liberty, to democracy and to other fundamental values which are the base for the democratic community of the Euro-Atlantic states. The imperative of counteract the new international terrorism wave by the democratic forces' cooperation- inclusive by common activities performed in the terrorism generating areas – represent a vital task.

The later changes produced in international geopolitical context have outlined a future script characterized by more instability and conflicts in which a series of new asymmetrical menaces, of military and non-military fact, intend to grow concerning the level of danger and of the probability to produce.

The risks and the menaces for Romania's national security are primarily perceived from the perspective of NATO and EU membership. In these conditions, even if the danger of a classic war of a conventional military aggression is very little probably to happen, the neglect of these kinds of risks could generate

major vulnerabilities for the national security and the action ability in order to accomplish the assumed international obligations.

Europe evolutes to a security environment by cooperation, having as basic aims the political and economic integration, the enlargement of the community with states which agree and promote the democratic values.

The risks of a major military confrontation appearance on the continent have significantly diminished. However, instability and crises phenomenon persist at under- regional level, as also fragmentation and isolation tendencies pf some states.

Thus we witness the development of some new mechanisms of continental and global assurance, based on conflict prevention, on the growth of the diplomatic role and of the civil abilities of crises management.

We can appreciate that the already known European security environment, met in the latter half of the XX<sup>th</sup> century and the beginning of the XXI<sup>th</sup> century a series of stages:

- the one which immediately followed the second world conflagration, especially characterized by the East-West confrontation, in the Cold War. The main menace was constituted by massive attacks started between the two parts with conventional and nuclear weapons;

- in the period following the end of the Cold War, the European security environment was influenced by the conflicts in the former Yugoslavia and Soviet Union.

The terrorist attacks on the 11<sup>th</sup> of September 2001, on the USA territory, and later then, the bombings on the European continent, in Madrid and in London, constituted the main reasons which led to the recognition of some new types of menaces in the European areas. Thus, the appearance of some adequate answers from the decisional part has become a prior necessity.

The globalization process brings with itself the expansion of democratic values as also the perspective of some mixed menaces, like terrorism development in the conditions of CBRN menace existence. For fighting

efficiently against the organized crime and the terrorism, which caused the tragedies in New York, Istanbul, Madrid or London, the cooperation between democratic governments has to be extended. The common access to information concerning the terrorist or criminal activities, the cooperation between justice representatives and police forces, as also the supervising of communications and monetary transactions are essential for the assurance of success in this fight.

The enlargement process constitutes a part of the EU answer to the contemporary challenges, an effort to consolidate the political stability and economic security.

The existent lack of poise in the actual world can be fulfilled by implementing a higher level of security, prosperity and stability, so acts like crime and terrorism have to be rarely or inexistent. Even if the main actor, as organization forms, on the international scene is the nation-state, the majority of the challenges reminded before act by their nature at up-national level. Thus, the discussion plan moves from the level of the institutions and country security organizations to those of the international level: UNO, NATO, and EU. The parallel enlargement processes of the two organizations, EU and NATO, led to the enlargement of the European area, so at its borders there are Ukraine, Republic of Moldova, the countries of the former Yugoslavia, the Caucasian area, the Caspic Sea and an important segment of the extended Middle East. This whole area is far from being a stable one, which could contribute to the European security and stability. This reality drove to the necessity of creating a new security program with common elements for the both organizations, each having its good points and succeeding to offer specific advantages. The localization of these areas of instability in the neighborhood of the European area, and of the Euro-Atlantic area, makes absolutely necessary the cooperation of the two organizations, with the mission to accomplish common political and strategical goals.

## **2. EUROPEAN SECURITY STRATEGY**

The Security and Defense political concept,

outlined beginning with 1999, refers to the development of an independent capacity of decision, and in case the North Atlantic Treaty, as a whole, is not engaged, also to the starting and to the coordination of some military operations under the authority of the EU, as an answer to crises situations. This process is part of the EU decision to apply Common European Defense Policy which would consolidate, concerning the military, his common foreign and security politics.

The political document which depicts the security strategy of the EU is represented by the "European Security Strategy", its title being "A safe Europe in a better world".

With the appearance of this concept, Europe created for the first time a common security strategy, this being considered a correspondent, and also a reaction to the National Security Strategy.

The document begins with the following statement "Europe has never been so flourishing, safe and free", but ends "we live in a world with new dangers, but also with new opportunities". Near these statements, the document sustains the idea that for ensuring Europe's security in a world of globalization, the many-sided cooperation in Europe and outside it, has to be an imperative because "no nation is capable to confront itself with actual complex challenges".

The European Security Strategy identifies a series of menaces for Europe to confront: terrorism, proliferation of mass-destruction weapons, regional conflicts, bankrupted states and organized crime.

Representing an economic force, but also a significant demographic one, the European Union tends to develop also a military part, which would permit it to increase its active role on the international arena, especially concerning the prevention of crises and conflicts, the peace and stability insurance, on its continent, but also in the world. With this purpose, the EU has to proceed on many more levels like: the strengthening of the strategical dimension of the Common Foreign Security Policy; the final abandonment of neutrality for certain member states; the strengthening of the military power and of the political will, without nothing would be possible.

The European Security and Defense Policy, the military part of the Common Foreign Security Policy, has the purpose to permit the EU to develop its civil and military abilities to manage the crises and to prevent conflicts at international level. Thus, its contribution to the maintenance of peace and international security, according to the Charta of UNO, would considerably increase proportional with its economic and demographic increase.

The essential features of ESDP resume to the following:

- ESDP is not synonym with the creation of a distinct armed force of the EU. It evolves in a compatible and coordinated way with the North Atlantic Treaty; actually, each member state contributes of its own will, responsible, active and conscious to the make up of the military structures which act and will act in the name and under the control of the EU for the prevention of crises and conflicts.

It has to be mentioned that there exists military command and task structures at the level of the EU, but there is not an army of the organization; there is a military and civil power which the EU uses in need, in order to play his role as world actor, which assumed itself new responsibilities concerning the security, the maintenance and/or reestablishment of peace on the continent or wherever in the world.

The military structures which will carry out missions according to the Petersberg Treaty and to Europe's Constitution, result from the member states. The Security and Political Committee, the Military Committee of the EU and the Military Staff of the EU. Actually, the practice of ESDP is made with the help of some actors and CFSP instruments.

- May mean a specialization on military positions of the member states. The specialization consists of placing each member state, which will desire to, in the domain in which it has all or a part of his military ability or technology. The advantage of such a construction would be, concerning the military, the avoidance of the wasting and dilution the means. This idea needs to grow up, the European states still being at different reflection stages. Thus, in this view, there is not yet a consensus.

In these conditions it is recommended for

the ESDP to be from now on, the object of a strengthen cooperation between the member states of the EU, but also with NATO. This necessity to cooperate imposes like never before to go deeper into the future of ESDP. However, there will be situations in which all the member states will agree to participate in cooperations, but it is also possible for some of them not to be able to deal with. In the later case, those who want can use the instrument of strengthen cooperation for ESDP.

- It excludes any form of territorial defense. This remains in the exclusive competence of the national states and of NATO. The Constitution for Europe stated a solidarity clause in case of an armed aggression, but it will not be available unless this document will be agreed by all the member states. In other words, each national state has to directly take care of its defense, whether in an individual way, or in a collective way, more exactly by using its quality of member of a military and political organization.

- It can make use of the civil and military power ensured by the member states in order to accomplish missions of crises and conflicts management.

- It collaborates tight with NATO, in order to proceed the management of crises and conflicts, especially concerning the infrastructure and the logistics.

- ESDP has the essential purpose to promote the security and defense interests of the EU as an entity, and not the interests of a single member state. ESDP includes the following seven activity domains: humanitarian and evacuation missions; peace building operations; fighting forces for the crises management; peace enforcement; support operations; peacekeeping operations.

The participation of the member states in the EU missions of prevention and management of crises and conflicts is an own will, responsible and conscious action. Also, the active involvement of the up-mentioned states in the missions led by the EU is made according to the national interests of each member state, on a side, and according to the EU, as an entity, on the other hand. In

other words, the impact of ESDP upon the National Security and Defense Policy does not bring offense in any way to the national interests, but in contrast, it helps them to take shape.

ESDP has a significant and multidimensional impact upon the NSDP of the member states of the EU.

This common defense policy can lead to the construction of a common defense if the European Council makes a decision concerning this part, and if this is agreed by all the member states, but ESDP does not modify in any way the individual engagements of the member states in the security and defense domain, for example of the countries who are also NATO members.

The policy of the EU, in this way, is oriented to the development of the existent power at national and multinational level which could be used for crises management operations in the following directions: the rapid deployment, the troops support, the cooperation, the flexibility, mobility and the command.

Thus, referring to the utilization of the military power of the Union, the Strategy highlights the necessity of a rapid reaction to the potential menaces and challenges, which sometimes supposes even preventive actions for crises. On the other hand, the Strategy suggests that the variety of the operations that the EU can accomplish (the Petersberg operations) is not an opened topic because the European Community, having a flexible approach, it has to be able to answer also to other challenges. Thus, the dimension of the military activities can also include the peace enforcement operations, the crises management, peacekeeping operations.

As a consequence of this long term process which was accelerated especially after the terrorist attacks on the 11<sup>th</sup> of March in Madrid, it was introduced in the Treaty of Instituting a Constitution for Europe, the solidarity clause in case of a terrorist attack and in case of natural or human caused disasters. This solidarity supposes the mobilization of the EU member states, of all the available instruments, and also of their military resources or those of the Union as a

whole.

The introduction of the Constitutional Treaty in the final text and the using in the Reformation Treaty Project of the EU, of the clause concerning the military assistance in case of an aggression or in case of an armed attack against a member state of the EU, even if it does not state clearly the role of the European armed forces in this situation, it can lead, in the future, to the identification of some new types of operations for the military dimension of the EU.

Also, the Strategy emphasizes the civil and humanitarian dimension of the operations, pointing out that the military operations have to proceed according to the humanitarian actions and to the different international organizations, because none of the new menaces to the international security is pure military and cannot be approached just within military means. The European Security Strategy admits that many of the potential operations of the European forces will be accomplished in cooperation with NATO, according to the treaties (Berlin plus), in order to strengthen the operational capabilities of the EU and to provide a support for the strategical partnership between the two organizations in the crises management.

In conclusion, ESDP represents the instrument within the EU desires the increase of its military political role in the regional and international plan. This is a responsible, voluntary and conscious construction of all the member states of the EU, build up according to the European Security Strategy.

### **3. THE MILITARY CAPABILITIES OF THE EU**

In the end of 1999, the member states decided as purpose for the military capabilities of ESDP (2003 Global Goal) the EU ability of deploying within 60 days, an army up to 50,000-60,000 military men and to ensure support in the theatre of operations for a year (in reality the necessary number for achieving this goal is of 180.000, if it is taken into consideration the necessity of guaranteeing three rotations in a year). The

force support supposed the assurance of the necessary command-control capabilities, military information and intelligence, fight support, logistic support (including the air and navy necessary elements). Not to forget that “The Global Goal” is not the creation of a European army. It is more about the national bases to which the European Council can appeal to, if it decides in unanimity, to intervene in a region of the world.

In May 2003 it was stated that the EU has the necessary operational capabilities to accomplish the whole Petersberg mission variety, with some limitations imposed by the difficulties concerning the logistics.

The quantitative goal was easy to achieve. The member states provided a “reserve” of over 100,000 people, 400 airplanes and 100 buildings, and engaged themselves to identify other military powers, in consensus with “The Global Plus Goal”. But, concerning the qualitative part, there were many problems to confront with. The Catalog emphasized the existence of some serious insufficiencies in terms of transport and command.

Concerning the military operation organized by France in 2003 (Operation Artemis), often given as example of the first military operation of ESDP in a farther theatre, it is to be reminded that it was about a very short time action and limited just to Bunia town. The problem of the power remained intact, and sends to the fragile problem of the European military budgets and their reconstruction.

The biggest part of the European armies are still structured like in the time of the Cold War, thus designated to defend the European territory against an eventual army invasion, the EU being incapable to perform specialized far-off missions.

Truly, if the member states count around 1,8 millions of soldiers, just 12 % of them can be deployed in the foreign countries. Or, despite the efforts made, the ESDP does not always have the sufficient means to guarantee the far-off support of the troops and their mobility.

With the adoption of the European Security Strategy, the EU decided for a new goal – The 2010 Global Goal – which would reflect the

changes produced in what concerns the security environment as also the technological evolution in the military domain. By this goal, the member states were appealed to answer to the whole spectrum of specific crises management operations, by rapid and decisive actions.

In order to identify the necessary military capabilities for the 2010 Global Goal, there were taken in consideration five possible scripts: humanitarian assistance, evacuation operations, conflict prevention, peace enforcement, peacekeeping operations. The military capabilities which the member states engaged to ensure were included in the EU Catalog of Forces, and received the title – Battle Group (BG).

The BG concept represents the main modality of developing the rapid reaction capabilities to crises situations, according to the provisions of the Headline Goal – HLG – 2010.

On the 1<sup>st</sup> of January 2005 it was declared the initial operational power, and at the beginning of 2007, it was realized the final capacity (FOC).

At the base of the constituting typology of a Battle Group there are forces of reduced dimensions, but credible concerning the military efficiency. It can be rapidly deployed, capable of independent actions or as a first impact force in the initial phase of an extended military operation. It has the dimension of a consolidated battalion (round 1500 military men), with battle support elements and logistics, as also the necessary capacities of strategical transport (deployment in 5-10 days) and of support in the theatre (30-120 days). On its base there is the multinational principle. It can be constituted on the “frame nation” principle, but also as a multinational coalition of member states, with the achievement of interoperability and military efficiency conditions. Also, states willing to join, candidate states or 3<sup>rd</sup> parties, can participate in a Battle Group, on condition to be associated in advance with a headquarter of the force. It has to be able of self-support in the theatre of operations for 30 days, with extension to 120 days.

In 2007, 25 member countries were participating to the “BG – Full Operating Capability” program and 15 battle groups were planned to form by 2010, thus the years 2008, 2009 and 2010 being covered, each with 2 structures for every semester.

Because the discrepancy between the total number of the European forces and their deployment capacity for the strategical level engagement, in the Unions area of interest, is major, the improvement of the qualitative aspects of these military capabilities is imposed, first of all, in terms of support and deployment capacity.

In this idea, when deciding the Task Catalog for the 2010 Global Goal, there were taken in consideration the qualitative aspects of force (the mobility, the support, the rapid deployment capacity, the interoperability) and less the quantitative aspects, and the possibility to perform, simultaneously, at least two operations.

The major difficulty of the Rapid Reaction Force of the EU (the military capabilities included in the Catalog of Forces) is that any contribution to such an operation will always depend on the formulated operational tasks, of the forces availability at that moment and of the member states’ will to participate in the multinational operation, led by the EU.

Concerning the military part, a last initiative was adopted in December 2004. Then, in an informal council the ministers of Defense of France, Spain, Italy, Portugal and South Countries, proposed the creation of a European gendarmerie Force, of 3000 men and women, which would be able to deploy in the foreign countries in 30 days.

This Force should be different from other military initiatives by its military-civil hybrid character. Truly, it responds to a pressing need of the international community, the one of integrating a civil dimension (much more in the domain of police and law state strengthening) in the military crises management missions. The gendarmerie force will be in the service of ESDP, ESCO, NATO and UNO operations.

These initiatives to strengthen the operational capabilities of the Union do not have to lead to the doubling of the existent

means at hand of NATO, applying the principle ‘separable but not separate’, because there would be produced a dissipation of the resources. The contact between ESDP and NATO must be continuous to obtain the synergy of the process and to evaluate permanently the integration level of these abilities.

The European Union is already a global actor in numerous domains and to become a more important player in international relationships is necessary to develop its own military abilities and to assume more responsibilities to assure its own security and the areas from its proximity.

#### **4. THE CONTRIBUTION OF THE ROMANIAN ARMY TO THE CONSTITUTION OF THE MILITARY ABILITIES OF THE EU**

Romania, in its quality of a member with full rights of the EU, militates for the increasing of ESDP’s role in the effort of ensuring the security of the European area by preventing and administrating the crises and the conflicts from its proximity and it proposes new instruments to edify a common military policy.

Within the framework of the Supplement of the Catalog of the EU Forces 2004, the contribution of Romania included units of all the categories of forces: land forces (at the level of infantry brigade and special forces), NBC protection, military police, CIMIC, logistic support, military intelligence), navy (battleship, a support ship, special forces, mine sweepers) and air force (strategical and tactical transportation capacities, helicopters for medical evacuation). Meanwhile, the Romanian Armed Forces participate with military forces and capabilities to the ALTHEA Operation in Bosnia-Herzegovina, launched by EU in 2004.

In the development process of the operational dimensions of ESDP, the Romanian Army established the offer of the forces for the EU according to the Requirement Catalog (RC-O5), offer represented by quick reaction capacities and which assumes the participation of the



constitution of two Tactical Fight Groups of the EU: starting with the 2<sup>nd</sup> semester of 2007, with Greece, Bulgaria, Cyprus (BG HEL BROC) and in the 2<sup>nd</sup> semester of 2010, with Italy and Turkey (BG Italy).

Romania's contribution to ESDP also assumes the participation to the European Plan of Action into the domain of the Defense capacities and to the European Defense Agency.

The experience obtained by Romania through the participation, military speaking, to different regional initiatives, may be constituted into an important contribution to the edification of ESDP in the center and south of Europe.

## **5. PERSPECTIVES OF THE EU SECURITY**

Since its foundation, in 1999, ESDP has made important and unexpected progress, imposing as an undeniable reality of the European integration process.

Today, the debate regarding the future development of ESDP involves many stakes, among which there can be stated: the coherence between ESDP and NATO, the problem of the democratic control from the European Parliament, the finance of ESDP, the problem of the EU military abilities and national defense budgets.

The relations between ESDP and NATO and the problem of the military and civil capacities of the Union, they are all extremely significant for redefining the future face of the EU.

Once ESDP was founded, the problem of its relationship with NATO was very acute taken into consideration because of a series of reasons. Among the latest, there can be specified: the clear defining of the frame of the European countries' intervention namely under NATO or not; the rigorous establishing of the value added by ESDP comparing to NATO.

The relationship between ESDP and NATO yet cannot be reduced to a simple coordination issue. It regards, of course, a more important stake, which is the one of the military autonomy and, so that, of the political

autonomy of the EU comparing to the USA. An autonomy that could modify Europe's statute in the world and that could lead to a certain rivalry between the two continents.

The progressive foundation of ESDP was accompanied by unstopped criticism of Europe's military capacities, especially when it is confronting with the American ally. As we could see, "The Global Goal 2003" and "The Global Goal 2010" have represented the opportunity to identify the gaps of the European forces concerning technology, transportation, progress and command.

In European political, military and industrial environments, many voices have raised to claim a higher support to the industry and to the technological research concerning the weaponry.

At the EU's level, there gather almost 2 million men and women in the army (the USA have 1,433 million people in the army). In the perspective of a common European Policy, this big number is useless and involves a waste of considerable human and financial resources. The experts in the military field claim a transfer of personnel resources to the weapons industry and to the technological research, to get to harmonious and rational deeds at European level.

The promotion of a restructure of the military budgets of the member states, the rationalizing of the existent resources, a better coordination in the matter of equipment, a shy opening of the defense marketing represent important objectives for ESDP.

Through ESDP, the EU seems to want also the promotion of a rising of the military budgets and, for a short period of time, a rearming of Europe. The debate about the military necessary capacities to the EU to carry out its missions does not limit to a simple integration and harmonization matter of the legislation national defense budgets.

ESDP has the purpose to promote and protect general interests concerning the security of the EU as an economical, social and political entity. Through these, of course, it also takes place a promotion of the security interests of the member countries, the more that they take a series of security measures

concerning European security.

The EU is not a small political organization and its external capacity of action is not to be neglected. Though, nothing is left to this organization but to widen numerous domains. Through these there are: the adoption of the Constitution Project; the relationship clarification with the USA; the strengthening of the strategical dimension of the CFSP; the improvement of the institutional system; the final abandonment of the neutrality for some member states; the strengthen of the military capacities and of the political will without which nothing is possible.

## **6. CONCLUSIONS**

Transatlantic relationships will continue to exist in the context of the consolidation of the role and influence, both NATO and EU in Euro-Atlantic area. The bigger growth of the EU's political power has to be reconciliated with the essential role of NATO in ensuring the security in the interest area, even if the European Community wishes to develop its own military capabilities.

The complexity and proliferation of the new threats and dangers to the international security needs quick, complex answers, and also adequate evolutions in multiple domains. The missions with humanitarian purpose, the administration and prevention of crises ones, carried on cooperation, in interoperability conditions, are being more and more important, which means the exponential increase of financial needs.

The budget adopted by the EU for 2007-2013 does not offer very encouraging perspectives, concerning the introduction and development of several CFSP and ESDP objectives, when the Union develops nowadays a lot of operations in Europe as well as on other continents, which are in fact complex and very appreciated operations.

Romania is aware of the fact that the Euro-Atlantic Community's security is indivisible so that it supports actively the overtures regarding the necessity of a profound transformation of NATO, the mutual functional need of security and defense of both NATO and EU, as well as the need of avoiding the parallelism and

competition in the domain of strategies, capabilities and command structures.

As regards the EU, Romania will sustain the development of CFSP, including by increasing the contribution into military capabilities and those that fight against terrorism and administrate civil emergencies in the community's area.

As a border state of both NATO and EU, having interests to the Black Sea, Romania has to adopt a pro-active attitude in applying firmly its principles and in watching over the accomplishments of the European Policy of Proximity objectives, the administration of "frozen conflicts" from the ex-soviet area inclusive, militating for the strengthening of ESDP's role in the European security System.

We may say that the EU can redefine, state and consolidate the place and the role in the new global context at the beginning of the millennium, according to its real capacity of counterattacking the forces and the gravitational tendencies of different intensities which act presently over the full integration process of all member states in a structural and coherent institutional frame.

Among these forces and tendencies can be enumerated, at random: the insufficient convergence and solidarity demonstrated among the member countries, in different domains; identity crises and those regarding the traditional attributes of the national sovereignty, emphasized by the impact of globalization; the necessity of speeding the integration rhythm of the new countries allowed to join the Union or those, that are waiting, simultaneously with the keeping of the essential attributes which made it very attractive; the reduced coherence of the European policies or of the mechanisms that make possible the implementation of some essential decisions, adopted at the top of the communitarian organisms; the lack of a true European identity feeling; the gap between the economical and the political power – and so on.

Of the answer that the Union will give to these elements with potential risk of disintegration, it depends if the regionalization on the European continent

will lead to its final unification, according to the optimistic vision, and to the regaining of its long last position, of cultural, economical and political world center.

The experience gained in the last years by the Europeans, as also the future challenges, show clearly the fact that, in the European Security and Defense Policy domain, only the common action, based on an efficient cooperation and on a convenient distribution of the military costs, could constitute the necessary element of a competitive development and of a credible military component of the UE. Concerning this, Javier Solana, the General Secretary of the European Council and the Senior Representative of the EU for CFSP, was declaring: "only if we act together, we can have more influence in the world".

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## CRISIS MANAGEMENT - CIVIL AND MILITARY WAYS OF ACTION

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**Abstract:** *Every crisis is unique. As a result, unique strategies and solutions must be formulated and adopted to deal with new conflicts and crises. A multilateral framework provides each management phase with greater political impact and power of persuasion. Civil-military cooperation and coordination of these activities need particular attention to ensure coherent and effective policies. There are different models to bridge diverse structures and philosophies. Yet, despite the provision of huge resources in manpower, skill and finance by the International Community the final result of these operations remains uncertain.*

*Crisis management needs to be understood as a beneficial long-term investment in a safe and just world. Although it maybe very cumbersome and demands a lot of patience, it should be of concern to all of us and needs genuine support.*

**Keywords:** *Crisis, management, force, capabilities, civil, military, cooperation, coordination.*

### 1. FEATURES OF CRISIS MANAGEMENT

The aim of crisis management is, first, to defuse the crisis or resolve a conflict. Secondly it seeks to establish a secure environment to enable parties to deal with the causes of a crisis or conflict. Finally, it aims to initiate reforms of institutions or policies to prevent a follow-on crisis. Crisis response operations are part of crisis management. They support the peace process in a conflict area and include peacekeeping and peace enforcement, as well as conflict prevention, peace making, peace-building and humanitarian operations.

Crisis management is a very complex task and none of the participating states and international organizations has all means necessary at its disposal. Whenever possible, a crisis should be brought to a good end by diplomatic efforts. But very often this is not possible, and other options need to be considered, including the military one to end a crisis or conflict by force. In most cases, after having ended the acute crisis, armed forces are employed to establish and maintain a secure and stable environment in which the structural causes can also be addressed and UN Security

Council resolutions or peace agreements be implemented [1].

Each modern crisis is unique. Each has its specific line-up, its particular mixture of possible forms of violence and conflict. From the very beginning, political goals need to be clearly defined and adhered to, unless there is a fundamental change in the situation. This is an important precondition for success.

Crisis response is a staged process:

#### ***Phase One: Diplomacy Backed by Threat***

An ideal type of crisis management may start with an attempt to persuade the country breaking the rules to change its behaviour by “***diplomacy backed by threat***” [2]. This could be economic, financial sanctions, travel restrictions for members of the government or a threat of military action. This is accompanied by shuttle diplomacy and intense consultations.

The reaction of the International Community in a particular crisis is difficult to predict, even if the facts appear to justify an intervention. Respect for national sovereignty is always a great concern, and reasons to violate it must be very substantial. As a result, often intensive crisis management measures are taken only, if public and international

pressure through media and other means are too strong to withstand, or if the conflict has turned to violence.

Unfortunately, however, sanctions and threats seldom result in their intended effect. Too often sanctions actually strengthen the target regime and make, against all intentions, the population suffer instead.

Iraq under the rule of Saddam Hussein is a good example for this.

***Phase Two: Diplomacy Backed by Force***

The next step in crisis response is “***diplomacy backed by force***” to signal the resolve of the International Community and avoid any misperceptions by the government concerned. It is the last opportunity for the state to assess what it could save by accepting the demands of the UN and what it would risk by not doing so. The consequences of non-compliance must be very serious.

An example from the Balkans: in the case of Bosnia and Herzegovina, in November 1992, enforcement operations in support of the sanctions and embargo began at sea. In March 1993, enforcement of the no-fly-zone over the country was authorized. Air operations started in April and involved finally more than 200 aircraft of various NATO nations. In one incident, several aircraft were shot down by NATO as they broke the regulations.

***Phase Three: Force Backed by Diplomacy***

If the International Community still does not reach its goal, phase number three, “***force backed by diplomacy***”, aims to destroy the adversary's power base. Yet, this is still far from a war situation, because the aim is not to occupy territory permanently, simply to make the regime yield. In this phase, it is particularly important that politicians responsible and the military executing their orders work closely together and in great confidence. Phase three can last some time, according to the degree of force applied. Politicians and public opinion observe operations very intensely to make sure that the use of force is not excessive and that collateral damage is kept to a minimum. The opposite would be disadvantageous in operational terms too: it could bolster adversarial propaganda and strengthen the resistance. In this phase as in others, there is always a diplomatic back channel kept open to

the opponent to make sure military action does not last longer than necessary.

In Bosnia, the third phase started in February 1994. It employed NATO air strikes against artillery and mortar positions in or around Sarajevo at the request of the UN to protect the Muslim population from Bosnian Serb attacks. In October of the same year, NATO fired missiles at Bosnian Serb radar sites and executed air attacks on a Bosnian Serb command and control bunker in support of UNPROFOR (UN Protection Force). These events were decisive in convincing the Bosnian Serb leadership and the government in Belgrade to give their consent to negotiate a peace agreement. The agreement was later initialled at Dayton and signed in Paris in December 1994.

***Phase Four: Diplomacy Backed by Reconstruction***

After crisis or conflict resolution, “***diplomacy backed by reconstruction***” works to create a situation where intervention and the application of force are no longer necessary. The goals of the ensuing peace-building include self-sustained stability, ensuring human rights and democratic principles and security sector reforms to make it subordinate to directives by an elected government. Structural changes of state institutions may also be necessary. In this phase, operations by international military forces guarantee security and stability, which need to be used as effectively as possible by non-military actors.

Sustainable reconstruction requires the commitment of sufficient funds and other resources - above all time. This part of crisis management needs a clear mandate.

The sequence of steps in the reconstruction process is essential. Without sufficient time to establish security and the rule of law and to allow new parties to form and mobilize effectively, nationalistic parties won, the very ones which had been responsible for the war in the first place.

It is important in the reconstruction and peace building process to involve the local authorities and population, to lead them to ownership and retaking responsibility for the affairs of their country. This is not an easy

task. The extended length of the operations often creates a certain dependency among local governments and public, but it is necessary for them to come to terms with this critical task nevertheless.

## **2. MULTILATERAL CHARACTER OF CRISIS MANAGEMENT**

Crisis management has a greater effect if it is multilateral because it is an expression of solidarity with a wider range of options and capabilities and a broader basis for the legitimacy of the action. Consequently, organisations acting under a UN or other mandate will try to have as many countries take part as possible. For example, 33 nations are taking part in EU Operation Althea in Bosnia, 25 in KFOR (Kosovo Force) in Kosovo and 37 in ISAF (International Security Assistance Force) in Afghanistan.

Still, this form of multilateral cooperation has a downside as well: The more participants there are, the more difficult it is to agree on the concrete measures to be taken. Many rounds of consultations in different multilateral for a need to be coordinated, as in the conflicts in the Balkans the UN, the OSCE, the Contact Group (United States, Great Britain, France, Germany, Italy and Russian Federation), NATO and the EU. Moreover, inside NATO and the EU, there are political and military committees that also have a say in the preparation of a decision. (In NATO - the Political Committee, Policy Coordination Group and the Military Committee. In the EU - the Political and Security Committee and the Military Committee.) In addition, there are a number of bilateral contacts underpinning the multilateral process. This is obviously very time-consuming. The United States, in particular, has had problems at times with this cumbersome way of reaching agreements. During the Balkan crisis, General Wesley Clarke, then NATO commander, criticised the Alliance's way of doing business as "war by committees".

To illustrate the complexity of decision-making consider the following: In the UN Security Council a majority of nine out of fifteen votes is needed, if none of the permanent members vetoes a measure. In the

NATO Council 26 states have to agree, and in the EU 27. If the EU wants to use NATO assets and capabilities in a crisis management operation, the consensus of 31 nations is necessary [2].

## **3. DOMESTIC DECISION-MAKING**

In parallel to the decision-making on the international level, in participating states a comparably difficult process of coordination also takes place domestically. Governments are organised in departments and agencies. As a result crisis management is a particular challenge to them because it typically involves more than just one administrative actor. Furthermore, countries that intend to participate in crisis management operations aim to secure public support at home. This is particularly important if armed forces are to be involved.

The opponents in a crisis or conflict know very well that, in democracies, it is difficult to govern against public opinion. Therefore, as in Afghanistan at the moment, opponents target public opinion in participating nations with their attacks on ISAF troops hoping to break up the front by inflicting a growing number of casualties. A broad public mandate can reduce the danger of this happening.

The length of this reconstruction phase - from 1995 to today - shows how difficult and important this mission is to fulfil. Hostile attitudes have had to be overcome and genuine cooperation between former conflicting parties had to be established. This is a truly long-term process and demands patience and persistence.

## **4. CRISIS MANAGEMENT CAPABILITIES OF NATO AND EU [1]**

A look at the crisis management capabilities of NATO and the EU shows that NATO basically uses military capabilities whereas the EU employs a comprehensive mix of civilian means in addition to the military. This "soft power" component constitutes a comparative advantage over the Atlantic Alliance in crisis management operations. EU member states are ready and

able to send specialized personnel in large numbers into crisis and disaster areas at short notice. More than 5,700 police, 630 experts for law and order, 560 experts for administration and management, and about 5,000 personnel for emergency services are available.

As the military capabilities of the EU are still limited, large-scale military crisis management operations are only possible, if the organisation is able to take advantage of NATO assets and capabilities. This has been made possible through agreement of "Permanent Arrangements" between both organisations in early 2003, which provides the EU the use of NATO planning capacities. Furthermore, in particular cases, the EU also has access to collective NATO resources and capabilities - including the NATO command structure and communication systems. Preconditions are that NATO "is not engaged as a whole", meaning the USA is not interested in taking part in this particular crisis management operation, and there is the agreement of all NATO members. In Bosnia, the EU uses NATO command facilities, infrastructure, communications, transport and much more. It is the biggest operation under the "Permanent Arrangements" so far. The cooperation on the ground is excellent, the information flows smoothly and the result has been extremely positive.

To date, NATO and EU have twice exercised crisis management consultations and procedures to train participants and find out where improvements in the process were necessary.

## 5. CIVIL-MILITARY COOPERATION AND COORDINATION

One of the important aspects of consolidating EU civilian crisis management is to ensure coherence between civil and military capabilities. A new dynamic security environment requires the use of a wide range of instruments available to the EU and their use in the most effective and co-ordinated way. Civil-military interactions are increasingly a crucial part of EU operations. The two concepts of Civil-Military Co-operation (CIMIC) and Civil-Military Co-ordination (CMCO) apply to this area. As CIMIC is primarily related to

cooperation between different actors in the field at operational-tactical level. CMCO is still a "work in progress" and its dimension of intra-pillar co-ordination is perhaps the most important, although the inter-pillar co-ordination dimension can also apply to certain priority areas like civil protection or disaster response [3].

The European Security Strategy (ESS) states that "none of the new threats is purely military; nor can any be tackled by purely military means. Each requires a mixture of instruments". When necessary, civilian crisis management missions must be able to draw on military enabling capabilities" [4].

The military is increasingly engaged in multifaceted missions where it is tasked with activities which are not strictly military. CIMIC derives from a military perspective that is concerned primarily with force protection, and the need to co-operate with local authorities and civilians to achieve that aim, as a part of a complex military operation. There are two types of such interaction: *firstly*, crisis management operations partially dependent on civilian institutions and population for resources, information and even security; *secondly*, co-operation of military forces with other international or non-governmental organisations. It is therefore an externally oriented military support function. CIMIC is thus also an important feature of EU-led crisis management operations aiming at enhancing the effectiveness of those operations. CIMIC is based in broadly defined civil-military relations that also cover other areas such as civil emergency planning, military assistance in humanitarian emergencies and host nation support. In the field CIMIC aims at mutual support and common goals based on transparency and communication.

There is no single universally agreed upon concept of CIMIC, but different concepts of CIMIC exist in civilian, humanitarian and military communities [5]. The CIMIC approach is also developed both at national and international levels. Within the European area, NATO espoused a specific approach upon its greater involvement in peace support operations in the Balkans. The military goal

of operation remains supreme and CIMIC is presented as a tactical doctrine and specific tool available to NATO commanders for achieving given objectives.

The EU adopted its own concept on CIMIC for EU-led crisis management operations, establishing permanent CIMIC structures and incorporation of CIMIC structures into specific EU-led operations, while stressing a comprehensive EU approach towards crisis management building upon a uniquely wide array of both civilian and military instruments.

The EU has, however, declared a clear ambition to develop both civilian and military crisis management capabilities. Apart from the CIMIC concept needed for cooperation with external actors in EU-led operations, the EU therefore had to develop an internal co-ordination concept as well - Civil-Military Co-ordination (CMCO).

CMCO serves thus primarily as an EU internal function facilitating successful planning and implementation of the EU's response to crisis. Its aim is to encourage and ensure co-ordination in the actions of relevant EU actors in all phases of the operation. CMCO thus looks beyond the operational-tactical level issues dealt with by CIMIC and takes into account unique features of the EU at political-strategic level. The overall approach is both to establish a coherent EU response to a specific crisis situation and to build a culture of routine co-ordination at every phase of EU crisis management.

Procedural innovation in the CMCO area is reflected in the creation of a Crisis Response Co-ordinating Team (CRCT) *as an ad hoc* body [3] without decision-making powers and composed of senior officials from the Commission and the Council Secretariat. The CRCT should act during the preparation of the Crisis Management Concept (CMC). At staff level, the CRCT should ensure full coherence between military strategic options, police strategic options and other civilian strategic options, the different CONOPS and OPLANS. The CRCT should further assist in ensuring full coherence between the civilian and military aspects of the EU action in the implementation phase. But the role of CRCT was in reality confined mainly to formal coordination

between the Council and the Commission at a senior level.

In the field, the crucial role in the CMCO area is reserved for a particular EU Special Representative (EUSR) who maintains an overview of the whole range of activities within an area of operations and closely co-ordinates with the EU Force Commander, the Police Head of Mission and Heads of Mission for other EU civilian operations.

The framework for EU crisis management efforts was created by the military, while civilian input came later on and did not change the strategic planning approach fundamentally.

Military and civil crisis management measures take place one after the other or in parallel. For instance, talking about Bosnia, the main coordination of actors happens under the stewardship of the UN head of mission. Although NATO has only military capabilities in its inventory, it fulfils many tasks that also benefit civilian authorities and the public. Returning to Bosnia, SFOR provided a wide range of assistance to other participating organisations. It created a secure environment for municipal elections in 1997 and supported the OSCE in the preparation and conduct of these elections. It assisted the OSCE in implementing the Confidence and Security Building Measures and Regional Arms Control agreements. The Office of the High Representative received telecommunications, engineering and air transport support. The UNHCR (UN High Commissioner for Refugees) got assistance in its task to arrange for the return of refugees and displaced persons. Close cooperation took place with the International Police Task Force through surveillance, communication and transport, as well as back up for their operations. Some military specialists have even built houses for returning refugees.

The EU has conducted 18 civil and military crisis management operations to date [2]. Most of them were small civil missions focussing on law and order such as police advisory functions as in Macedonia, in Iraq or in Congo. In Bosnia, the EU carries out three missions in parallel: the military Operation Althea and two civil ones, the EU Police



Mission and the EU Monitoring Mission.

To strengthen the network between deployed armed forces and the multitude of civil governmental and non-governmental actors, the EU established Civil-Military Liaisoning. Civil-Military Coordination on the other hand, aims at linking more closely together all civil and military functions and actors in the ESDP (European Security and Defence Policy) framework to make sure policies are coherent.

In Bosnia, the EU works together with the UN to exercise pressure on conflict parties and to coordinate the civil implementation of the Dayton Agreement. It supported the reconstruction of infrastructure, cooperation initiatives, customs operations, establishment of free media and judicial reform.

A very different coordination concept is used in Afghanistan. Here, civil-military activities are coordinated in the Provincial Reconstruction Teams. PRTs are multinational, inter-departmental and inter-agency structures. They cooperate closely with the local and regional Afghan authorities, international and non-governmental organisations.

All these measures show how decisive cooperation and coordination are for the success of the missions as a whole. They try to bridge the different organisational principles, responsibilities and modes of operation of government departments, EU commission general directorates and a multitude of governmental and non-governmental organisations.

## **6. ROLE OF THE CIVIL-MILITARY CELL**

The Civilian/Military Cell (Civ/Mil Cell) came about as part of a compromise package, where the most contentious issue was the establishment of an autonomous operational HQ [6]. The Council envisaged five main functions of the cell [7]:

1. link work across the EU states on anticipating crises, including opportunities for conflict prevention and post-conflict stabilisation;

2. assistance in planning and co-ordinating civilian operations;

3. developing expertise in managing the civilian/military interface;

4. conducting strategic advance planning for joint civil/military operations;

5. reinforcing the national HQ designated for an EU autonomous operation.

The Civ/Mil Cell is now almost completely staffed and has a Military Director and a Civilian Deputy Director. The Cell consists of a Strategic Planning Branch and permanent key nucleus of the Operations Centre. The Strategic Planning Branch is especially relevant for CMCO issues. It has 17 staff members, including 7 military planners and 7 civilian planners. Among civilian planners there are two Commission officials acting as liaison officers and having expertise in humanitarian aid and disaster response and the management of reconstruction assistance respectively. This permanent link to the Commission, its experience and expertise in humanitarian operations is an important institutional innovation. The Civ/Mil Cell is entrusted with strategic contingency planning bringing together views from different EU actors from both pillars and Member States, but also from both civil and military dimensions. Within crisis response strategic planning, Civ/Mil Cell provides assistance to political-military strategic planning regarding also the civilian/military interface and possible civilian or military support [8].

Even more importantly, the Civ/Mil Cell should contribute to crisis response strategic planning for joint civil/military operations through developing joint strategic options including civilian and military dimensions. This is especially acute, as there has not been a truly joint EU civil / military operation carried out yet, although there is a clear need for such operations. The second significant improvement that Civ/Mil Cell may achieve is in the area of development of doctrines and concepts that would enhance the civil-military interface in areas such as security sector reform or disarmament, demobilisation and reintegration, where civilian and military expertise are naturally intertwined, as well as assisting civilian crisis management operations with expertise in areas such as

logistics, communications and information systems and planning expertise. The Civ/Mil Cell has also an opportunity to integrate reports on lessons learned from separate civilian and military operations conducted side by side in one territory, as is currently the case in Bosnia. The same joint lessons learned could be drawn also from EU exercises.

In general, the Civ/Mil Cell has to rely on its ability to convince and to bring people together, thus establishing the habit of working together and strengthening feedback between Commission and Council Secretariat structures. The Civ/Mil Cell will be also in a position to increase awareness of CMCO issues by presenting briefings in various training programmes. The advantage of the Civ/Mil Cell may be seen in the fact that it neither manages funds, nor runs operations (although it may assist in running operations). It is free of direct interests in concrete EU operations and can therefore better focus on the overall picture of civilian and military instruments available for a joint mission or better interlink-age of existing separate missions in one territory. The Civ/Mil Cell is now designated as a strategic planning branch and staffed by personnel with a solid planning background and good awareness of the EU institutional environment [3].

## **7. PROSPECTS FOR FURTHER STRENGTHENING OF CMCO IN EU CRISIS MANAGEMENT**

Major differences persist in terms of the types of capabilities needed in the military and civilian dimensions as well as their state of readiness. While the military side works usually with units and technical capabilities, both available on reserve, the civilian side deals with human capabilities such as highly qualified individuals (civilian experts) or small units (police), usually not available on a reserve status. In future, the decision in principle has been taken to set up pre-identified and pre-trained Civilian Response Teams for EU Rapid Response operations.

CMCO issues are therefore taken seriously, even more so as geopolitical reality will increasingly lead the EU towards complex crisis management activities for which it will be

obliged to draw upon the wide range of civilian and military instruments at its disposal. This impetus is likely to be sustained through deployment of new parallel (civilian and military) EU operations in Africa, the Balkans and elsewhere. The next stage would certainly be planning for a truly joint EU operation, and overcoming the institutional separation of different civilian and military tools available for conflict prevention, crisis management and post-conflict stabilisation. It is easy to see an added value of using a mixture of these tools at the disposal of a unified EU presence in a given territory. A clear candidate for such a novel approach would be the EU follow-up mission in Bosnia.

Another aspect of CMCO improvements is connected to new institutional developments represented for example by the Civilian/Military Cell that may become a natural CMCO interlocutor within the EU structures. Also, overall drive for improving EU capabilities is now likely to be more focused through the linking of the Civilian Headline Goal 2008 and Headline Goal 2010 processes.

Lastly, perhaps the most crucial part of building a well-established civil-military co-ordination within the complex institutional framework of the EU lies in a continuous process itself. The culture of CMCO will have to be carefully nurtured in both intra-and inter-pillar senses, through continuous training both for officials in Brussels and EU capitals and personnel earmarked for field missions. EU institutions in particular will have to sustain this CMCO culture even in the absence of the powerful external forces that would have been created by the EU Foreign Minister and unified European External Action Service as envisaged in the EU Constitutional Treaty [3].

## **8. CONCLUSIONS**

Every crisis is unique. As a result, unique strategies and solutions must be formulated and adopted to deal with new conflicts and crises [2]. But we can also learn from past experiences. We have seen that crisis management operations are very complex

enterprises. A multilateral framework provides each management phase with greater political impact and power of persuasion. However, it also requires comprehensive efforts in consultation and decision-making. Civil-military cooperation and coordination of these activities need particular attention to ensure coherent and effective policies. There are different models to bridge diverse structures and philosophies. Yet, despite the provision of huge resources in manpower, skill and finance by the International Community the final result of these operations remains uncertain. Ultimately, a fresh start cannot be made without also a new mindset of the local populations. Nothing less can lead to a lasting solution for these deeply rooted problems.

Crisis management needs to be understood as a beneficial long-term investment in a safe and just world. Although it maybe very cumbersome and demands a lot of patience, it should be of concern to all of us and needs genuine support.

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## CORROSION DAMAGE OF ENTRANCE BUCKET

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**Abstract:** *Corrosion damage of the metal to the crystal boundary, seen as a process, it is called intergrain corrosion. This can be observed the best to the best to the entrance bucket from the austenitic steels with an addition of chrome and nickel in the salinity conditions of the air. Intergrain corrosion manifests into the non-air water too, into high pressure steam when the temperature is bigger than 360<sup>0</sup>C and, the most common in the presence of the stress tensile. In the small proportion, the intergrain corrosion can be seen to the ferrite and austenitic steel also. Intergrain corrosion appears at the welding belt too, in the thermal action zones. Some steel tending at in corrosion identifying methods are being developed. The widest spread theory, which explain the development the intergrain corrosion process, is the exhauster of the steel with chrome intergrain limits theory. Because of the low diffusion speed of chrome, in comparison with the carbon round chrome one, there are created adjacent formations of the chrome. In consequence, the potential different is being created, which in some conditions, produces the intergrain corrosion.*

### 1. THE CORROSION CRACK

This appears due to the combined actions of the corrosive medium and local stress. Apart from intergrain corrosion, the corrosion crack process of the austenitic steel manifests at low temperatures, and the crystalline granules interior. The general resistance to corrosion of the material doesn't determine the predisposition to corrosion crack. The changing of the thermal manufacture technique and, balanced, of the chemical composition as well, practically changes a few the material resistance to corrosion crack.

The most probable is the corrosion crack process development caused by the local electrochemical corrosion, which leads to the formations of some ting crack of isolated holes shape. By the time the hole develops, in its superior part it is produced the concentration of stress and, in consequence, the local plastic deforming, which can produce the fragile destroying process. Depending on the test item shape, on the strain application type, on the experiment condition and on the

energetic state of the metal, components of the fragile degradation process, the crack can spread all over the length of the model, leading to spontaneous destructions or, spreading itself on some distance, it can stop.

### 2. THE ATMOSPHERIC OXIDATION

The atmospheric oxidation is a reaction process of the metal with the air components: oxygen, nitrogen, carbon dioxide and the water steams. The nickel steel nitration process, refractory and high temperatures resistant, in the atmosphere, has place relatively slow, because the aluminum, chrome and iron nitride witch formed in the superficial layer lead to the reinforcing of the surface. As a result of the interdependence with the oxygen produces the formations and enlargement of the scoria and, as well, the composition changing and the enlargement of the depth under the oxidation layer.

In the initial stage of the oxidation process, the proportion between the elements from the oxidation film and the ones from the alloy is the same. The formed scoria layer represents a specific barer which doesn't permit the

oxygen to move from air to metal. When the width of the rusty film is not sufficient, the chrome and nickel flux prevails, whose free ions concentrations is higher than to other components of the alloy. Once with the enlargement of the scoria width, it grows the diffusion role of the elements: the layer under the rusty film are enriched with nickel and chrome oxide, which leads to a improvement of the protection properties. In the same situations it is possible the break of scoria and the progressive exhaustion of the chrome layers which are under the rusty film one. When the time of maintaining at thermal treatment grows, the enrichment of the scoria layers produces, which diminish the protection properties.

The periodic coating of the models can produce scoria. As in time of some cyclic and continue experiments the intrusion speed of chrome doesn't change, the scoria has a varied composition. Consequently, the scoria extracted from CrNi78Ti after some cyclic experiments at 1050°C contents Cr<sub>2</sub>O<sub>3</sub> and a small quantity of NiO Cr<sub>2</sub>O<sub>3</sub>, but after same cyclic experiments the scoria contents only spinel (crystallized magnesium ore into cubic system divert color, with high hardness, used as precious stone).

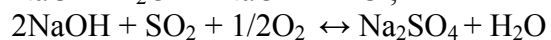
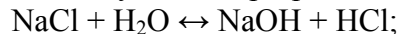
The tension stress applied to the models intensifies the oxidation process: because of the stress actions it produces the destroy of the fragile scoria and the growing of the diffusion process. The exhaustion degree with alloying elements and the depth of the layers above the layer works out from the chemical composition of the material. For example, after the experiments in 3000h at the 1200°C temperature, alloy CrNi70Y the layer under the oxidation one contents 2,5 – 3% Al. Apart from Al, a positive influence to the oxidation process slowing have the chrome and tantalum. The tantalum role is illustrated by a high resistance of the alloy TAZ-8A with 5,5%Cr and tantalum in comparison with the hasteloy X alloy, with contain 22%Cr but not tantalum. At temperatures of more than 1000°C, in the scoria it spontaneously grows the amount of molybdenum. The composition of the scoria formed at temperatures up to 1000°C, identifies with the spinel and

(Ni.Co)O(Al,Cr)<sub>2</sub>O<sub>3</sub>. At over 1000°C the scoria has three layers: the exterior of NiO, the middle one of spinel, and interior of spinel and NiMoO<sub>4</sub>.

### 3.THE SULFURIC AND VANADIUM CORROSION

During the analysis done on the deposit formed on the rotor and stationary blade were discovered important quantities of sodium, kalium, calcium, and, as well, dioxide of silicon, oxide of nickel, of iron etc.

In the gas kinetics flux of the gas turbine, sodium and kalium came from the fuel and the air salt too. The comparison of the sulphur quantity from the gas turbine with quantity of sodium and kalium, proves that the sulphur quantity is a lot of bigger than the necessary for attaching Na and K in the sulphats. The interaction behavior between sulphats and chloride can be studied with the help of the phase equilibrium, based on the thermodynamic properties of the reaction:



The experiences show that, at high temperatures, the chlorine – ions quantity in condensed form, is a lot more smaller that the SO<sub>4</sub> ions.

Table 1

Material	Na <sub>2</sub> SO <sub>4</sub> +10% MoO <sub>3</sub>	Ni <sub>3</sub> S <sub>2</sub> +Ni	
t, [°C]	565	645	
Material	Na <sub>2</sub> SO <sub>4</sub> +31% NaCl	MgCl <sub>2</sub> +H Cl	NaCl+ MgCl <sub>2</sub>
t, [°C]	620	429	450

### 4.THE SULFURIC CORROSION

The role of the coating on the metals, in sulfuric corrosion process, is especially based on stopping the formation of an protective film. In the interaction process between the refractory alloy and the rusty film from their surfaces, there can be created compounds easily fusible, which have following melting temperatures:

The compounds easily fusible, which are created on the blade surfaces, produce the intergrain corrosion of the metal. The

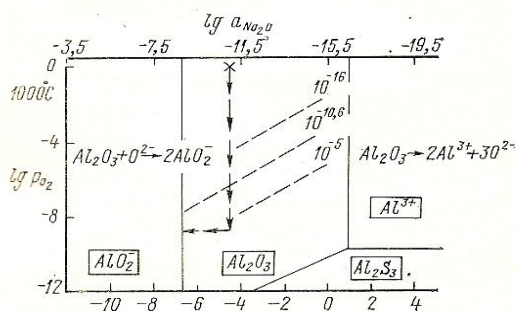
crystallization of compounds easily fusible, during the cooling and melting time at high temperatures may lead to accelerated spreading of the intergrain crack.

When analyzing the sulfuric corrosion, the equilibrium diagrams are studied, which is based on some thermodynamic dates required in the  $\text{Na}_2\text{SO}_4$  reactions with other oxides. As an example is given the equilibrium (diagram1)  $1000^\circ\text{C}$  which corresponds to the reaction:



As it can be seen from this diagram,  $\text{Al}_2\text{O}_3$  must be resistant to the interaction with  $\text{Na}_2\text{SO}_4$  in the area which corresponds to an equilibrium pressure  $\text{SO}_3$  during the condensation time of  $\text{Na}_2\text{SO}_4$  on the turbine components. The laboratory and stand experiments done on the gas turbine with alited vanes show that the  $\text{Al}_2\text{O}_3$  film is damaged in the sulfuric corrosion process.

An important influence on the corrosion process produced by sulfur and vanadium is represented by iron oxides, which enter in the turbine from the admission device, combustion chamber and, as well, form fuels. This influence may, to an extend, be connected with the fact in the iron oxides presence the rusty film adhesion on the vane surfaces is eased. On the other hand the molybdenum oxides form, with  $\text{Fe}_2\text{O}_3$ , on the alloys surfaces with molybdenum, eutectics with a  $T_{\text{melt}}$  of  $705, 722, 878, 881^\circ\text{C}$ , which have actively influence the metal. So when trying the model made by alloy based on nickel, which contained molybdenum, after the time of maintaining to extension thermal treatment at  $850 - 900^\circ\text{C}$ , there have been found corrosion dirt pits.



**Diagram 1.** Thermodynamic diagram of aluminum phase, of constants from  $\text{Na}_2\text{SO}_4$  at  $1000^\circ\text{C}$  ( the arrows indicate the changing of  $\text{Na}_2\text{SO}_4$  composition during the Hydrogen and Sulphur exit; the discontinuous lines- sulphur isobars , and the isobar  $10^{-10,6}$ , the sulphur pressure needed for the aluminum sulphur formation in the lower part of the diagram, which corresponds to the  $\text{Al}_2\text{O}_3$  of the steel Ni with 31% Al)

### 5.THE CORROSION PRODUCED BY VANADIUM

When using the gas turbine which consume vanadium, sodium, and sulphur containing by fuel, on the vanes it's discovered rusty film with a totally complex composition: :  $\text{Na}_2\text{SO}_4$ – sodium sulphate ;  $\text{Na}_2\text{Mg}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O}$  –sodium – tetrahydrate of magnesium sulphat;  $\text{MgSO}_4$  –magnesium sulphat ;  $\text{Na}_2\text{O} \cdot \text{V}_2\text{O}_5$  – sodium – vanadil – vanadat;  $\text{Na}_2\text{O} \cdot \text{V}_2\text{O}_5$  – sodium metavanadium;  $\text{V}_2\text{O}_5$  – vanadium pentoxyde ;  $(\text{VO})_2\text{SO}_4 \cdot 16\text{H}_2\text{O}$  – vanadil- sulfat-hexadecahidrat;  $\text{V}_{12}\text{O}_{26}(2\text{V}_2\text{O}_4 \cdot \text{V}_2\text{O}_5)$  – vanadil-vanadat;  $\text{NiO}$ –nickel oxide. Very aggressive at a  $t > 647^\circ\text{C}$  is sodium – vanadil – vanadat.

The diminishment of the vanadium part from the fuel is received by his water wash. Reaching the vane surface, in amorphous state, the vanadats glue on them, damaging the gas flowing and, consequences, the turbine efficiency reduces. There have been made several proposal connected with the causes of the aggressive action of the vanadium among metals:

- vanadium pentoxide is the catalyst – the oxygen's agent, that is why reaction  $\text{V}_2\text{O}_5 + \text{Me} \leftrightarrow 2\text{MeO} + \text{V}_2\text{O}_3$ ;  $\text{V}_2\text{O}_3 + \text{O}_2 \leftrightarrow \text{V}_2\text{O}_5$  is very quick;

- in the decomposition process (oxygen separation) of the vanadium peroxide or of the vanadats form the active or atomic oxygen, which produces the intergrain corrosion;

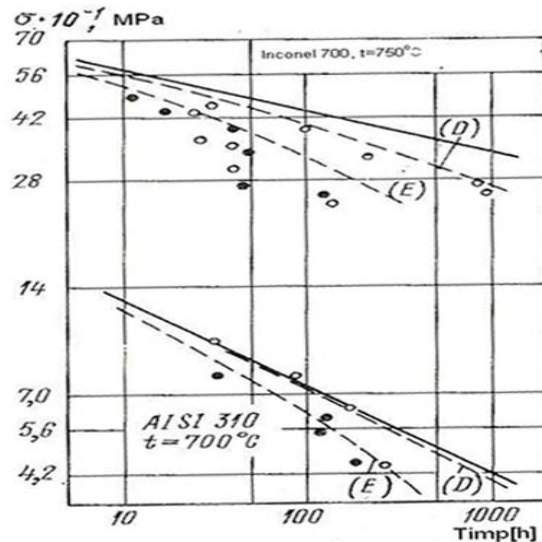
- vanadium pentoxide oxides the sulphur gas from the burning products of the fuel into a much more aggressive sulfuric anhydride;

- melt vanadium pentoxide easily damages the protective film and oxidizes the metal as:  $V_2O_5 + 2 Me \leftrightarrow 2MeO + V_2O_3$ .

The corrosion slowing in oxygen absence proves the three first devices. There is not an unique opinion nowadays regarding which device and in what cases plays an essential role, although there has been done a lot of research.

Different experiments revealed the following results. Steel similar to Cr18Ni9 at  $850^{\circ}C$ , in  $V_2O_5$  presence, oxidizes 50 times faster, than in his absence. At the chrome – nickel austenitic steels based on iron, in  $V_2O_5$  presence, a porous film is formed and the corrosion process develops under it. Nickel and cobalt alloys are, as well, corroded by vanadium, but less than iron based alloy. The corrosion resistance grow, in this conditions, is observed at the alloy with a higher silicon composition (10-15%). The growing of the chrome quantity doesn't affect the vanadium corrosion speed.

Under the influence of the applied stresses, the development of the vanadium corrosion changes: the stresses intensify the oxidation to the limit of crystalline granules of the metals. It has been discovered that, in corrosive atmosphere, which contained vanadium, the time and the number of the cycles until the damage at  $700-800^{\circ}C$  reduces, so, for example, at  $800^{\circ}C$ , for  $N_p=3 \cdot 10^8$  cycles,  $\sigma_{-1}$  reduces from 240 at 80MPa. The experiments done to evaluate the resistance to fatigue demonstrate that the time until the probe damages depends on the existence of the corrosive environment.



**Diagram 2.** Endurance of Inconel 700 alloy and of steel AISI 310 in corrosive medium: ● - determination dates; ○ - experimental dates.

As a comparison, in the diagram 2, there are curves calculated on the supposition of the linear sum of damages, which regards the stress growing as a result of the corrosion during the experiments. The majority of the time results recorded until the Inconel 700 alloy was damaged, are lower than the calculated ones, which indirectly proves the existence of an adsorption activity of the vanadium compounds. The corrosion influence on the fatigue resistance was even more visible, because, in this case, the damage of the surface determined by corrosion had the concentrate role, which immediately reduces fatigue resistance. About the high plasticity, it has been discovered that the alloy based on iron and cobalt had a lower sensibility to the characteristic of on time resistance in different environments.

## 6. CONCLUSIONS

Vanadium caused corrosion influence on nickel alloys resistance is smaller than the sulfuric corrosion influence. On the other hand, when the vanadium amount is much more bigger than the sodium one, the last one (sodium sulphates) has not a visible influence on corrosion process.

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## THE FUNCTION BEHAVIOR AT STATOR'S AND ROTOR'S TURBINE BLADES

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**Abstract:** Modern gas turbines differentiate due to their architectural diversity, type (open or closed cycle) and destination (stationary, of transport, aeronautics and maritime). The demands for turbines components with various destinations are taken into consideration during the design phase, but the technological, architectural requirements as well as the ones regarding the materials they are made of, set the limits for turbine design. The main determiner is the temperature. The vane wheel is thermally and mechanically the most stressed component, fact which leads to the use of superior quality materials. The majority of jet propulsion units are exposed to several elements while being used, such as a great number of ignitions and various services of functioning, and this leads to special requirements for design, execution and usage.

### 1. SERVICE REQUIREMENTS FOR THE STATOR BLADES

The turbine stator blades heat up the most as compared with all the other components (except for the liner and gas collector). In contrast with the rotor blades, whose temperature is determined using the average temperature of the combustion gases, the stator blades may reach 50<sup>0</sup>C, and in certain circumstances even 100-150<sup>0</sup>C above the average temperature of the combustion gases. Because in the section the stator blades are bigger than the rotor blades, the change in temperature which occurs during ignition, shut down or other phases of engine running has as a result bigger thermic tensions.



Fig.1. Corrosion stains and asperities on the stator blades

Depending on the structure, the blades are elongated due to the creep tension caused by the weight of the stationary elements, but mainly because of the stretching caused by the force produced by gases. Nevertheless the tensions from the stator blades are fewer than those from the rotor, which stand up to the centrifugal force.

The most frequent types of blade deterioration as a result of a long time usage are:

- corrosive deteriorations which lead to the attenuation of the blade's leading and trailing edge, to corrosion stains and asperities, all of these diminishing the aerodynamic qualities (figure 1.1);



Fig.2 Cracks in the blade's leading and trailing edge because of the thermal fatigue



Fig.3 Cracks which lead to tearing of the material

- Thermal fatigue which leads to cracks in the blade's leading and trailing edge (figure 1.2);
- Cracks which lead to tearing of the material affecting the other components (figure 1.3);
- Changes in their geometry which lead to blade resistance loss while being thermally challenged (figure 1.4);
- Superficial disruption of the blades made of materials less flexible because of different objects entering the jet propulsion unit (figure 1.5).

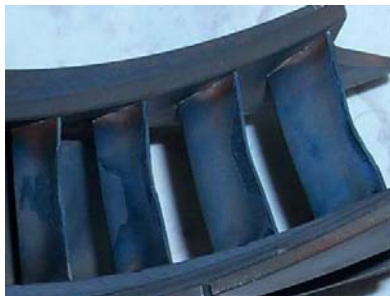


Fig. 4 Changes in their geometry



Fig. 5 Superficial disruption of the turbine's stator blades



Fig. 6 Curves of the leading and trailing edge

The impairment of the turbine's stator blades caused by corrosion is the result of the interaction between the materials of the blades, the gas surrounding them deposits of ash which contain several combustion composites. The corrosion process is more aggressive on the blades if in the fuel there are vanadium and sulphur and if maritime salt enters the propulsion unit. Cracks which appear due to thermal fatigue are the most frequent phenomenon. Their cause is the thermal load of the blades, blades which undergo thermal variation during the several stages of flight. During the ignition the temperature at the middle section of the blades is significantly higher than the temperature at the peripheries and when the blades are bandaged and do not elongate freely, curves of the leading and trailing edge may appear, leading to the reduction of the director apparatus and (figure 1.6) of course to the a minimized effectiveness of the engine.

## 2. FUNCTIONAL REQUIREMENTS FOR THE ROTOR'S TURBINE BLADES

The rotor's turbine blades undergo the effects of the centrifugal force which produce variable tensions inside them on the entire length, the maximum tension being on the blades root, and if the root is bandaged it may be somewhere else on the blade, for example under the bandage or in the bandage. Under the influence of the combustion gases huge bending tensions appear at the blades root. Rotor blades have different temperature in length as well as in depth. Temperature gradients have a sudden rise during ignition

and shut down, the result being a field of thermal tension.

In the crept blades the air flow improves aerodynamically and therefore its performance is better than in the case of the straight blades. The elongation tensions caused by the centrifugal forces are irregularly dispersed on the transversal section: in the middle the tensions are bigger than the average ones, and in the trailing and leading edges they are smaller.

After cooling in the leading and trailing edges the elongation tensions are overlapped by the compression tensions, the total nearly reaching zero. The middle section of such blades has lower temperature, and the thermal tensions are by comparison smaller (10-30Mpa).

The part where they are hinged (pinecone or T shaped) has significant tensions concentrator; each tooth undergoes bending and crushing tensions. A great influence in the equal distribution of the tension acting upon the blades resides in the production efficiency. Besides the static tensions there are some vibration tensions which act upon the blades, and their action leads to the tearing of the blades – tearing caused by usage. These are connected to the fact that the level of dynamic tensions from the designed turbine blades can not be known (there are no computing methods). The vibration of the blades may reach high levels, when the frequency corresponding to a certain main form of vibration coincides with the frequency of the perturbation force, the multiple of rotation, and as a result the resonance occurs.

The level of dynamic tensions while the resonance occurs depends on the hardness of the blade or of the blades assembly, on the loss of energy during the vibration, and finally on how close in time the vibration of each blade and the vibrations of the assembly occur. It is thought that between the vibrations and the bending tensions within a blade there is a correlation because together are determinate by the exhaust gases. This is the reason why in the production process the thickness of the blades is reduced to the minimum taking into account the fact that the bending forces do not influence the endurance of the blades. The fact

that the level of dynamic tensions depends on a small scale on the operating conditions of the engine. The level of the dynamic tensions may be highly influenced only by producer. A decreasing in tensions level is possible due to the following aspects: decreasing surfaces roughness, the proper junction where the sections connect, the proper junction between the blade and the disc for maximal damping, the use of bandages, thickening the blade's root.

Using materials with a high level of endurance the level of vibrations may be increased to the maximum admission level. A certain decrease in vibrations may also be obtained by using materials with better damping qualities. Materials which have such qualities are steels containing chrome, which has the highest level, but the austenitic steel has a lower level.

The impairment of the rotor blades is the most common cause for turbine failure. The causes of blade tearing are: foreign particles which enter the air flow, the level of vibrations, thermal fatigue, overheating when the composites are not heat proof enough. Impairment statistics show that the rotor blades are often damaged by collateral materials and wrecked elements. Most of the times these lead to indentations, recesses and scratches acting like cuts that produce tension intensification the result being a decrease in endurance. The impairment of the rotor blades due to the centrifugal forces (figure 7) is the result of increase in the maximum temperature level with 300 °C. This occurrence was caused by the incomplete combustion in the combustion chamber and the continuation of the process on the turbine's blades.



Fig. 7. The impairment of the rotor blades

### **3. CONCLUSION**

In addition to the service parameters which influence the choice of material, one has to take into consideration the temperature at which the components function, its variables, the type of fuel and its chemistry, and the way the installation is being used. The fuel may have impurities from the entities where it is stored. The air flow that enters the jet propulsion unit may contain salts from the water drops which are sucked in with the air,

the sand and the dust from the atmosphere, all of these having a negative influence when it comes to corrosion resistance.

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## TRAINING IN CINCU RANGE ONLY BY SIMULATION?

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**Abstract:** *One of the political defence goals of Romania is the development of the army acquisitions, a priority of the following period for the end process of the armed forces reorganisation. The modernization policy takes into account, on the one hand, increasing the performance level of the existing technical basis and on the other hand, supplementing with technique and equipment compatible with those owned by the NATO member countries armies.*

*Regarding modern armed conflicts, training through simulation is a way of checking some scenarios as well as of developing the battlefield management.*

*Specialists from the Domain and Infrastructures Agency and from Agency from Research and Military Technologies made clear an exercise which allows the effectiveness development of planning and management activities for firing in Cincu range, providing the user a series of means for visualizing and analyzing digital geographical data and also equipment specific for artillery troops.*

*Resourced used:*

*- hardware (computer, network, common inputs-outputs, peripherics especially used for collecting data, communication network etc),*

*- software (system programmes, communication programmes, programmes for data management, programmes which assure changing and validating the collected data, programmes for geographical analysis etc.),*

*- sources and information which are offered by the Military Topo-geographical Department,*

*- technologies for collection, validation, organisation, stocking, issuing and usage of data and information by different means.*

### CINCU RANGE - OVERVIEW

Cincu range has at its disposal the building (barracks) 957Cincu with a surface of 10 363, 47 ha. and can be found in the list of goods which make up the state public property, on the basis of H.G.R 1705/2006.

According to the juridical documents, Ministry of National Defense has the right to manage the area of 27,38 ha.

The terrain annexed to the range has been taken over from the Austrian/Hungarian Army, hired by contract for 60 years.

This is situated on the field that belonged to the inhabitants from 7

communes from Cincu Mare and strikes, which means 10 362,82 ha:

1. commune Cincu Mare - 7.564 jug. 4174 st.p.,
2. commune Merghindeal - 3.190 jug. 2795 st.p.,
3. commune Sulumberg - 3.332 jug. 74 st.p.,
4. commune Iacobeni - 204 jug. 5459 st.p.,
5. commune Hundrubechin - 1813 jug. 8450 st.p.,
6. commune Selistat - 927 jug. 2177 st.p.,
7. commune Rodbav - 947 jug. 8607 st.p.,

## SIMULATOR FOR DIRECTING THE FIRING IN CINCU RANGE OVERVIEW

The application has three different components: a database with geographic and descriptive information for

Cincu range, a database with information about the artillery ammunition and a programme (figure 1) wich manages these databases and offers necessary tools for viewing and analyzing the geographical data and also for planning and firing simulation using artillery ammunition.

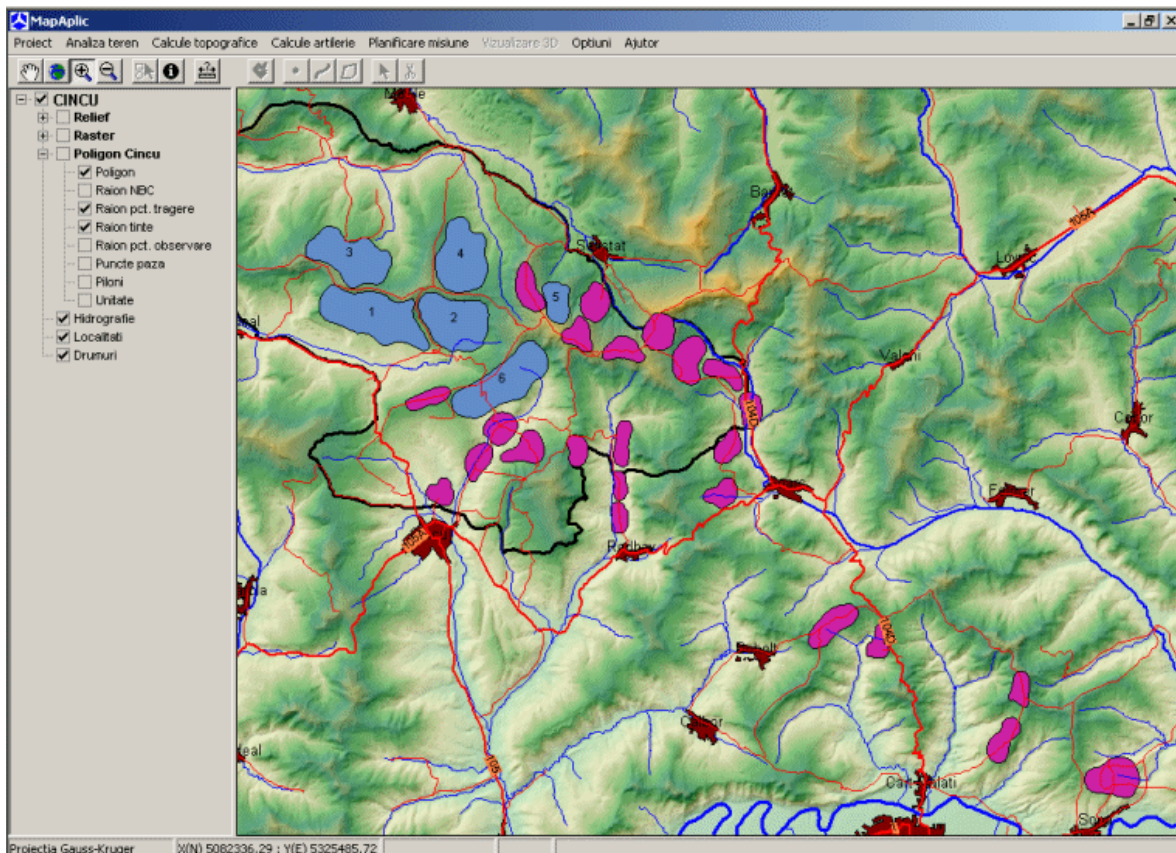


Fig 1. The main window of the application MapAplic 1.0.

The geographical data used by MapAplic 1.0. can be found as a digital map with different themes. The application consists in information with references to: roads, places, hidrography, relief, magnetic declination, objectives areas, firing areas,

points of observation areas, points of defence and C.B.R.N. areas.

To the vectoial layers there are added three raster layers: two layers containig relevant images of the relief, made up on the basis of the altimetric type of the terrain and a layers wich consists in an aerial photocopy of the range (fig 2).

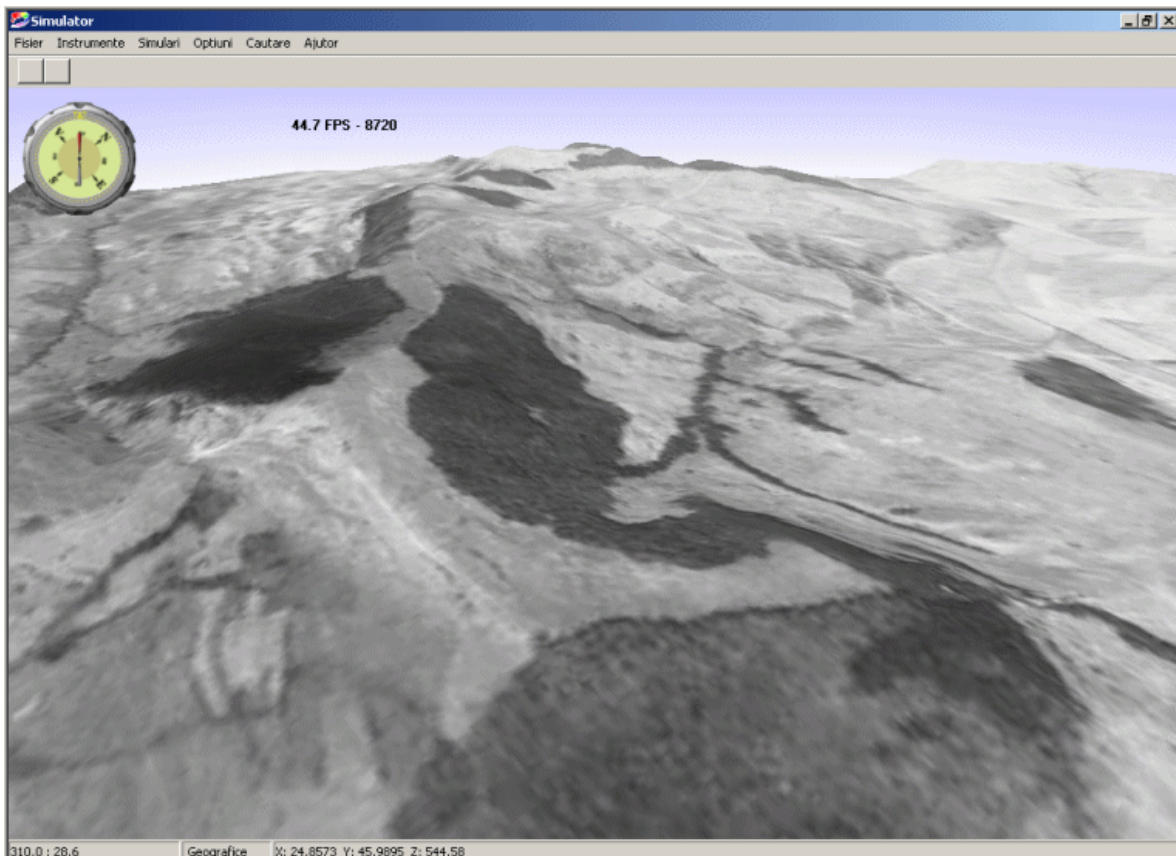


Fig 2. 3 D plotting of the relief.

As pont of the application, the digital altimetric model (M.D.A.) represents the basis for drawing out the features and characteristics associated to the field. Information can be achieved in two ways:

- throught visual analysis of the plotting or through quantitative analysis of data regarding the terrain (interpretation). The interpretation results can be used as admission data for analyses of the

enviroment, hydrological simulation, visibility, drawing the traiejectory etc.

A series of characteristics can be drawn out from M.D.A.: specific points for surface (hollows, picks etc), linear characteristics (drains) and a category of functions wich are used in applications such as road map or visibility study. The profiles are achived by interpreting the terrain highs in its crossing points with M.D.A.(fig 3).

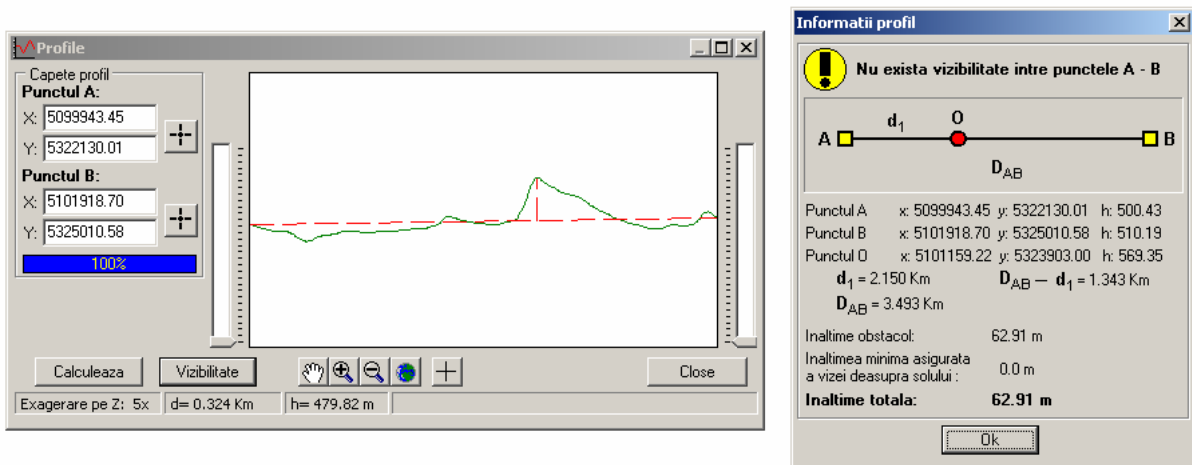


Fig 3. Determination of terrain profile.

Another important function, derived from the visibility survey on a certain direction, is to determine the visual field.

From a given point is made an analysis of the terrain visibility, determining the visible and invisible areas.

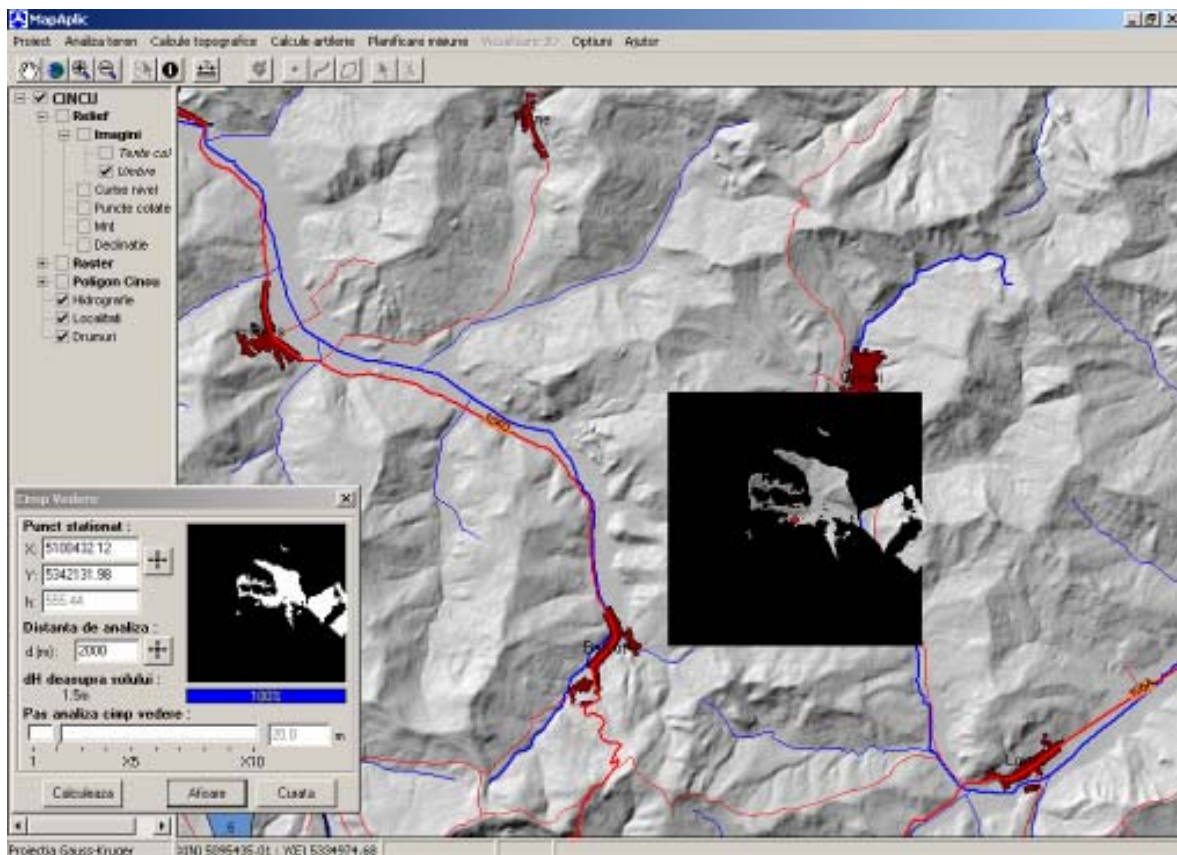


Figure 4. Determination of sight field from a certain point.

The application provides a series of tools for:

- the layer control,
- coordinate changes between different coordinate systems used in our country (geographic, Gauss-Kruger),
- establish the altimetric type of the field between two points,
- establish the visibility area from a certain point,

- 2 D and 3 D visual of the interest area,
  - search different elements of the map,
  - update the geographical databases.
- Specific means useful for the development of the activities from the range
- artillery firing simulation,
  - training direction,
  - determine and achieve the projectile direction (fig 5),



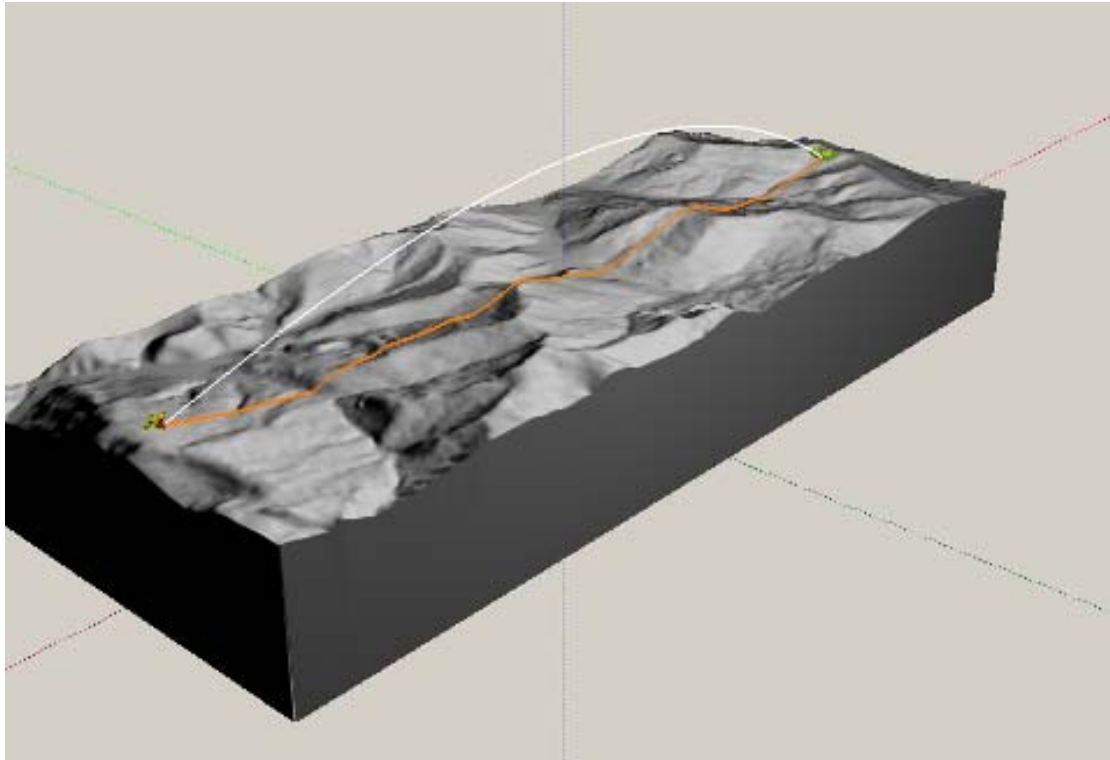


Figure 5. Establish the projectile direction.

- establish the basic firing direction;
- mission planning (fig 6);

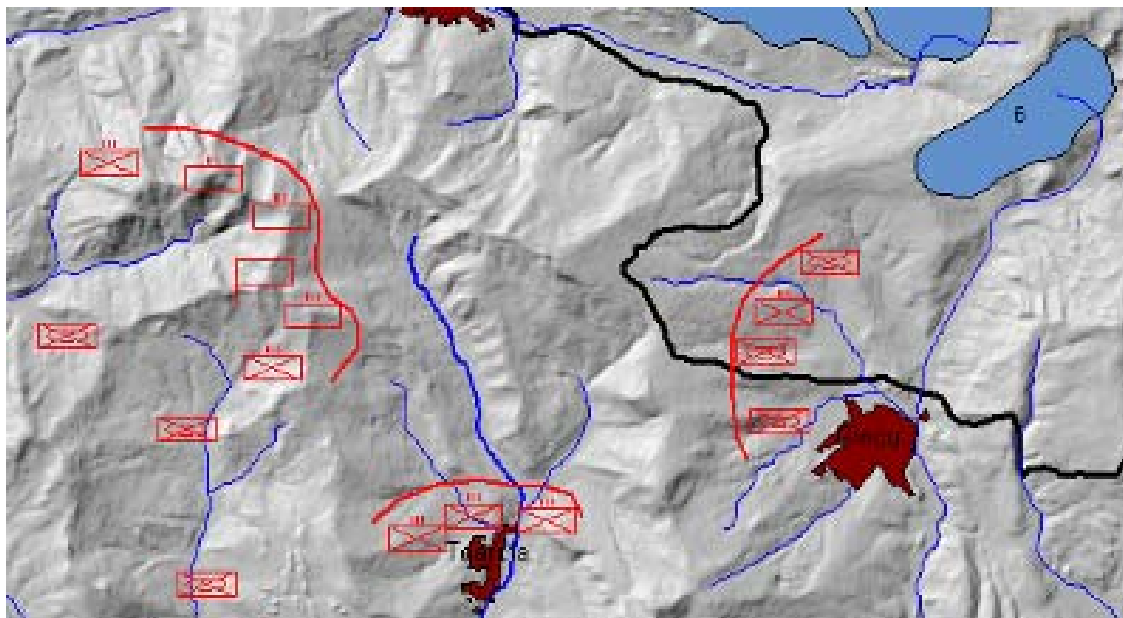


Figure 6. Planning the battle mission.

- Choose the command-surveillance spot and the firing position,
- Search the field and choose the reference points
- Determin the target coordinates,
- Topographical link of the disposition of forces,

## **CONCLUSIONS**

The advantages of using the simulator for monitoring the fire in Cincu range are:

- diminish the routine operations and make the decisions for such issues which implies the use of geographical data,
- identify the organisation problems and technical operations using the geographical data,

- objectively control the data quality and operation,
- automatic check-up for accomplishing the restrictions, rules and norms in the field of artillery,
- remove duplicates while dealing with data and geographical information,
- decrease the training period for the mission,
- diminish the reconnaissance period of the firing position,
- vary the presentation forms of goods as thematic military maps.

## THE IMPLICATIONS ISSUE OF THE INTEGRATION IN NATINEADS ON THE NATIONAL AIR DEFENCE SYSTEM

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**Abstract:** *Over many decades, the NATINADS has been the cornerstone of the Alliance defence. It safeguarded the integrity of the airspace in NATO Europe and, at the same time, clearly demonstrated as well as contributed to NATO 's political and military cohesiveness.*

*The NATINAD concept, in particular its integration, remains viable in NATO's new environment. However, whilst preserving its capabilities from further erosion, NATINADS needs to be adapted, most notably to accommodate the flexibility in collective defence, the need for EAD, Enlargement, Crisis Response Operations and closer integration of maritime assets. NATINEADS includes NATINADS and EIADS and while the NATINADS must incorporate capabilities for EAD, it must also be adapted to meet future challenges.*

*In case of collective defence, Article 5 or non-Article 5, NATINADS would be strengthened with other national air defence assets and interregional reinforcements, both of which require increased mobility and transportability and would also require the increased use of maritime assets. An adapted NATINADS would provide the needed integrated air defence capabilities in support of CROs, making use of the inherent deployable capabilities for collective defence. In CROs Coalition Partners could contribute to the deployed NATINADS capabilities with their air defence assets. Enlargement: for full integration to NATINADS, Invited Countries must adhere to a set of common technological, material and logistic standards; this is the reason for this article.*

The Romanian Army is about to achieve modern qualities and structures based on efficient concepts and technologies which will it able to answer to the future challenges within the framework of the Alliance it belongs to.

One of the modern domains, both conceptual and technologic is represented by the one of air defence with its base on, action part of the Romanian Air Forces, constituted on the ground base of classical ostensible forces and means, but completely modernized as structure, qualification, endowment and usage.

Analyzing the air defence relied on earth using an incorporated system we will discover some concepts, techniques and procedures fundamentally different from those applied not a long time ago, which could offer solutions for many problems that have to be solved next years from the point of view of the

overtones and consequences of the new architecture of security, on the virtue of the provisions of the National Security Strategy and of the assumed commitments once adhering NATO.

The reasons of this approach consist of the following aspects:

- Incorporating in NATINEADS is a very complex process, firstly including a developed system of collecting and processing information which allow permanent supervising, both on peace and on crisis of army conflict to avoid surprising:
- The forces and the means this system is based on are very sophisticated and modern, efficient enough;
- The system must be based on a very developed analysis port, able to use all

disposal data and information to identify dues to pass from the state of stability to that of instability in all domains that have influence on the state of security of our country and of the allies;

- Implementation of some measures meant to realize a modern and efficient system

of air defence with its base on ground, integrated, operational and efficient, supposes the changing of some concepts that will be surpassed, referring to the design of the structures of the specialized forces and means, of the endowment and preparation, based on some equipments and technologies that will come as well as of the concepts and doctrines of using these with a view to bringing these forces and means at the standards of interoperability specific to the Euro Atlantic and European integration of our country.

At the end of March 2004, immediately after our country's joining the North Atlantic Alliance, the Romanian connection to NATIONADS (NATO Integrated Air Defence System), through COAP. Corresponding to the operational plans drawn up by NATO operational commands, the Romanian national air space was incorporated in that of the Alliance becoming subject of collective defence. At the same time, the Romanian air space extend beside the Bulgarian one in the Combined Air Operations Center- CAOC' s responsibility zone located in Greece at Larissa. Connecting to NAINADS included a series of legislative, operational and technical actions, the most important of all being the transfer of authority of Romanian forces available for NATO by SAUCER. Thus, beginning with 29<sup>th</sup> March, 2004, 6 P.M., Romania fulfils the service Air police under the command of NATO, through CRC from COA of COAP.

Naturally, some problems referring to the implications of the air defence with its base on ground appear if the proposed solutions from collective defence answer to the specific and needs of security of our country in the new geo-political and geo-strategically environment which is the operational architecture of the system, as the whole, from the aspect of training forces, of

the endowment with technique and materials, of C4I2 components, of costs and efficiency on peace, crisis, war and post conflict situations, on the background of risks and threatening our country next period of time.

NATINADS ( NATO Integrated Air Defence System) includes both elements from the command and NATO forces structure and means and methods necessary to fulfil missions specific to air defence of NATO (CAOCC, CRCs, QRAs, agreement, procedures, stuff, etc.). NATINADS is remembered only as concept, the name of NATINADS being preferred for the system. In this case, air defence includes the fully meaner means to neutralize or reduce the efficacy of hostile air actions. Extended air defence represents the existing air defence and its extensions for the conventional prevention of the entire sort of air threatening represented by tactical missiles, cruise missiles or other types of enemy flying object that threatens the means of the Alliance.

NATINADS ensures the air defence of the entire zone of ACE responsibility. It contains the oversight and air control system (ASACS) and the weapons system for air defence. These elements are either NATO command Forces being under operational SACO command, used on peace, crisis and conflict situations, or NATO forces. The effort to make air defence is a common one, and the close cooperation with ground and maritime forces a is an important premise.

The final point of reference regarding the planning of the Alliance defence remains the maintaining of the ability to discourage and, if necessary, to defend against some aggressions of vast proportions. However, in the historical context of the operations provided at Article 5, the new conditions, in which NATO acts must be considered. This instability, combined with the increased proliferation of weapons much more sophisticated and powerful, and the possibility of NATO to execute operations that are not referred in Article 5, had therefore the creation of new conditions that could be more requesting than those we faced with in the past and which obligate to participate at common efforts with forces, means and resources at

collective defence. The integration of AABS system in NATINADS (NATINEADS) constitutes a necessity and an obligation also, an obligation with certain effects in the plan of national and regional security.

Integration in NATINEADS concerns the participation of the National Air System together with those of the member states of the Alliance, at collective air defence of NATO in a unified system at the level of Europe. The essence of integration in NATINEADS is represented by the transfer of responsibility, forces and authority necessary to use these by the SACEUR – Supreme Allied Commander, Europe, for the defence of the European countries, members of NATO, against air attacks and conflict / war situations. NATO is confronted with a new and reconsidered request regarding perspectives which requires both a reorientation of the anterior air defence efforts and the development and the flexibility of new capability.

Efficient satisfaction of the requirements from domains as EAD (extended air defence), the synchronization with the capabilities of the maritime forces, the expansion and management of the crisis situations in limits imposed by budget, the acquisitions and modernization, will impose a collective approach.

Integration and interoperability which NATINADS bases on represents the only sustainable approach for the achievement of sufficient protection levels. Maritime, air, special and ground contributions will ensure a way of action and bigger reaction capabilities for NATINADS, for the Romanian air space in that of the Alliance must be realized with the compliance of the guiding principles and conceptions of the Alliance, for the fulfillment of the collective air defence mission.

In time of peace, ASACS destined units maintain the permanent supervision of the air NATO space and of the vicinity of planes by ACE to obtain, evaluate and supply early warning information. They ensure navigation assistance at request, to the civil and military aircraft: the assistance includes warnings in connection with the rest of the air traffic, with different dangers, weather bulletins, data about airports. They also ensure flight

assistance to aircrafts under emergency situations, in collaboration with the proper civil air traffic authorities in accordance with the established procedures. The National units meant to air defence ensure hunting planes for the rapid alert force of reaction (interception) – QRA (I), available for rapid take – off at alarm intercept, examine and identify unknown airborne platforms, discovered by ASACS. Weapon systems of air defence maintain the fight preparations state to facilitate the generation of a sufficient big power and of the necessary competency to satisfy the mission requirements on war crisis situation.

In a crisis situation the specific functions of peace will be extended. The fight preparation state of air defence forces will be increased according to the situation requirements. In the case of a conflict the integrated defence is ensured through the using air airborne entities disposed on ground intended to air oversight and weapon control but also using a large range of hunting planes and AABS armament against air dangers with and without pilot.

The inherent advantages of every air defence system are exploited to increase the total capability at maximum use, realized through proper usage of the most proper system to realize a specific mission. Air defence units are integrated in all the other mission of aircrafts, missiles attacks and requirements regarding marine and ground forces, through CAOC (Combined Air Operations Centre).

Romania could own ground air defence structures to center under the operational command of NATO since the time of peace, to be used on our country territory on outside.

To realize the integration and the creating of a sustainable NATINEADS we agree that fulfillment of the following requirements is necessary:

- a) common procedures to be applied on the entire system and to allow continue operations;
- b) common standards which are the basis of NATINEADS creating elements and

- based on them the efficiency of these elements can be evaluated;
- c) common language which allows the operators to collaborate and change information quickly and clearly;
  - d) fight preparation state according to the main risk / danger situation;
  - e) forces availability depending on the operational needs and, at the same time, compliance with a fair distribution of tasks;
  - f) NATO meant forces training through participating to multinational exercises;
  - g) Unified/unique command structure which ensure clear distinction of the responsibilities and enables the progress of a rapid process of determination.

The future quality of NATINEADS depends to a great extent on a reliable and complex system of command and control which is sized properly for the future NATO operations. This command-control system can be approached the best through the following 5 main components: command structure, infrastructure, system, doctrine and procedures, the stuff.

Allied air defence structure will continue to offer relevant information to NATO countries of national interest. These will include necessary information from NATO military authorities meant to national control on civil defence, civil aviation and the fulfillment of other national responsibilities.

Some functions, like internal security and national commitments outside NATO must enter the national responsibility area. In the case in which the circumstances impose the use of the national forces for such aims, the necessary forces formed of staff and equipment can be receded from the forces lines designated by the respective country, according to the procedures presently approved. Undoubtedly, it is discussed the problem of acquisition of technique and means to fulfil the integration requirements in

NATINEADS among these counting the "PATRIOT" missiles system force and tactic ballistic missile, must be discussed.

Considering the structure of the air defence system with its base on ground we appreciate the fact that it corresponds to the role and missions that are concerned and it was accurately defined and designed in the period of reconstruction of the Air Forces. In the next period, the human and material efforts will have to be concentrated on the identification and implementation of those procedures and action techniques to put to account at the maximum level the facilities of the techniques and equipments that will be introduced in the endowment and to ensure a high level of interoperability with NATINEADS forces and means.

The implications issue of the integration in NATINEADS on the national air defence system with its base on ground represents an important domain of the security medium and of the military phenomena that has several connotations on peace time, for their solution and approfondation a significant effort is needed at a high level. This effort relates both to the activity of studying and analyzing by specialists and to the material, technological and financial implications that the integration and active participation at the modern compatible and interoperation system from the Alliance assumes. We consider that the centre of gravity of these efforts must be distributed on conceptual, theoretical aspects that need to be implemented and sustained before any other overtures, just to create the scientific foundation of the future actions and overtures for a long period of time.

We can say that the attention must be paid to the identification of the most significant aspects, to find and propose some solutions and suggestions to contribute to the solving of the problems analyzed in this material.

## AERO DYNAMICAL STUDY ON RELIEVING ROPE

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**Abstract:** The paper covers some aspects regarding the theoretical determination of some aero dynamical parameters of the system which can allow a theoretical analysis of the relieving rope. The theoretical determinations are made using finite element software and trajectory analysis programs. The study is about the 7.62 machine gun - relieving rope system modified through theoretical tests that allow an analysis of its behaviour. Theoretical tests are made complying with the system environment conditions.

**Keywords:** Aero dynamics, finite volume, relieving rope, drag, external ballistics.

### 1. INTRODUCTION

The relieving rope represents a wooden “pear” saddled with plumber, fixed at the end of a slim rope, that is thrown on shore or on board in order to bend and haul the bowlines.

This paper proposes the study of some configurations of “pear” type bodies with the purpose to obtain a bigger throwing distance.

For the proposed study we will take into account: the determination of a drag function for each configuration; the determination of the maximum throwing distance for each configuration.

### 2. ANALYSIS

#### 2.1. Analyzed Configurations

The length of configuration A is 200 mm and the maximum diameter is 58 mm. The relieving rope with configuration A is shown in Figure 1.

The length of configuration B is 350 mm and the maximum diameter is 58 mm. The relieving rope with configuration B is shown in Figure 2.

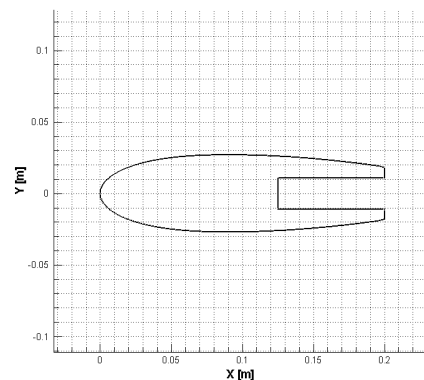


Fig. 1 Relieving Rope – Configuration A

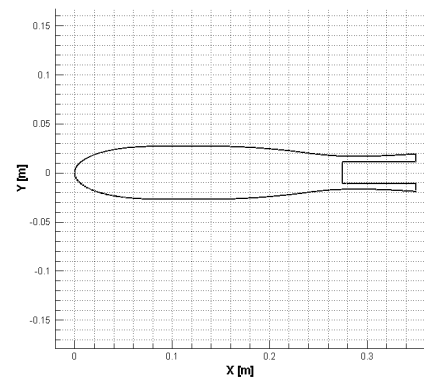


Fig. 2 Relieving Rope – Configuration B

## 2.2. Drag Functions

The following values of the aerodynamic coefficient  $C_x$  were obtained for configuration A (see Table 1).

Table 1 Values of the aerodynamic coefficient

No.	Speed [m/s]	Angle [°]	$C_x$
1	30	0	0.02394
2	35	5	0.02655
3	40	10	0.03563
4	45	35	0.14139

The following values of the aerodynamic coefficient  $C_x$  were obtained for configuration B (see Table 2).

Table 2 Values of the aerodynamic coefficient

No.	Speed [m/s]	Angle [°]	$C_x$
1	30	0	0.02864
2	35	5	0.03523
3	40	10	0.05787
4	45	35	0.34451

The drag functions for configuration A, respectively configuration B will be:

$$R_{\text{configuration}} = \rho \cdot S \cdot C_x(V, \theta) \cdot \frac{V^2}{2}, \quad (1)$$

Where  $\rho$  is the air density,  $S$  is the surface of the relieving rope,  $C_x(V, \theta)$  is the function of the variation of the drag aerodynamic coefficient determined for each configuration through two dimensional merging,  $V$  is the speed of the relieving rope, and  $\theta$  is the angle between the fore-and-aft axis of the relieving rope and the horizontal axis.

The values of these functions were determined using the 2D spline merging along the movement of the relieving rope on the trajectory taking into account the angle and the speed of the relieving rope. Also, for the determination of the drag aerodynamic coefficients an analysis software with finite volume (FLUENT) was used on structured meshes and with an approximate number of volumes of about 200.000. The simulations

were made for different incidence angles of the speed ad infinitum and for different speeds.

## 2.3. Mathematical models and types of analysis

A numeric code performed in FORTRAN was used to determine the maximum throwing distance. The system of equations for the movement of the relieving rope on the trajectory and the drag functions determined for each configuration stood at the base of the BEX.EXE program. The reductionist hypotheses for this model are:

- The fore-and-aft axis of the relieving rope is practically a tangential path (it is along the vector of the mass point speed);
- The weather conditions on ground are normal (standard) and the variation of the meteorological parameters with the altitude respects the normal principles, so the atmosphere is standard;
- The gravity acceleration  $\bar{g}$  is constant as quantity and direction, being parallel with the vertical circle of the trajectory's origin;
- The relieving rope is not captive.

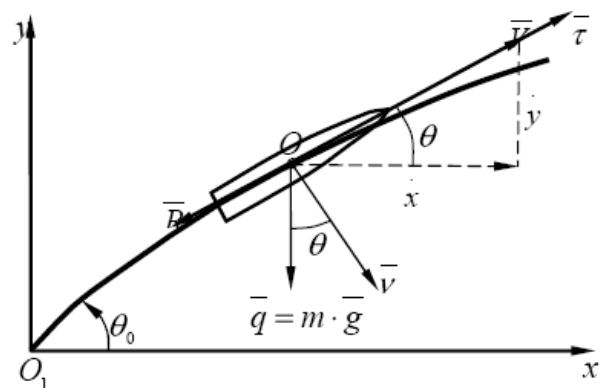


Fig. 3 Forces that act upon the relieving rope

Analyzing figure 3 and the reductionist hypotheses, gravity and drag are acting upon the relieving rope. The equations of movement of the relieving rope mass point by the tangent to trajectory  $\bar{\tau}$  and by the normal to trajectory  $\bar{\nu}$  are:

$$\begin{aligned} m \cdot a_{\tau} &= -R - m \cdot g \cdot \sin(\theta) \\ m \cdot a_{\nu} &= g \cdot \cos(\theta) \end{aligned} \quad (2)$$



Writing back the system of equations (2) and taking into account relation (1) and the representations in figure 3, it results:

$$\begin{aligned} \frac{dV}{dt} &= -\frac{R_{\text{configuration}}}{m} - g \cdot \sin(\theta) \\ \frac{d\theta}{dt} &= -g \cdot \frac{\cos(\theta)}{V} \\ \frac{dy}{dt} &= V \cdot \sin \theta \\ \frac{dx}{dt} &= V \cdot \cos \theta \end{aligned} \quad , \quad (3)$$

Where V is the relieving rope speed on the trajectory, m is the mass of the relieving rope,  $\theta$  is the angle between the fore-and-aft axis of the relieving rope and the Ox axis in the terms of the reductionist hypotheses, and g is the gravity acceleration.

#### 2.4. RESULTS AND CONCLUSIONS

The results obtained for each configuration are presented in Table 3. The initial information for the numerical simulation was:

- Mass of the relieving rope = 0.250 g for configuration A, respectively 0.300 g for configuration B;
- Initial speed  $V_0 = 40$  m/s;
- Launching angle  $\theta_0 = 35^\circ$ .

Table 3 Values of the throwing distances

No.	Configura tion	Initial speed [m/s]	Angle [°]	Throwing distances [m]
1	A	40	35	152.96
2	B	40	35	150.25
3	A	40	25	123.42
4	B	40	25	120.50

As we can see in Table 3, configuration A offers better performances than configuration B. These two configurations were fundament on a NACA 0012 profile whose coordinates were changed.

This study gave the possibility to a theoretical analysis and subsequently to choose a relieving rope configuration so as to obtain a maximum for the throwing distance.

The study can be extended to more than two configurations depending on the throwing distance needs and the material possibilities to accomplish and test in real conditions.

This kind of studies allows the cutting of the research costs needed for defining the optimal configuration of a product.

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## CONSIDERATIONS REGARDING THE FLYING CONDUCT OF THE CLOSE OBSERVATION SYSTEM SUPERVISOR COMBAT COMPONENT

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**Abstract:** *The Supervisor system is a modern product which allows troops to obtain supplementary information upon visual area on the battle field. This information is achieved through a camera launched using the 40 mm calibre ammunition. The paper covers different aspects regarding the theoretical determination of some aerodynamic parameters of the system that can allow an analysis of the combat component trajectory. The theoretical determinations are made using software with finite element and programs for the trajectory analysis.*

**Keywords:** *Aerodynamics, finite volume, supervisor, relieving rope, drag, external ballistics, system.*

### 1. INTRODUCTION

The Supervisor system represents a modern product which allows troops to obtain supplementary information upon visual area on the battle field. These images are obtained using video cameras and systems for distance data receiving.

The paper proposes the study of one system configuration in order to obtain its maximum throwing distance and the maximum surface for image viewing. The following will be taken into account for the proposed study:

- Determination of drag function of the system by a numerical simulation using FLUENT;
- Determination of the maximum throwing height for the proposed configuration;
- Determination of the maximum viewing surface considering the characteristics of the video camera.

### 2. ANALYSIS

#### 2.1. Analyzed Configuration

The length of the considered system is 160.1 mm and the maximum diameter is 40 mm. This configuration is presented in figure 1.

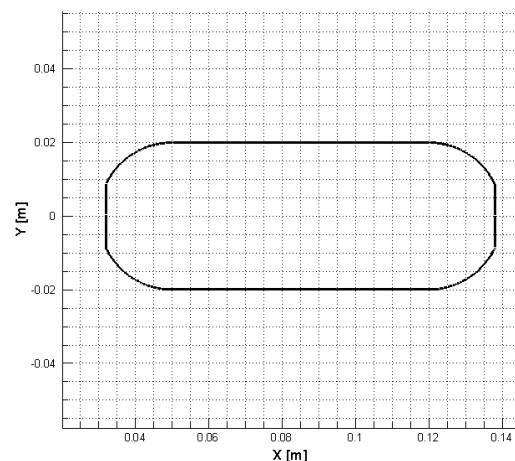


Fig. 1 System's configuration

## 2.2. Drag Function

The following values of the aerodynamic coefficient  $C_x$  were obtained for the system's configuration (see Table 1).

Table 1 Values of the aerodynamic coefficient

No.	Speed [m/s]	Angle [°]	$C_x$
1	50	0	0.026949
2	70	35	0.065949
3	80	45	0.098091

The drag function for the system's configuration will be:

$$R_{\text{configuration}} = \rho \cdot S \cdot C_x(V, \theta) \cdot \frac{V^2}{2}, \quad (1)$$

Where  $\rho$  is the air density,  $S$  is the system's surface,  $C_x(V, \theta)$  is the function of the variation of the drag aerodynamic coefficient determined for the system through two dimensional merging,  $V$  is the speed of the system, and  $\theta$  is the angle between the fore-and-aft axis of the system and the horizontal axis.

The values of this function were determined using the 2D spline merging along the movement of the system on the trajectory taking into account the angle and the speed of the system. Also, for the determination of the drag aerodynamic coefficients an analysis software with finite volume (FLUENT) was used on a structured mesh and with an approximate number of volumes of about 150.000. The simulations were made for different incidence angles of the speed ad infinitum and for different speeds.

## 2.3. Mathematical models and types of analysis

A numeric code performed in FORTRAN 77 was used to determine the maximum throwing height. The system of equations for the movement of the system on the trajectory and the drag functions determined for the system stood at the base of the BEX.EXE program. The reductionist hypotheses for this model are:

- The fore-and-aft axis of the relieving rope is practically a tangential path (it is along the vector of the mass point speed);

- The weather conditions on ground are normal (standard) and the variation of the meteorological parameters with the altitude respects the normal principles, so the atmosphere is standard;

- The gravity acceleration  $\bar{g}$  is constant as quantity and direction, being parallel with the vertical circle of the trajectory's origin.

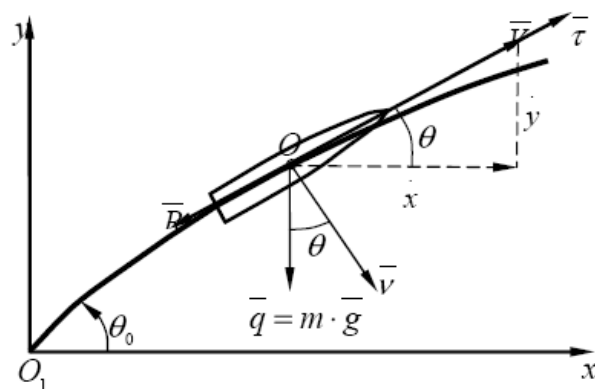


Fig. 2 Forces that act upon the system

Analyzing figure 2 and the reductionist hypotheses, gravity and drag are acting upon the system. The equations of movement of the system's mass point by the tangent to trajectory  $\bar{\tau}$  and by the normal to trajectory  $\bar{v}$  are:

$$\begin{aligned} m \cdot a_{\tau} &= -R - m \cdot g \cdot \sin(\theta) \\ m \cdot a_{\nu} &= g \cdot \cos(\theta) \end{aligned} \quad (2)$$

Writing back the system of equations (2) and taking into account relation (1) and the representations in figure 2, it results:

$$\begin{aligned} \frac{dV}{dt} &= -\frac{R_{\text{configuration}}}{m} - g \cdot \sin(\theta) \\ \frac{d\theta}{dt} &= -g \cdot \frac{\cos(\theta)}{V} \end{aligned}, \quad (3)$$

$$\frac{dy}{dt} = V \cdot \sin \theta$$

$$\frac{dx}{dt} = V \cdot \cos \theta$$

Where  $V$  is the system's speed on the trajectory,  $m$  is the system's mass,  $\theta$  is the angle between the fore-and-aft axis of the system and the  $Ox$  axis in the terms of the

reductionist hypotheses, and  $g$  is the gravity acceleration.

The 4<sup>th</sup> order Runge Kutta method was used for the integration of the differential equations system.

2.4. Results and conclusions

The results obtained for the system are presented in Table 2. The initial information for the numerical simulation was:

- Approximate system's mass = 0.300 g;
- Initial speed  $V_0 = 80$  m/s;
- Launching angles  $\theta_0 = 35^\circ$ ,  $\theta_0 = 55^\circ$ .

Table 3 Values of the arrows for different angles

No.	Test	Initial speed [m/s]	Launching angle [°]	Arrow [m]
1	I	80	35	103.26
2	II	80	55	203.36

The results on the trajectory are represented in figure 3 for test I, respectively figure 4 for test II.

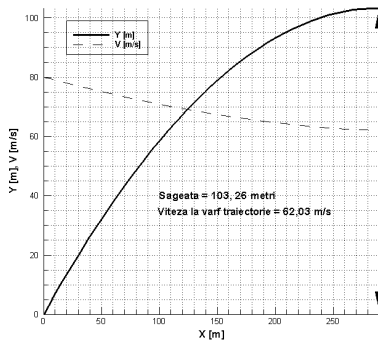


Fig. 3 Test I, the upward part of the trajectory (arrow and speed)

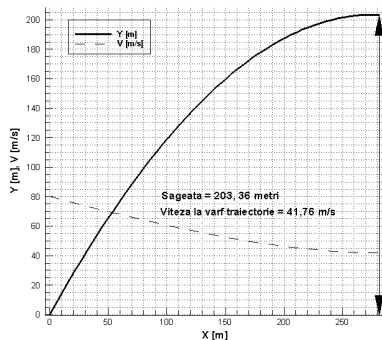


Fig. 4 Test II, the upward part of the trajectory (arrow and speed)

For the height values of the two cases (tests) the right type of video camera can be chosen in order to have a wider covered area.

If we consider a video camera with a horizontal viewing range  $\gamma = 25^\circ$  and a vertical viewing range  $\beta = 15^\circ$ , we can calculate the covered area by the video camera using the following formula:

$$S_V = H^2 \cdot \text{tg}(2 \cdot \gamma) \cdot \text{tg}(2 \cdot \beta), \quad (4)$$

Where  $S_V$  is the area covered by the video camera,  $H$  is the arrow, the appropriate maximum height from Table 2 calculated using BEX.EXE program,  $\gamma$  is the horizontal viewing range of the video camera and  $\beta$  is the vertical viewing range of the video camera.

Table 3 Values of the areas for different launching angles

No.	Test	Initial speed [m/s]	Launching angle [°]	Area [m <sup>2</sup> ]
1	I	80	35	11,804.26
2	II	80	55	45,891.27

As we can see this analysis allows us to choose the appropriate video camera for the Supervisor system and not only. The following issues can be analyzed:

- Maximum weight of the Supervisor system;
- Determination of the tossing blasting powder in order to obtain the needed height (arrow);
- Determination of the maximum height.

This kind of analysis may be helpful for the determination of the appropriate configuration of the Supervisor system, when the maximum video surveillance area is imposed.

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## „NEW METHODS IN EDUCATION OF AIR DEFENCE STUDENTS“

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**Abstract:** *The contribution speaks about decision – taking and decision – making process in military environment. In the concrete cases presents decision support systems which were created on the base computer's software, by teachers and students of Air Defence Faculty former Military Academy and their application to education of students Armed Forces Academy.*

**Key words:** *Education, transformation, Air Defence, assessment, radar field, optimisation, simulation technologies centre, models of Army*

The education was, is and will be the impulsive engine of every society, this motto is known already from the history and probably will be actual also for next generations. It holds also in warfare, where many military academies belonged to the peak of educational institutions of developed countries. Today is the situation not so good. The fundamental problem is to change education to the process, where the students obtain necessary knowledge and are able to understand their relative connections. Despite the continuous transformation of military education in conditions of Slovak republic, this task has not been yet completed. The transformation of military education registered the sequence of thoughtless, spread and insensitively carried actions implemented by management of the government department, but also by the previous management of the academy. The worse problem is that the transformations follow the previous actions in the short time. We prepare the Model 2010 but with realization in 2005, we prepare Model 2015, but with realization in 2010 and now we preparing Model 2020, but with time of realization in 2012.

This changes were not only about the organisational structures, but mainly about contents, methods and forms of education. Using this „approach“ we achieved the state, which we can name as a rarity among military academical educational institutions. This voluntaristic experiment of non-competent people in the management of government department was very expensive. The creation of two institutions in one place without correctly functioning linkages, abandonment of the part of education for public schools, abandonment of second and third level of education, of possibility to execute habilitations and professor denomination, that were the mistakes, which impacts could be hardly repaired and which will we feel some incoming years. Already today we have the slack of guarantees for the second and the third level of education, but the worst problem is poor quality of expert preparation of graduates, which is not completed and equally matured. This mistakes affected the academical and military education, but also the area of science and research. We are missing the graduates, who in the past led by professors and associated professors had been creating valuable

projects especially for the defence government department. Indeed, we have graduants, but they are studying in other schools and producing things necessary for these subjects. Of course, their outputs are missing and it has the impact also on valuation of our departments in complex accreditation. This state is not very good and evokes the resentment and mistrust of possibilities and competencies of AFA from side of the final purchaser – GS AF SR and single types of forces. In the following table are marked shortly the results of the project, which enabled to evaluate the education of military professionals in armed forces of developed countries of NATO [4].

From presented table we can see some important information:

- also countries, which traditionally had problems with military education have oriented their attention in last years to preparing of the officer with academical education in compliance with enclosures from Bologne;
- except AFA everywhere exists parallel academical and military education.

Gratifying, the presentation of these findings, the negotiations in MOD SR and GS AF SR and other activities of present management of AFA contributed to cancelling of introduced system of education. The most important changes cover the content of education of future military professionals. After years of ramble is the most important change the return to fields of study from the system of fields of study „Defence and warfare“.

It is necessary to realize that new challenges are concerning also us – the teachers preparing officers for Air Forces. New Technologies influenced all areas of social life, the area of warfare too. Epochal changes in the sphere of information and communication systems, new weapon and

command systems fundamentally change the thoughts of operation art, leading of operations and the tactics of forces use.

How to respond to this situation, to the reduction of financial sources, reorganisation together with providing the quality in education using modern methods, which would reflect the actual trends in developed countries of the world.

One of the hits of the last decennary in military academies and universities was the establishment and activity of simulation technologies centres. They enable training and preparation not only of the students, but also, of the officers, staffs, units, regiments and brigades of various types of Forces. The advantages of CST training is the higher effectivity, lower costs than the training with real technics, it is less time-consuming for teachers and students. If we count also the most important advantage – the student obtains the new knowledges and acquires new methods of training – we can state that this is what we need.

More detailed look indicates that it is not so exactly in that manner. There are more reasons:

1. The content and range of education – presented possibilities often don't fulfil the standards. If we say squad that we make the training of mechanized brigade it is not true, because we are really able to train the level of company or the trained activity responds maximally to staff training. This is better case, by Air Forces we could not talk about the training at all, if we don't consider as a training the simulation of two fighters fight. Training of tasks of Air defence fight stays on the level of reflections. The time for such training is longer than for the traing with real technics. It is necessary to manage usual expert tasks but also the separate departments and communication between them.

Tab. 1 The system of military education in selected countries of NATO

Investigated section		Military educational institute				
		Denmark	Norway	Belgium	CR	SR
1	Career system – in dependence on age	Given by years in function (in rank)	Given by years in function (in rank)	Given by years in function (in rank)	Given by years in function (in rank)	Given by years in function (in rank)
2	Career system – in dependence on education and training	Given by education and system of career courses	Given by education and system of career courses	Given by education and system of career courses	Given by education and system of career courses	Given by education and system of career courses
3	The number of VVŠ	3 of kind of forces, 1 KAO	3 of kind of forces, 1 KAO	1 VVŠ with 2 faculties	1 VVŠ with 3 faculties	1 VVŠ and 1 NAO
4	Standards required for entrance - educational  - other	mathematics, english, native language, specialized school graduation citizenship rights, integrity, mental and health eligibility, physical fitness	mathematics, english, native language, specialized school graduation citizenship rights, integrity, mental and health eligibility, physical fitness	mathematics, foreign language  citizenship rights, integrity, mental and health eligibility, physical fitness	mathematics, foreign language  citizenship rights, integrity, mental and health eligibility, physical fitness	mathematics, foreign language  citizenship rights, integrity, mental and health eligibility, physical fitness
5	Required special military preparation before studies	yes, 1,5 – 2 years	yes, 1,5 – 2 years	no	no	no
6	Accreditation of study programs (specializations)	accredited in VzS, NS not accredited in PS	accredited in VzS, NS not accredited in PS	fully accredited	fully accredited	Bc. accredited, Ing. not accredited
7	Length of study	Bc. 3 years Ing. (Mgr.) 1 year	Bc. 3 years Ing. (Mgr.) 2 years	Bc. 3 years Ing. (Mgr.) 2 years	Bc. 3 years Ing. (Mgr.) 2 years	Bc. 4 years
8	Continuousness of study Bc. – Ing. (Mgr.)	After duty in practice	After duty in practice	Fluent continuation	Fluent continuation	Not given
9.	Simultaneous process of accredited and special military education	Yes, special training as a part of ŠP	Yes, special training as a part of ŠP	Yes, partially	Yes, special training as a part of ŠP	no
10.	Proportion of academical education to special military education	1 : 1 (1 : 2 by naval forces)	1 : 1 (1 : 2 by naval forces)	2 : 1	1 : 1	1 : 0
11.	Development of military science on VVŠ	yes	yes	yes	yes	partially
12.	Proportion of science employees to teachers	10 – 20%	10 – 20%	50%	13%	1%
13.	Proportion of employees to students	VVŠ DS 1 : 1 KAO 2 : 1	VVŠ DS 1 : 1 KAO 2 : 1	1 : 1	1 : 1	1 : 1
14.	Proportion of women from students (year 2005)	up to 5%	up to 5%	14,5%	15%	32%



2

Economical and personal heftiness – this area would be as a limit factor and we have to state that the training in CST is not cheap, the opposite is true. CST represents from organisation view 8-10 employees what means considerable costs, in addition the preparation of trainings is provided in interoperation with civil firm, and it is disputable which element executes managing and which one the supporting activity. Presented financial sources are irrelevant compared to the costs which are paid to the private firm by the defence government department. It means millions per year and this costs farly exceed the costs for real training with military technology.

I wouldn't like that in the context of valuation of CST activity purports my valuation as only negative. The positive aspect is e.g. the fact that today we could train also some tasks of crisis management, e.g. the activity of crisis staff on particular levels of management of state administration and autonomies in the case of crashes or disasters.

It is necessary to consider listed positives and negatives soundly and then to decide what to do next. We have also other possibilities in this area, how to prepare projects orianted to modernization of education and equally for the needs of Armed Forces. We would have to return 5-10 years ago and to continue where we stopped, where the graduants led by experienced professors and associated professors had created valuable projects for operational-tactical but also technical utilization. From the area of Air Defence we can mention such projects as RL field, Optimalization or Assessment of the results of air defence fight.

The program Radiolocation field for needs of Radiotechnic Forces [1] enabled to valuate radius of all types of radiolocators which were in equipment of

RTF from emplacements of radiolocation units on the basis of digitized terrain model, also to assess the possibilities of radiolocators radius interpenetration of metre, decimetre and centimetre waves, to identify of the areas of radiolocation visibility and the possibilities of covering by mobile radiolocation devices [Fig. 1].

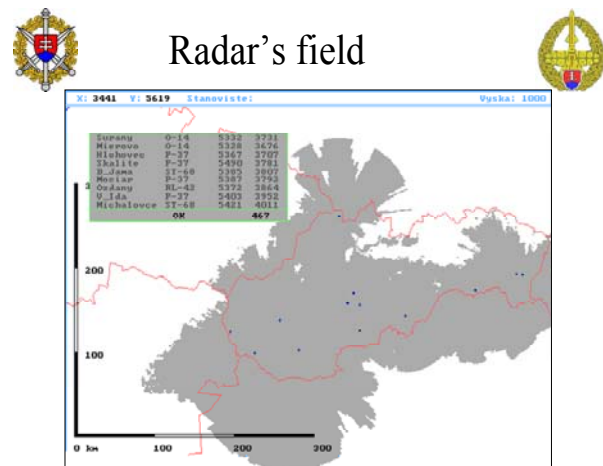
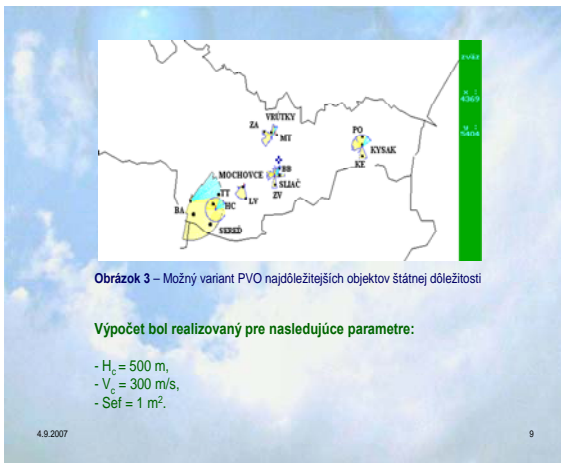


Fig. 1 Program Radar field

The program Optimalization of Air Defence was processed for the needs of Air Defence of ground forces (AD GF) [2]. On the basis of the digitized terrain model it enabled to display defenced forces and objects, following the chosen criterias it enabled the optimalization of the selection of firing-points and field formations of units, regiments and brigades AD GF, the calculation and display of the areas of coverage for various heights, speeds and target echoing areas, the possibilities of centralized fire control of underling units and the possibilities of the creation of combined formations of various types of anti-aircraft missiles systems [Fig. 2].

The both programmes was in the first half of the nineties inovated from the reason of organizational changes, modernisation of the equipment and in the first place the new hardware and operation systems in computers.



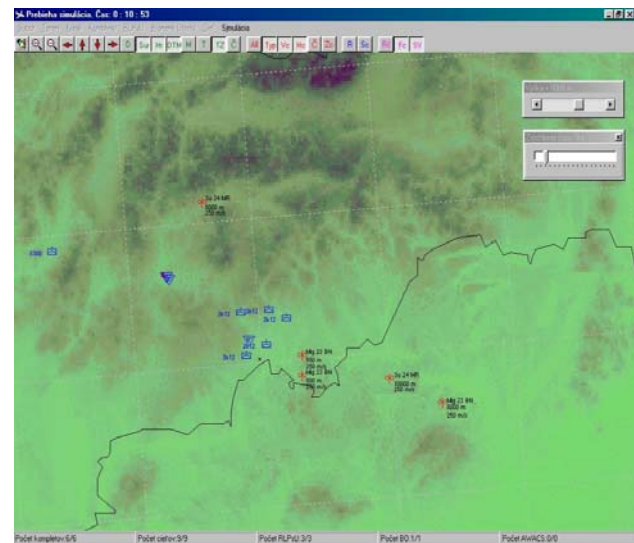
**Fig. 2 Program Optimization of Air Defence for the specification of air defence possibilities of ground forces and objects.**

The program Assessment of results of Air Defence fight enabled to display the emplacement of Air Defence and Air devices, the areas of detection and coverage of the targets by firing devices and units, to valuate the results of the battle of oponent aircraft with Air Defence systems [3]. It enabled to formulate and illustrate graphically and numerically the counts of planes in the strike, route of the targets, fighting characteristics of Air and Air Defence devices and the result of the fight (counts of destroyed aircraft and Air Defence devices) [Fig. 3].

The most of these programmes was used not only in school conditions but also by forces. During the exercises of Army Corp Air Forces and later of headquarter of Air Forces was used programmes RL field and Optimalization of Air Defence. During the international exercises „Common force“ was for the valuation of Air Defence effectiveness used the programe Assessment of results“. Over and above, these programmes withstood also in the comparison with similar projects used in Armed Forces of NATO.

The both programmes was in the first half of the nineties inovated from the reason of organizational changes, modernisation of the equipment and in the

first place the new hardware and operation systems in computers.



**Fig. 3 Program Assessment of the results of Aviation and Air Defence systems fight**

In the conclusion we could put the question what to do next. In the future would be necessary to continue in successful cooperation of the school and the command of the various types of forces, to clearly define the objectives and requirements in this sphere. This would be one of the preferred tasks for Armed Forces Academy in the future „similary as in other Armed Forces of developed countries.

## The demonstration of the project OPTIMALIZATION

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## AIR FORCE ROLE, PLACE AND CONTRIBUTION AS SECURITY PROVIDER IN NATO AND EU

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**Abstract:** *The role played by the two international organizations, NATO and EU has put to a direction Romania's politics after the Cold War and also the September 11 terrorist attacks, in 2001, when the security environment has suffered a rapid and radical transformation, with major changes into the global, regional and national security.*

*The new approach of security is focused on preventive diplomacy, on participation to cooperative security and on the new types of conflicts that determine major changes within the military domain. Therefore, it is necessary to transform the Armed Forces from a simple defensive structure into a peace support and regional stability one.*

*The strategic perspective essential elements of using the Air Force in any type of armed conflict, either symmetrical or asymmetrical, are: air superiority, information superiority, strategic effect attack, precision engagement, rapid mobility, agile support in operation, all within an effects-based approach to operations.*

*The role and contribution of Romanian Air Force within NATO and EU are given by its forces, means and capabilities that ROMANIA committed but it is yet essential to engage them within multinational task force that can provide the operational framework necessary for the missions' accomplishment. The action priorities in accomplishing the required capabilities are: readiness and affirmation of the force packages, full integration within NATO and EU and the achievement of work capabilities, the staff professional formation and development as well as the acquisition of new military equipment and modernization of currently in use one.*

*The experience gained as a result of participating within NATO and UE operations, such as: ALTHEEA, KAIA, BALTICA-07 and NATO SUMMIT 2008, form the necessary basis for future decision making and training improvement in order to optimize the participating capabilities to NATO and EU operations.*

*Without airspace control capability there is no freedom of action for Land and Naval Forces and also, lacking air transport and air-to-ground attack capability, the force mobility (including Special Operation Forces' mobility) and concentrated efforts drop down to a level where they pose no threat to an enemy.*

**Key words:** *security, challenges, airpower, capabilities, priorities, lessons learned.*

### 1. NATO AND EU WITHIN THE COMPLEXITY OF SECURITY ENVIRONMENT

Although we entered the 21<sup>st</sup> century, the world is still confronting with harms and difficulties created in the 20<sup>th</sup> century. The national and international security environment is changing at this moment both rapidly and radically, the challenges that next

generation is going to face are already present and difficult as well and surely, more complex than the problems during Cold War and also in the near future period of time. The foreign affairs and security politics is important not only for Romania and not precisely/strictly for the region. It is important for Europe and for the North Atlantic Alliance whose core is NATO.

We have to remind the fact that NATO is not a simple 'inclusive' international organization, although its main purpose, from the very beginning, was to become a pluralistic security community. More precisely, the Alliance was projected as a defense shield to protect and promote the transatlantic values, norms, rules and democratic procedures.

The September 11 terrorist attacks led to a complex transformation and reassessment process of the organization, of the member nations and of candidates, both at the internal arrangements' level and their strategic interaction.

In this respect, we may notice that the main institutionalized allied capabilities had been designed from the very beginning to defend and reproduce at the interstate level the fundamental principles of the institutional democratic characteristics. Furthermore, after the Cold War ended, NATO has provided to the new democracies 'the strategic compass' necessary to face the growing number of the international complex challenges. At the same time we must not neglect the support given to the specific internal processes of the security sector reform. As a consequence, the countries in the Eastern and Central Europe have defined the NATO integration objective as being in accordance with their politics and strategic intension and, not the least, with their cultural needs.

The North Atlantic Alliance could, therefore, be perceived and understood as a plural security community, of which tradition of half a century, and of which the high level of institutional democracy had already transformed it into the best mean to face the difficult transition to the systematic strategic realignments after the Cold War. In the last decade, NATO evolved considerably towards a defense and collective security organization, which approaches the present international challenges in a complex manner with multiple sides: from the promotion of the fundamental democratic values to the military exercises and operations in the areas of instability or from the extension up to the crystallization of the different frameworks and cooperative programs with the partners.

This strategic 'backbone' was put to a hard test on September 11, 2001. These events proved to the officials of the Alliance and each member country that the conventional military means are not enough to face the new strategic environment. The main lesson was that what happened in the U.S. could have happened anywhere else in the world. That is why, at the Alliance level, there was a great amount of work and there were internal debates for the assessment of the collective ways to the new global threats, such as terrorism. The starting point was that the vulnerabilities are not to be measured in terms of national/international but in terms of transnational phenomena. At the decision level, the consequence of those attacks determined the Euro-Atlantic community to focus more and more on the preventive, discouraged and reaction means and ways. Accomplishing this objective means first the understanding and the capacity to monitor and prevent the actions of an unpredictable and complex enemy.

The North Atlantic Alliance is a complex organization. Alone, it cannot be capable to face the present threats, but it is essential in providing the cohesion and the deterrence capabilities against a possible aggression. Invoking Article 5 after September 11, led to precise measures within NATO especially with the purpose of intensifying the early warning and surveillance, protecting its south-Mediterranean side and supporting the member countries' military efforts. Apart from the political debates in that time, the member countries have become aware of the fact that, for the future, a different type of forces and means will be needed to react rapidly to such events.

The Prague Summit has led a number of initiatives regarding the improvement of the Alliance military capabilities. It became obvious that NATO's presence is necessary in different parts of the world. Building of a NATO Response Force (NRF), capable to deploy within five days, improving the Alliance capabilities towards supporting the forces within the theatre of operation, enhancing the surveillance and identification capabilities, are only several measures from those in progress at the moment.

The size of the transformation goes beyond a concept and specific arrangements, strictly military. The confrontation with terrorism and criminal networks involved in proliferation of weapons of mass destruction raise inevitably the problem of institutionalized interagency cooperation. For instance, NATO and EU have recently launched common initiatives regarding border security and intensified the cooperation within protection and information exchange domain.

The way the strategic environment changed after September 11 is unique. Apart from the cyclical feature of the history, once again it has been proven that humanity offers its own surprises, sometimes unpleasant. The perception over terrorism has evolved from a rather internal issue, to apply the penal legislation, towards one of international security, which, if it is adequately approached, needs a large spectrum of political, economical, informational, legislative measures but also a serious and thorough involvement, in which the military factor plays an important role.

Apart from capabilities, the ways to use them - when, how and against what enemy? – represents crucial aspects in preparation of defense and security policies. That is why we need a greater amount of quality information to define and accomplish objectives, of rapidly deployable forces, capable and adjustable to the requirements, to be able to ensure the success of the more and more complex military operations, and to directly contribute to the Euro-Atlantic security guarantee.

The new millennium Europe is seen, especially through EU, as an area of institutions, cooperation and integration, an area of accomplishment of liberalism concepts. Within the terms of security, the European Union could be defined as ‘a security community’. Apart from this positive demonstration, in Balkans and Caucasus, the characteristics of Europe in the 1914 and 1939 - *ethnic conflicts, disputed borders, political extremism, nationalist passions, economical underdevelopment of some regions* - continuously influence the logic of the international balance. Practically, two worlds physically coexist, but linked to the

fundamental different times: *a 21<sup>st</sup> century world, laid on legitimacy principles*, which keeps under control the action of latent forces and *one of basic interest harsh impacts*, in which the old rules, considered to be immutable, of geography and physical power let these forces to express themselves freely.

## **2. NEW APPROACHES TO MILITARY DOMAIN**

In the last decade, the armed forces, considered among the most traditional instruments of action of a state, have met changes without precedent in this century: the necessity to transform the armed forces into a different structure than the simple defense armed forces, simultaneously with the necessity to financially sustain the military effort to support peace and regional stability.

A new approach of the security focused on preventive diplomacy, on participation to cooperative security, and on conflicts’ transformation, determines a substantial change of the armed forces role in the 21<sup>st</sup> century. The possibility that Romanian Armed Forces be engaged in operations linked to its basic mission, defense of national territory, has considerably decreased, but has been increased its participation to large scale of crisis management missions.

During the last years, there were significant change of concepts regarding sovereignty and the role of state through increasing the role of non state actors, the borders’ permeability, the integration and regional building processes, the growing interdependence among states and subsequent decrease of their capacity to unilaterally ensure security.

The features of the future conflicts changed through the preponderance of low intensity crisis, religious and ethnic conflicts compared to the classic conventional wars. Armed forces intervention became more and more specialized. The information technologies tend to replace the nuclear deterrence, and the use of armed forces stresses more and more on the use of high tech systems, by gaining the victory through high

distance pointed attacks and by avoiding the human loss.

Romanian Armed Forces follow a similar process as the other NATO members, transforming from defense armed forces into security armed forces. Stability in Europe implies a long term preventive approach within which the military systems play an important role. Assuring national security implies direct participation to maintain regional stability and integration into North-Atlantic Alliance as a guarantee not only of the member countries border stability, but first of democracy and continental security.

In order to give an answer to the defense policy objectives, the Romanian Armed Force structure must be organized to provide: a credible contribution to the national territory defense, a significant contribution to the peace support operations, especially those that counter the risks addressed to the Romanian national security, a relevant contribution for collective defense, in the perspective of full integration within NATO and EU, and also the necessity of sharing not only the benefits but also the responsibilities within these organizations.

### 3. CURRENT SIGNIFICANCE OF AIRPOWER AND ITS FUTURE EVOLUTION

Given the existing geo-political and geo-strategic context, analysts and policy-makers are constantly concerned with observing the direction of the military phenomenon's evolution and, therefore, with 'building' the most viable and efficient security and national defense systems.

The future conflicts will be described by the selection of confrontation spaces and objectives, no massive combat actions, high intensity and short duration, increased force mobility and diversification of combat procedures, massive use of new generation of "intelligent weapons", electronic systems for surveillance, reconnaissance and strike of C4I systems and the whole specific actions.

The historical evolution of conflicts imposes a review of the armed forces' role within the critical change of the military tool

usage objective. The interest in occupying a territory has been replaced by the interest in influencing and controlling the course of events. The need for presence in the area has cleared the space for the pressing need to control in order to be able to influence and, possibly, to intervene anywhere in the world while trying to avoid fight, thus switching from the concept of causing the enemy massive damages to high precision surge operations and active force protection measures to achieve the objective and avoid collateral damages mainly of civil population.

Given this background, the Air Force will continue to play an important role in managing the crises at any level of the conflict through gaining temporary air superiority and control over the airspace of strategic interest; causing significant damages to key elements of enemy military potential and combat zone; and providing the proper conditions for the other military services to be able to accomplish their missions. Consequently, before being concurrent with Air Force operations, the Army and Navy actions will be normally preceded by employment of the Air Force.

Various possibilities of employing air assets allow national or multinational military leadership to deter and prevent aggression, to properly adjust the scope and intensity of the air operations conducted so as to solve crisis and conflict according to political requirements. *Air superiority, information superiority, strategic attack, precision engagement, rapid mobility and agile operation support*, all in the context of effect-based operations are critical elements of the strategic perspective on Air Force employment in any type of armed conflict, whether traditional or irregular. Besides these, the Air Force provides specific expertise and support to Special Operations Forces.

*Air superiority* has to make inefficient the adversary's air defence and limit the risks of its air attacks. In this way, there are requested not only capabilities to annihilate the adversary's air defence to ensure the freedom of action of own forces but also the efficiency and persistence of air operations beyond the spatial possibilities of adversary's air defence in difficult weather conditions.

*Information superiority* is based on: integration of manned, unmanned and space/cosmic reconnaissance systems; battle space image, which includes real-time recognized air picture; early warning; efficient use of intelligence to ensure the need of information and conduct of information operations; deny the use by the adversary of its C4ISR.

*Strategic attack* requires the swift and precise attack of adversary's centers of gravity ensuring the persistence of the effects.

*Precision attack* increase the number of stricken targets within a single aircraft sortie and the achievement of specific effects, eliminating the risk of fratricide and those related to collateral damage, and not the least, achieving significant effects both militarily and psychologically.

*Rapid mobility* allows the establishment of an air bridge during air/joint operations and a military capacity of efficient and timely movement inside the area of operations, interest area adjacent to the theatre of operation, anywhere and in any conditions.

*Agile combat support* allows the conduct of sensitive, persistent and efficient operations in any conditions.

Employment features and capabilities of the air assets make it almost impossible for any target to avoid striking. The resulted potential risk can be neutralized by similar types of assets only. Therefore, the airpower can be counterbalanced by airpower *only*. Alliances or isolated states may become subjects of intimidation unless they have a credible airpower.

As a conclusion, the airpower importance as to preventing and solving crisis and conflicts, emerges from its potential to accomplish a large spectrum of missions, precision attack on targets located throughout the theater of operations, almost real time reaction and capability to discourage any threats. Through its potential to quickly respond and deter, the airpower importance will be maintained if not increased at a major level in the years to come, too.

#### 4. SNAPSHOT - AIR FORCE MISSIONS WITHIN NATIONAL DEFENCE OF ROMANIA

Today's strategic environment is complex and subject of unforeseeable developments. Terrorism, instability due to failed and failing states, regional crises and conflicts are some of the most important factors causing these developments.

Under these circumstances, the Romanian Air Force represents a basic component of the National Defense System whose fundamental role is to generate, apply and sustain the airpower in operations conducted during peacetime, crisis and war, either within the national territory or abroad, along with our allies or coalition partners.

The essential Romanian Air Force's missions consist of ensuring Romania's sovereignty through surveillance and protection of the national airspace, cooperating with other forces to maintain or enforce peace, and fighting against international terrorism, in NATO and coalition operations, disaster relief and emergency operations.

The Air Force plays an important role in conducting military operations, obtaining temporarily air superiority, maintaining control of the airspace and striking in enemy-controlled areas, in order to damage key-elements of the adversary's military potential (command centers, chokepoints, offensive elements) and generate prerequisites to carry out various missions both by own forces and the other military services.

The Air Force platforms and weapon systems enable the achievement of the airspace control, which is necessary to ensure an adequate freedom of action during any type of military operations. Maintaining the airspace control and freedom of action ensure without any doubt the favorable circumstances for the success of own Air, Land, and Navy operations. As a result of the air strikes on the elements defining the enemy's centre of gravity, the Air Force is achieving strategic effects which undermine adversary's capability and will to begin or continue the aggression.



## 5. ROMANIAN AIR FORCE IN NATO ȘI EU

Within the two organizations, the role of Romanian Air Force is logically deduced by the package of forces, assets, and capabilities that Romania committed. The control of these forces as well as the Alliance's is provided by the Control and Reporting Centre (CRC), which has already become operational. Air defence forces and assets are able to execute the whole spectrum of air-to-air missions: air defense, interception, combat air patrol - CAP, sweep, escort, dogfight, etc. Fighter-bomber aircraft are able to conduct offensive air operations in adversary's tactical depth, carrying out missions to suppress the enemy's ground-based air defence, gain air superiority, as well as air interdiction, close or forward air support, strike with laser or infra red precision guided weapons, etc. Combat helicopters are capable to execute close air support (CAS), combat search and rescue (CSAR), airlift to conflict area, etc. Transport aircraft are able to support rapid deployment, rotation, and sustainment of forces within theatres of operations. The already operational, EOD module has an active participation in NRF, and in future, the Air Force contribution will be extended, after procurement and training, with one SHORAD module and its command and control element.

Operating from a FAOB (forward air operating base), located in a threat-emerging theater of operations, includes the involvement of other modules which are necessary to fully support the air operations. Therefore, it can be stated that the deployed Air Force package committed by Romania is not able to carry out air operations on its own, but within a multinational task force *only*. What cannot be conducted with the committed Air Force package is the airborne command and control, strategic air strikes, special air reconnaissance and electronic warfare and that is why we count on a supplement from the Alliance. Consequently, the Romanian contribution seems to be minor/modest when compared to traditional members' one, while nevertheless major, in contrast with many of new NATO members'.

In order to achieve the Air Force required capabilities, the following priorities are considered:

- *Achievement of operational status and affirmation of force packages under NATO command or designated to NATO/EU, in order to participate in stability operations and collective defense, in parallel with preparation for "the next war";*
- *Full integration in NATO and EU, and achievement of operating capabilities within a joint/multinational, enlarged and complex team;*
- *Professional built-up and development of the Air Force personnel in order to reach a competitiveness level, adequate to "the new war/war of future";*
- *Acquisition of new types of military equipment and modernization of the existing one, in order to optimize the military effectiveness of the Air Force specific systems, and manage the 21<sup>st</sup> century challenges, as well.*

## 6. EXPERIENCE ACUMULATED FROM NATO AND UE OPERATIONS – LESSONS LEARNED

The decisions that Romania has made since September 2001 as a de facto NATO member have extensively contributed to increasing Romania's image and credibility abroad. Romania's participation with troops in operations in Afghanistan, Iraq, Bosnia-Herzegovina and Kosovo, as well as in NATO and EU operations certify that Romania is an active member of the international community, a security provider. The Air Force has contributed to the deployment of Romanian contingents that are carrying out missions in theatres of operations. The Air Force has decisively contributed to the deployment of Romanian contingents assigned to perform missions within these theaters of operations.

The experience gained from these tasks form a helpful basis for future decision-making process. The C-130 aircraft proved its efficiency in theater and also certified that our aircrews meet the proper training level to jointly operate with allied members.

Modernization of the existing C-130 aircraft and acquisition of a new version are decisions we have supported as a result of the lessons we learned. Given the new challenges the Air Forces should face, we have examined the issue and set up appropriate medium- and long-term courses of action and steps to be done. It refers, mainly, to diversify the force offer and change the focus on deployable forces.

Within EU-led operation ALTHEA, the Romanian detachment's activity illustrated the individual and team feats of strength and skill and provided a unique experience that enabled amendments of the special training manuals, particularly those provisions on night helicopter training operations and the use of night vision goggles.

The knowledge and experience gained in the various missions within the area of operation, the development of English language communication skills, and especially the human relations built during the tour made this mission a genuine success.

During the mission '*Romania – Lead Nation KALA*', the Romanian Air Force Detachment took over the management of Kabul International Airport, coordinating daily air operations, processing meteorological data to ensure flight safety, maintaining and improving communications, providing supplies and logistic support for passenger and cargo processing operations on the terminal.

The mission, guided by the motto 'flight safety above all', provided ground operation personnel with outstanding experience in organizing and managing the activity on an in-theater airfield terminal, where the operational intensity tests the physical and mental capacities of the military personnel, and where adequate training, team work and information exchange proved their values.

*Air Policing over the Baltic States*, a NATO-led mission, was performed as an integral part of collective air defense to maintain the sovereignty of the designated air space and represented a beneficial experience for the Romanian Air Force, an opportunity and a challenge as well, designed to test their training, deployment and employment on an other NATO Nation's airbase.

The experience acquired by BALTICA-07 detachment revealed particularities that significantly contributed to the improvement of deployable force training. The emphasis was mainly placed on the importance of continuing the training under NATO command and control, significantly increasing aircrew practice, including air interceptions with live ammunition on board, flying formation adjustments to engage low altitude and low speed targets. Moreover, solutions to adjust the equipment and materiel inventory required for such missions were identified, including the improvement of detachment performance under limited host-nation support on the airfield.

Four years after accession to NATO, Romania hosted in 2008 the utmost summit in the Alliance's recent history. *Security operation for NATO Summit in Bucharest* was the first live operation of this type jointly conducted by Romania and NATO, enabling it to prove the level of procedural, operational and technical interoperability of the Romanian part, which demonstrated a remarkable teamwork.

The concept of operations proved to be appropriate, meeting the mission requirements. We have learned that flexibility is an incredibly important element of planning for a High Visibility Event. Working to adapt to airspace changes, for working with an ever evolving VIP aircraft bed-down plan, accepting very late notification were added to numerous other challenges.

*Joint exercises* have been part of the air forces' training, mainly aiming at certification and affirmation of deployable forces made available for NATO operations. During these exercises we have understood our capability limitations, especially regarding the in-service equipment and expeditionary logistic support. As a consequence, programs for modern equipment acquisition have been developed to remove these limitations.

The preparation and training of the deployable force still remain a challenge for the Romanian Air Force. Connection to in-theatre information flow, logistics and force protection on air bases with minimum Host Nation Support, are still open issues. To find

the appropriate solutions, it is necessary to continue our participation in common exercises and training events, thoroughly analyze their results, and constantly improve the information exchange with our allies.

## **7. CONCLUSIONS**

Particular significance of the airpower on the military power scene and, implicitly, on the armed conflict denouement has determined a complex approach of the issue.

It is essential to understand that there is no freedom of action for land or naval forces without airspace control, and also that, lacking air transport and air-to-ground attack capability, the force mobility (including Special Operation Forces' mobility) and concentrated efforts drop down to a level where they pose no threat to an enemy.

For future, the focus has to be moved on quality with all its associated elements in the context of participation with forces to NATO and UE. Current orientation toward Air Force inventory takes into account the operational requirements that have been defined by focusing on quality, thus enabling options for acquisition and modernization of a reduced-

than-the-existing-one inventory, but more capable. Besides this, we have considered creating capabilities for tactical airlift with fixed and rotary wing aircraft, where shortfalls have been identified at NATO level. A significant part of Air Force offer to NATO and UE is represented by helicopters and transport aircraft.

The Romanian Air Force has been undergoing essential and inherent changes, which will create the conditions to turn the existing forces into more flexible and agile, able to face the challenging security environment.

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## INFORMATION ON GASEOUS DETONATIONS

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**Abstract:** This paper provides an overview of detonation phenomenon which may occur especially in pipelines and vessels. The most known theories in detonation are shortly described here: Chapman and Jouguet (CJ) and Zel'dovitch, von Neumann and Doring (ZND); the first is based on pure gasdynamic and thermodynamic arguments, assuming infinitely fast chemistry. The latter introduces finite rate chemistry. The most interesting point of the paper is the structure of a detonation wave.

**Key words:** deflagration, detonation, Chapman and Jouguet (CJ) and Zel'dovitch, von Neumann and Doring (ZND), Le Chatelier's Rule

### 1. DEFLAGRATION AND DETONATION

**Deflagrations** propagate at subsonic velocities. The rate of deflagration is controlled by diffusion of heat and reactive species from the reaction zone (flame front) to the unburnt material. In practice the velocity depends on the degree of confinement and the size and shape of the flammable mixture.

Assuming that the unburnt gas is stationary, the flame propagates into the unburnt gas at a characteristic **laminar burning velocity**. This is a fundamental parameter whose value reflects the reactivity of the mixture.

If the unburnt gas is turbulent, the burning velocity can increase and is then called the **turbulent burning velocity**.

If the unburnt gas is moving, a stationary observer measures a flame velocity that is the sum of the unburnt gas velocity and the burning velocity. This observed flame speed is called the **deflagration velocity**.

Typical deflagration speeds range from a few m/s in an unconfined cloud to several hundreds of m/s in a pipe or other volume containing repeated obstacles.

In an enclosed vessel containing a fuel/air mixture, the deflagration pressure rise is typically seven times the initial pressure. For a low velocity deflagration, the pressure increase

at the flame front is very approximately given by  $1.2 M^2$ , where  $M$  is the *Mach number* (ie the deflagration speed divided by the sound speed of the unburnt mixture). Once the deflagration speed approaches sound speed, a shock wave will form.

A **detonation** travels at supersonic speeds. Typical velocities are of the order of 1,850 m/s for fuel/air mixtures and 3,000 m/s for fuel/oxygen mixtures. These velocities may be higher where hydrogen is the fuel.

The structures of deflagration and detonation waves are contrasted in **Fig 1**.

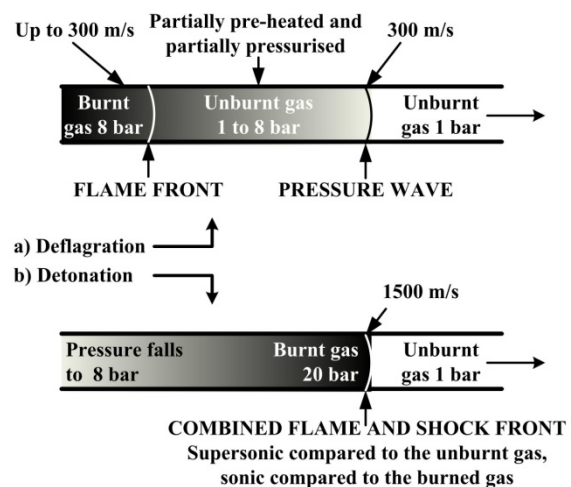


Fig. 1 Comparison of Deflagration and Detonation waves

In a detonation, a high pressure shock front travels approximately 1 to 10 mm ahead of the reaction zone, the reaction zone being the “flame” (in a fast deflagration, the reaction zone lags much further behind the shock front). Because chemical reaction rates depend exponentially on temperature, extremely rapid combustion occurs. High pressures arise from the strength (speed) of the shock.

Steady detonations have a characteristic pressure/time history. A typical example is shown in **Fig 2**.

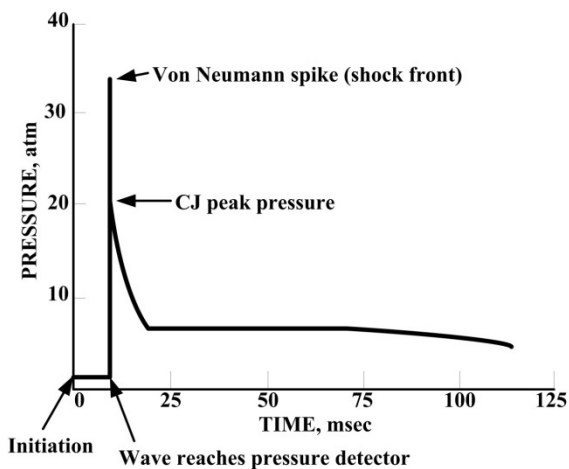


Fig. 2 Example of a pressure time transient for a stoichiometric acetylene-air mixture

There is a sudden increase in pressure, followed by a smooth expansion to a roughly constant value. In some cases, the pressure of the shocked gas mixture can be detected before it ignites. This so-called “leading shock” region is termed the von Neumann spike and has a higher pressure than the detonation pressure.

The initial pressure rise of a steady detonation is at a maximum close to the stoichiometric concentration, and decreases as the mixture approaches the detonation limits. Typical maximum detonation pressures are 15 to 19 times the initial pressure for stoichiometric fuel/air mixtures, and 25 to 30 times the initial pressure for stoichiometric fuel/oxygen. Turbulence can increase these pressures dramatically.

The temperature of the detonation products is typically 3,000 K for stoichiometric fuel/air mixtures, again decreasing as the mixture

approaches the detonation limits. For mixtures in oxygen, the maximum temperature increases to more than 4,000 K.

In practical explosions, there is an almost continuous spectrum of combustion front velocities, from laminar burning velocity, through deflagration and shock formation to detonation. In deflagrations, the flame speed is strongly affected by turbulence and a deflagration can be accelerated to detonation, for example by turbulence induced by obstacles.

The basis of operation of most commercial explosives is the direct initiation of detonation in the solid state. This subject is outside the scope of this report.

## 2. MATERIALS SUBJECT TO DETONATION

A limited study (“Flame acceleration and transition to detonation in pipes”, GO Thomas et al, draft report on behalf of PIPEX consortium, 15/9/99; “A preliminary study of a mimic gas concept to characterise potential explosion severity: influence of nitrogen dilution and comparison with published MESH data”, GO Thomas and A Hallgarth, University of Wales Aberystwyth Department of Physics) suggests that a useful indicator of a material’s susceptibility to detonation is its Maximum Experimental Safe Gap (MESG) value. The lower the MESG, the more easily a material will detonate, ie gases in Group IIC are most susceptible. MESG’s of some common materials are listed in **Table 1**.

Bull (in “Concentration limits to the initiation of unconfined detonations in fuel/air mixtures”) has collated data on the critical energies required (using a solid explosive initiator) to establish steady detonation in unconfined clouds of common fuel/air mixtures. This also gives an indication of a mixture’s susceptibility to detonation.

Unfortunately, no guidelines exist as to where the boundaries lie between those mixtures that will give low velocity deflagrations and those which will accelerate to far more destructive fast deflagrations and detonations. The situation is complicated by the dependence of flame acceleration on

effects such as vessel geometry and the presence of repeated obstacles.

Table 1. Maximum experimental safe gaps, deflagration limits and detonation limits for some common materials

MATERIAL	MESG (mm)	deflagration limits in air (% v/v)	confined detonation limits in air (% v/v)	unconfined detonation limits in air (% v/v)	confined detonation limits in oxygen (% v/v)	unconfined detonation limits in oxygen (% v/v)
Acetaldehyde	0.92	4.0-60	NR	NR	NR	13.0-48.0
Acetone	1.04	2.6-13	NR	NR	3.3-40.0	NR
Acetylene	0.37	2.5-100	4.20	NR	2.90	6.70
Benzene	NR	1.3-7.9	1.60-5.55	NR	1.55-36.0	NR
Butane	0.98	1.8-8.4	1.98-6.18	2.5-5.2	2.05-38	NR
Cyclohexane	NR	1.3-7.8	NR	NR	1.4-29.0	6.7-39.0
Diethyl ether	0.87	1.9-36	2.8-4.5	NR	2.6-40	4.7-29.0
Ethane	0.91	3.0-12.4	2.87-12.2	4.0-9.2	3.60-46.6	11.0-39.0
Ethanol	0.89	3.3-19	5.1-9.8	NR	NR	NR
Ethylene	0.65	2.7-36	3.32-14.7	NR	4.1-60.0	9.2-51.0
Hydrogen	0.29	4.0-75	18.3-58.9	15.0-90.0	NR	NR
Methanol	0.92	6.7-36	NR	NR	9.5-64.5	NR
Octane	0.94	LFL 0.95, UFL	1.45-2.85	NR	1.55-17.3	NR
Propane	0.92	2.1-9.5	2.57-7.37	3.0-7.0	2.50-42.5	7.0-31.0
Propylene	0.74	2.4-11	3.55-10.4	3.5-8.5	2.5-50.0	6.7-37.0
Xylene	NR	1.1-6.4	NR	NR	1.05-26.5	NR
NR=not reported						

Hydrogen, acetylene, ethylene, ethylene oxide, ethane and propane are some of the widely known materials that can detonate when mixed with air.

Detonations have also been induced under test conditions in many common solvent vapours such as acetone, benzene, methanol and xylene. However, the power of the ignition source and other test conditions needed to detonate these solvent vapours were probably extremely severe. Similarly, methane can only accelerate to detonation under extreme conditions, usually involving very long pipe runs and high levels of turbulence.

Most experimental work on confined detonations in air has been done on hydrogen, acetylene, ethylene and propane. Other studies include ammonia, cyanogen, carbon disulphide and tetramethyl silane in air or oxygen. There is some limited information on detonations in other oxidants, including halogens (chlorine/hydrogen mixtures being the most studied), ozone, hydrogen peroxide vapour, nitrogen oxides and chlorine dioxide.

### 3. DETONATION LIMITS

**Detonation limits reported in the literature should be treated, and applied to industrial situations, with great caution.** Literature values of detonation limits can be lower or higher than those in industrial plant. For example, some tests have been done in pipes which were too narrow and/or short to sustain a detonation. On the other hand, some tests have been done with excessively large ignition sources, which have overdriven the mixture (ie caused it to travel faster than the steady-state detonation velocity). This overdriven condition would not be sustained over long lengths of piping.

Detonation limits are typically measured in small vessels or tubes. Data is available for relatively few materials. The measured limits depend on the size, shape and geometry of the apparatus. The detonation limits of an unconfined mixture are narrower than for confined detonations. Deflagration and detonation limits for some common materials are given in **Table 1**.

Whilst a given mixture and pipe/vessel geometry may be capable of sustaining a detonation, it is not always the case that a detonation will develop.

There are methods available to estimate detonation limits using deflagration limits ("Gaseous detonations", MA Nettleton, Chapman and Hall, 1987). These usually tend to overestimate the detonable range.

Le Chatelier's Rule can be used to calculate the composite lower detonation limit:

$$L = \frac{100}{\frac{c_1}{L_1} + \frac{c_2}{L_2} + \dots + \frac{c_n}{L_n}} \quad (1)$$

where:  $c$  = proportion of each detonable gas (% v/v) and  $L$  = lower detonable limit of each gas (% v/v)

As with the calculation of composite flammable limits, this rule works well for mixtures containing hydrogen, methane, carbon monoxide and simple alkanes, but is not accurate for more complex molecules, or for sulphur-containing materials such as hydrogen sulphide and carbon disulphide.

#### **Effect of Initial Temperature, Pressure and Humidity**

There is very little data on the effect of temperature on detonation limits. Generally, increasing the initial temperature and pressure tends to widen the detonation limits, with the upper limit being more strongly affected. There are inconsistencies in the experimental results.

For example, the detonable range of hydrogen/oxygen was found to narrow with a temperature rise of 50 °C, however the limits of methane/oxygen widened.

Laminar burning velocity tends to increase with temperature. The increase is more dramatic in mixtures with relatively high burning velocities, such as hydrogen/oxygen.

It is recognized in the testing community, but seldom reported, that changes in air humidity can affect flame acceleration properties ("Flame acceleration and transition to detonation in pipes", GO Thomas et al, 15/9/99), although interpretation of the results in this reference is not straightforward because

these tests were carried out at varying ambient temperatures.

#### **Effect of Scale**

Detonation limits tend to widen as the size of the vessel increases. **The detonation pressure depends on the detonation velocity and is not a function of the vessel's diameter or volume** (but vessel shape and size do affect deflagration velocity).

#### **Effect of Oxygen and Diluents**

All mixtures are more susceptible to detonation when mixed with oxygen alone. The resulting detonation will have a higher detonation velocity, pressure and detonation product temperature than an equivalent detonation in air.

Diluents tend to narrow the detonation limits, particularly the upper limit. Relatively large amounts of diluent can be needed to suppress detonability and experimental data is needed for individual situations. Significantly more diluent is required at higher temperatures, as found in one study ("The influence of initial pressure and temperature on hydrogen-air-diluent detonations", DW Stamps and SR Tieszen, Combustion and Flame Vol 83, 1991) in which the initial temperature was increased from 293 to 373 °K.

A recent study showed that the nitrogen content of a fuel/oxygen/nitrogen mixture can critically control the explosion behaviour. This work suggests that the main reason for differences in the detonability of fuel/air mixtures is the differing nitrogen contents of the stoichiometric mixtures, not the fuel type per se.

## **4. STRUCTURE OF A DETONATION WAVE**

A planar detonation wave has a complex 3-dimensional cellular structure. A number of transverse waves run across the leading wave, reflecting from one another and from the walls and obstructions, creating a continually changing cellular structure with a characteristic "fishscale" pattern (see **Fig 3**). The surface of the leading front consists of a series of bulges (the so-called "Mach stems") and depressions (which are the decaying

incident blast waves), separated by triple points at the points where the shocks interact. The reaction zones trail behind.

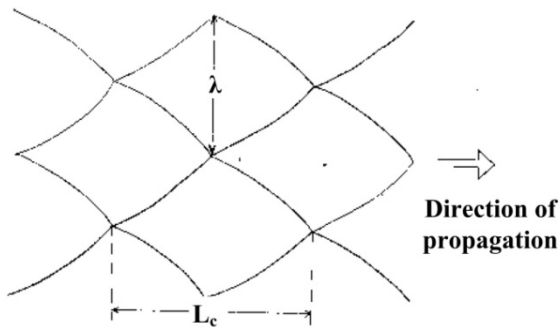


Fig. 3 Cellular Structure of a Detonation Wave

The cell width  $\lambda$  is a fundamental characteristic of a detonation wave, and varies from approximately 8 mm for hydrogen to 20 mm for ethylene. It can be used to calculate various parameters such as the critical pipe diameter (the narrowest pipe diameter in which a selfsustaining detonation can propagate. The cell length is usually termed  $L_c$ . The cell width is typically 0.5 to 0.6 times  $L_c$ , although Nettleton quotes 0.7 to 0.8 times  $L_c$  at atmospheric pressure.

18.  $\lambda$  is affected by the initial pressure, mixture composition and sensitivity to detonation.  $\lambda$  is measured by experiment and variations of a factor of two in reported values are not uncommon. More easily detonated (ie more reactive) mixtures have smaller cell widths:

Table 2. Average Measured Cell Lengths for Various Fuel/Air Mixtures

FUEL IN AIR	CELL LENGTH $L_c$ (mm)	CALCULATED CELL WIDTH $\lambda$ (mm)
Acetylene	13.6	9.8 to 10.9
Hydrogen	15.9	8.0 to 12.7
Ethylene	39	20 to 31
Propane	72	36 to 58
Ethane	88	44 to 70

The variation of cell width with mixture composition for various alkanes is given in "Dynamic properties of gaseous detonations", JHS Lee, Ann Rev Fluid Mech, 1984, Vol 16.

Cell width tends to fall as the initial temperature and pressure are increased, and is more sensitive to temperature than pressure.

For a given mixture, there is a critical pipe diameter, below which detonation will not occur.

This is because, in a sufficiently narrow pipe, there is not enough room for the detonation's cellular structure to exist. **For propagation of a detonation in a circular pipe, the critical pipe diameter is of the order  $\lambda/\pi$ .** This corresponds to a single detonation cell, wrapped around the circumference of the pipe. For square and rectangular pipes, see Fig 4.

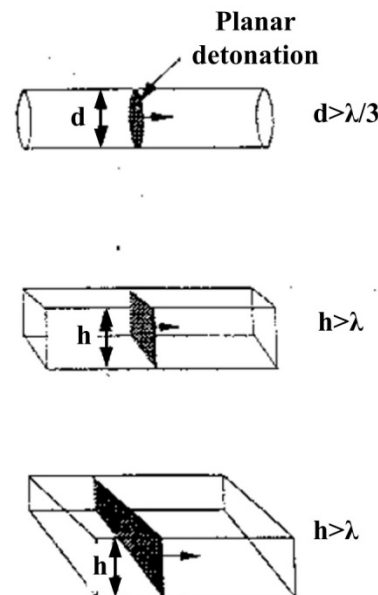


Fig. 3 Requirements for Successful Propagation of a Planar Detonation in Pipes and Channels

"Gas explosion handbook" (D Bjerketvedt et al, J Haz Mat, Vol 52, 1997) and "Dynamic properties of gaseous detonations" (JHS Lee, Ann Rev Fluid Mech, Vol 16, 1984) are useful for evaluating the likelihood of transmission of a detonation from a confined area (building, ventilation duct, culvert etc) into an unconfined situation. For successful propagation of a detonation from the end of a pipe into an unconfined area, the critical diameter is  $13 \cdot \lambda$  for a circular pipe and  $10 \cdot \lambda$  for a square pipe.



When using any of these relationships, a safety factor is needed to allow for variations in the reported values of. Using a critical diameter of  $\lambda/2\pi$  (i.e. 50% lower than the theoretical value of  $\lambda/\pi$ ) has been suggested by one leading expert professor GO Thomas, University of Wales Aberystwyth, Department of Physics.

### 5. DETONATION THEORY

The two well-known detonation theories are those of Chapman and Jouguet (CJ) and Zel'dovitch, von Neumann and Doring (ZND). The first is based on pure gasdynamic and thermodynamic arguments, assuming infinitely fast chemistry. The latter introduces finite rate chemistry.

Despite the omission of detailed chemistry, CJ predictions can be very accurate. The accuracy of ZND calculations is limited by the accuracy of the chemical reaction schemes used.

#### CJ Theory

This was proposed in the early 1900's. It combines an analysis based on the conservation of mass, energy and momentum with basic thermodynamics. It is a one-dimensional model, and assumes that the reaction rate is infinitely fast. The model's representation of a detonation, with an infinitely thin reaction zone, is known as an "ideal" detonation. The model neglects the high momentary pressure in the von Neumann spike at the leading edge of the detonation wave.

A CJ analysis can be used to calculate detonation properties such as velocity and pressure.

Table 3. Examples of calculated CJ pressures and velocities

	Hydrogen	Ethylene	Propane	Methane
CJ pressure (bar)	15.8	18.6	18.6	17.4
CJ velocity (m/s)	1968	1822	1804	1802

Predicted values compare reasonably well with experimental data and the model is still widely used.

The CJ model cannot be used to calculate parameters which require a knowledge of the structure of the detonation wave, such as detonation limits, initiation energy, critical pipe diameter and the thickness of the reaction zone. These so-called "dynamic detonation parameters" can be calculated (with varying degrees of accuracy) using the ZND theory.

The CJ (ie average) detonation pressure PCJ in bar is calculated by:

$$P_{CJ} \cong \frac{\gamma M^2}{\lambda + 1} \tag{2}$$

where:

$\gamma$  = ratio of specific heat at constant pressure to specific heat at constant volume

$P_i$  = initial pressure (bar absolute)

$M$  = detonation Mach number (ratio of detonation velocity to velocity of sound in the unreacted gas).

The peak pressure  $P_{vn}$  behind the lead shock wave in the von Neumann spike is approximately twice the CJ pressure:

$$P_{vn} \cong \left( \frac{2\gamma M^2}{\lambda + 1} - \frac{\gamma - 1}{\gamma + 1} \right) P_i \tag{3}$$

Munday (in "Detonations in vessels and pipelines", The Chemical Engineer, April 1971) suggests that **the maximum pressures achieved in practice could be twice the calculated CJ values**, due to the combined effects of high sustained pressure and shock loading.

Much higher pressures are often achieved in the overdriven detonation, which exists momentarily before the steady state detonation..

#### ZND Theory

In the early 1940's Zel'dovitch, von Neumann and Doring independently proposed a more detailed model. Instead of an infinitely fast chemical reaction assumed in the CJ theory, the ZND model assumes that the shock wave is separated from the reaction zone (this is a so called "non-ideal" detonation). This separation corresponds to the so-called

“induction delay period”, which arises from the finite rates of the combustion reactions.

The ZND theory predicts similar detonation velocities and pressures to the CJ theory.

These compare fairly well with experimental data, however the theory relies on the integration of detailed chemical kinetics schemes and is too complex for calculations to be done by hand.

Detonation limits, initiation energy, critical pipe diameter and the thickness of the reaction zone can be calculated, but their accuracies depends on the accuracies of the coefficients and reactions included in the kinetic schemes. These calculated values do not agree particularly well with experimental results.

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## COMPLEX ASPECTS OF DETONATIONS

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**Abstract:** This paper provides an overview of types of detonation, such as overdriven detonation, pressure piling, retonation, spinning detonation, galloping detonation, quasi-detonation. Detonation incidents in the chemical industry frequently involve deflagration to detonation transition (DDT) and for this, DDT, as well as damage caused by detonations are important parts of the paper, with useful and interesting information contained.

**Key words:** Detonation theory, Overdriven Detonation, Pressure Piling, Retonation, Spinning Detonation, Galloping Detonation, Quasi-Detonation, Run Up Distance

### 1. DEFLAGRATION AND DETONATION

**Deflagrations** propagate at subsonic velocities. The rate of deflagration is controlled by diffusion of heat and reactive species from the reaction zone (flame front) to the unburnt material. In practice the velocity depends on the degree of confinement and the size and shape of the flammable mixture.

A **detonation** travels at supersonic speeds. Typical velocities are of the order of 1,850 m/s for fuel/air mixtures and 3,000 m/s for fuel/oxygen mixtures. These velocities may be higher where hydrogen is the fuel.

#### **Detonation theory**

The two well-known detonation theories are those of Chapman and Jouguet (CJ) and Zel'dovitch, von Neumann and Doring (ZND). The first is based on pure gasdynamic and thermodynamic arguments, assuming infinitely fast chemistry. The latter introduces finite rate chemistry.

Despite the omission of detailed chemistry, CJ predictions can be very accurate. The accuracy of ZND calculations is limited by the accuracy of the chemical reaction schemes used.

### 2. ENHANCED PRESSURE EFFECTS AND UNSTABLE TYPES OF DETONATION

#### **Overdriven Detonation**

This is a detonation wave that is artificially supported above its CJ velocity and hence also has a much higher peak pressure than the CJ value. There is a rapid increase in pressure with the degree of overdriving (ie the increase in velocity above the CJ value). Overdriving can occur during the transition from deflagration to detonation, or during initiation by a solid explosive. This overdriven detonation can generate much higher pressures than the steady state detonation - up to 100 times the initial pressure (5 times the CJ pressure). Usually this pressure is short lived, but it can be sufficient to cause local mechanical damage.

#### **Pressure Piling**

This occurs when a detonation propagates through a medium that has been pre-pressurized by an earlier flame, for example in interconnected vessels. The CJ pressure is enhanced by the pre-compression ratio. The pressure is further enhanced if the detonation wave reflects off a wall or propagates into a corner.

Pressure waves ahead of the flame front may also be reflected, for example by bends,

obstructions or the far end of the line), and merge to form a pressure wave which travels back towards the flame. This reflected shock can accelerate a deflagration to detonation, and the initial pressure is increased by a factor of 2 to 5, due to the shock pre-compression. Both can result in devastating detonation pressures.

### Retonation

When a detonation is formed, a strong pressure wave can propagate back through the burnt gas. This is called the **retonation**. It can be enhanced if it propagates back through gas that has not all been burned during the flame acceleration phase. It can reflect (for example off a closed end or bend), and travel back towards the main detonation wave. Because of the increased speed of sound in the hot burnt gases, the reflected retonation overtakes the detonation. Under appropriate conditions, a combined detonation/retonation wave front can exist for a very short time. During this time, the overdriven pressure can be between approximately 2 and 5 times the usual detonation pressure.

### Spinning Detonation

Close to the detonation limits, or as the pressure drops to a critical level, the detonation front spins in a stable manner, producing a helical track on the inner surface of a dusted tube.

It is more easily observed in pipes of circular cross-section.

### Galloping Detonation

This can occur near to the detonation limits in a pipe. The velocity of the detonation wave front fluctuates dramatically between approximately 0.5 and 1.5 times the CJ velocity (see **Fig 1**).

A galloping detonation occurs because of repeated transitions to detonation in a mixture that is very near to the limits of propagation. Detonation is established initially but eventually decays to a shock-flame. The shock-flame is accelerated by wall boundary layer effects and undergoes a further transition to detonation, and the process becomes cyclical.

The oscillations can be remarkably consistent over a large number of cycles. Galloping detonation can cause severe damage

at the locations where the transition to the overdriven state occurs.

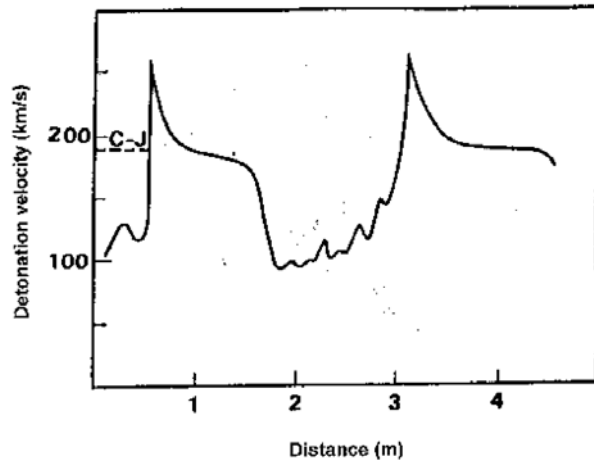


Fig. 1 Typical Velocity-Time Transient for Galloping Detonation

### Quasi-Detonation

In a quasi-detonation, the shock front and the burning zone are more decoupled (ie more separated). A quasi-detonation is effectively a fast deflagration following a lead shock wave.

This configuration is not naturally stable and requires the presence of repeated obstacles.

These provide energy and momentum loss that slow the wave but the obstacles also promote rapid energy release during turbulent combustion and transverse shock formation. When both these influences balance, a stable low velocity (compared to the CJ velocity) reaction wave can exist.

## 2. DEFLAGRATION TO DETONATION TRANSITION (DDT)

Detonation incidents in the chemical industry frequently involve DDT. A deflagration flame in a detonable mixture (typical velocity 1 m/s) can be accelerated to detonation by turbulence induced by friction with pipe walls, obstructions etc. Turbulence accelerates the flame because it wrinkles the flame front, which increases its surface area and therefore increases the rate of reaction. This results in a shock forming ahead of the flame as the flame approaches sonic velocity. The shock front acts like a piston, heating and

compressing the unburnt gas ahead of the flame. Eventually the unburnt gas autoignites, and a detonation wave is formed ahead of the flame. This occurs at a flame speed of approximately 1,000 m/s.

A shock forms and there is a volume of compressed gas, with undisturbed gas ahead of it.

DDT leads to overdriven detonation in the compressed gas. If the shocked gas volume is large enough, a steady detonation propagates through it. Once the shocked gas has been burned, the detonation continues into the unshocked gas, initially as an overdriven wave which then decays to a steady detonation. Following DDT, a blast wave is also transmitted back into the burnt gas.

Very reactive fuels such as hydrogen, acetylene and ethylene in air, and other fuels in oxygen-enriched atmospheres, are particularly susceptible to DDT. Nevertheless, DDT has been observed in mixtures of less reactive fuels in air. In one experiment using propane/air and a weak ignition source in a test vessel with confinement and obstructions, DDT occurred in less than 10 m. In British Gas experiments using propane/air in a pipe rack layout, DDT occurred after 15 m. **DDT is therefore foreseeable in a gas cloud within the detonable range, if there is a high degree of confinement and/or obstruction.**

The composition of the mixture and the size, shape and geometry of the vessel have a strong effect on the transition to detonation. **Great care is needed when extrapolating the results of research to a particular application.** Often, in very critical circumstances, recourse has had to be made to direct testing, using apparatus as close to the application geometry as possible.

#### **Run Up Distance**

This is the distance between the steady deflagration and the formation of a steady detonation wave. Bollinger (in "Experimental measurements and theoretical analysis of detonation induction distances", LE Bollinger et al, ARS Journal, May 1961) presents experimental data on DDT and an equation to calculate the run-up distance. **A length to diameter ratio  $L/D$  of 10-60 is usually required for DDT, with an  $L/D$  of 10 for**

**more sensitive turbulent mixtures.** Exceptions are highly reactive, unstable fuels such as acetylene and ethylene, which require an  $L/D$  of only 3. It is important to bear in mind that  **$L/D$  ratios are highly system-specific and it is extremely difficult to apply them to other situations or experiments.** Nettleton (in "Gaseous detonations", MA Nettleton, Chapman and Hall, 1987) **suggests that run up distances in industrial pipes could be 50% of the measured values.**

Recent measurements of transition distances in pipes of diameter 150 mm and 300 mm with hydrogen/air and ethylene/air mixtures were of the order of 9 m and 15 m respectively ("Flame acceleration and transition to detonation in pipes", GO Thomas et al, draft report on behalf of PIPEX consortium, 15/9/99). A strong dependence on ambient atmospheric conditions (temperature and humidity) was also noted.

The pipe must be at least as wide as the critical diameter for DDT to occur.

#### **Effect of Initial Temperature and Pressure**

There is little data on the effect of temperature, although it appears that an increase in temperature tends to increase the run-up distance, possibly due to the reduction in density.

The run up distance tends to decrease as pressure increases and as the mixture tends towards stoichiometric.

#### **Effect of Scale**

From the limited data available, it appears that run up distance increases with pipe diameter (ie DDT occurs at a constant length to diameter ratio). Most tests have been done in relatively narrow pipes (maximum diameter 50 mm). It is difficult to extrapolate the results to pipes typical of chemical plants due to the unknown effects of bends, junctions etc. Also, drag effects (which tend to reduce flame acceleration) are less significant in larger bore pipes.

Sudden changes in pipe direction and decreases in pipe diameter tend to favour DDT because of the additional turbulence they introduce. Increases in pipe diameter reduce the likelihood of DDT and can even cause a detonation to decay into a fast deflagration.

### Effect of Obstacles

The effects of obstacles on DDT can be classified into four regimes:

- Quenching regime - the flame extinguishes as it passes over the obstacles, due to rapid entrainment and mixing;
- Choking regime - quasi-steady propagation at 600-1,000 m/s;
- Quasi-detonation regime - DDT occurs, velocity > 1,000 m/s but less than CJ velocity;
- Steady state detonation regime - with sensitive mixtures, obstacles have no effect and a steady CJ detonation develops.

### Effect of Vents

Carefully designed venting can prevent transition to detonation by relieving the pressure.

However, once a detonation is established in a confined volume, venting will not reduce the explosion pressure.

**Where only limited venting is provided, vents can act like obstacles and induce turbulence.** For example, in large scale tests using hydrogen/air mixtures, the flame speeds and overpressures were higher than for the unvented case when a small amount (13%) of top venting was used with a rich mixture (>18% hydrogen). However, flame speeds and overpressures were lower for leaner mixtures. It was also found that obstacles can negate the effects of even very large vents in sufficiently sensitive mixtures. Where obstacles were absent, a large amount of top venting (50%) **did** suppress DDT and reduce the overpressure.

### Direct initiation of detonation

This is where a mixture is ignited, for example by a solid explosive or an extremely energetic spark and, due to the strong blast source, forms a detonation without any intervening deflagration phase. In practice, detonation tends to occur in gases/vapours by DDT, and direct initiation is unlikely in typical industrial situations.

## 4. DETONATIONS IN UNCONFINED VAPOUR CLOUDS

If a **deflagration** propagates from an obstacle filled region into an unconfined and unobstructed area, the flame front will usually

decelerate and the explosion pressure will decrease. However, in a similar situation a **detonation** emerging from the confined region may propagate unabated into the unobstructed area, resulting in even the unconfined parts of the gas cloud generating very high explosion pressures. An exception may be if a detonation emerges from a pipe, where the critical conditions for propagation apply.

The Port Hudson incident was the only example of an incident in which a detonation **may** have occurred in an unconfined vapour cloud in air, although the valley may have provided a degree of confinement.

The detonation limits of unconfined mixtures are narrower than those measured in the smallest tubes. There is little information available on specific detonation limits of unconfined mixtures, due to the source energies and test volumes of mixtures required to carry out the tests.

Bull (in "Concentration limits to the initiation of unconfined detonations in fuel/air mixtures", 1979) has collated data on the critical energies required (using a solid explosive initiator) to establish steady detonation in unconfined clouds of common fuel/air mixtures.

There is a technique ("Gaseous detonations", MA Nettleton, Chapman and Hall, 1987) for estimating the minimum cloud diameter needed for detonation. Evidence from incidents suggests that this is at least 50 m for a relatively low energy ignition source such as a spark.

There are theories which attempt to model the acceleration of an unconfined flame front.

## 5. DAMAGE CAUSED BY DETONATIONS

The theoretical CJ and peak pressures can be calculated using equations, or more accurately using an appropriate numerical calculation procedure using real gas thermodynamics. Munday (in "Detonations in vessels and pipelines", 1971) suggests that **the maximum values achieved in practice could be twice these values**, due to the combined effects of high sustained pressure and shock loading.

Pressures increase significantly when a detonation reflects off a solid wall. For example, for ethylene/air the peak pressure increases instantaneously from approximately 18 bar to 45 bar.

There is no general theoretical treatment of the interaction of a detonation wave with confinement. Even a simplified theory can only deal with the diffraction of a shock by an isolated wall. In more complex systems, the interactions of the various reflected wave systems make analysis extremely difficult, and there are many discrepancies between predicted and observed phenomena.

The dynamic load of a detonation inside a vessel is a combination of a constant, high intensity "running load" and a transient impact load. The running load can be withstood by comparatively weak structures. The transient impact can be up to 100 times the initial pressure, but has a very short duration. **Both peak pressure and overall impulse must be included when considering the failure potential of vessels and other structures.**

Detonation can produce large numbers of small fragments due to brittle failure, however large distorted and twisted fragments can be produced if the vessel is sufficiently strong.

Another typical sign is balls missing from valves. Estimates of effective detonation pressures, based on measurements of deformation, can often vary by up to an order of magnitude. **It can be difficult to distinguish a detonation from a fast deflagration.**

As with blast waves, a detonation which occurs outside a vessel generates a so-called "diffraction load" and a "drag load". The diffraction load arises from the differential pressure across an object as the blast wave travels over it, the difference in pressure generating the loading. The drag load arises from the blast wind (ie the air movement caused by the explosion) exerting a load on the object.

### **Pipelines**

Experiments have shown that pipelines designed for a nominal pressure of 10 bar tend to rupture at the points where DDT occurs, but can withstand the steady-state detonation

pressure without rupturing. This is due to the short duration of the transient overpressure.

Failure of a pipeline can occur at fairly regularly spaced intervals due to galloping detonation. This is due to acceleration of the flame up to detonation, followed by the quenching of the unstable overdriven wave as the pipe fails. This process is repeated as the flame re-accelerates.

Frequently, failure occurs in regions such as bends and junctions, due to the high pressures generated by the partial reflection of the incident wave. Sometimes elbows can be missing. Damage is less severe for more gradually sweeping bends and junctions (ratio of radius of curvature to bore radius of at least five), because this helps to preserve the planar nature of the front as it propagates around the bend. The bend configuration has a critical effect on the point at which the maximum pressure is generated.

A detonation exerts tremendous stresses on the pipe mountings as well as on the pipe itself, and pipes typically bounce off their supports. Failure usually occurs because the supports are designed to carry the static pipe load, not severe internal transient pressures.

### **Deducing the trajectory that a detonation has taken through a plant**

Information on the trajectory that a detonation has taken through a plant can be obtained by metallurgical analysis of so-called Luders lines, which appear in steel that is stressed beyond its elastic limit, and the herringbone patterns associated with brittle failure. It is also possible to calculate the detonation trajectory from the positions of plant fragments, although this can involve a fair degree of uncertainty.

## **6. DETONATION MITIGATION**

There is a German standard on containment of detonations, which specifies a design pressure of 50 bar ("Technical regulations for flammable liquids: general safety requirements", TRbF100, July 1980, incorporating amendments and supplements to technical regulations for flammable liquids (TRbF) September, 1981, HSE Translation 16063I, July 2000). Enhanced pressure effects

could create transient pressures greatly in excess of this. However, if the characteristic response time of the vessel or key components is less than the duration of the potentially damaging overpressure, catastrophic failure may not occur. In some circumstances, finite element calculations may be appropriate although these are not that well validated.

Passive detonation arresters are used in many countries. There are many different designs. The arresting element can be similar to those used in deflagration arresters, but the element has to be stronger or more rigidly held to withstand the higher pressures generated by detonations. Drawbacks are the back-pressure created, and the potential for blockage.

Active detonation arresters are systems that detect the propagating flame front and activate suitably located rapid isolation valves and pressurised suppressor canisters (see Fig 2). The rapid acting valves close in 20-40 ms, and suppressors activate within 10-20 ms.

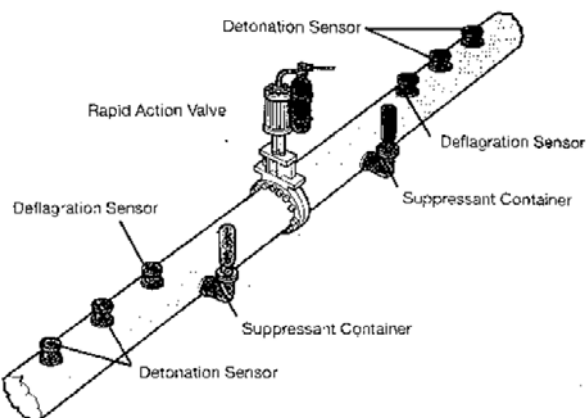


Fig.2 Active Detonation Arrester System

They rely on sophisticated ancillary electronic systems. Often, suppressors are located ahead of the valves to reduce the potential for deformation of the valve plate when the detonation shock wave hits it. Venting may also be needed. It is not possible to rely on venting alone to successfully mitigate a detonation.

For partially confined explosions, conventional water spray deluge systems have been shown to be capable of providing beneficial effects against fast deflagrations.

## 7. OTHER ASPECTS OF DETONATIONS

### Gases and Vapours that are Detonable in the Absence of an Oxidant.

These include gaseous acetylene, ethylene at pressures above approximately 69 bar, ozone and hydrogen peroxide, various azides, chlorine dioxide and nitric oxide. Other materials which are detonable under certain conditions include diazomethane, ethylene oxide (but not propylene oxide), possibly butadiene, cyanogen, propargyl bromide, vinyl acetylene and possibly hydrides of boron. Each material has a minimum pressure needed for sustainable detonation.

There are no recorded well-authenticated examples of detonations in these types of self-decomposing materials in the absence of confinement.

### Detonations in Dusts

There are few, if any, examples of a powder detonation in an industrial situation. Typical conditions in which a dust detonation could occur are long (several hundred metres), wide lines such as in pulverised fuel power plants. It is much more difficult to detonate a powder than a gas, and run up distances for powders are much larger. Li states ("An experimental study of deflagration to detonation transition supported by dust layers", *Combustion and Flame*, Vol 100, 1995) that, in some cases, transition to detonation has occurred in the secondary explosion of accumulated dust, and that the  $K_{st}$  value is not a reliable indicator of detonability.

Confined clouds of aluminium powder in oxygen (possibly also unconfined), coal dust in oxygen and probably corn dust in air or oxygen can run up to detonation. DDT is more likely with finer powders approaching 10 m diameter. Bartknecht states (in "Explosions - course, prevention, protection", Springer-Verlag, 1980) that, in pipes between 20 m and 40 m long, and dusts with  $K_{st}$  values greater than 200 bar m/s (eg polyethylene, wood, aluminum), a deflagration can run up to a detonation. Similar pressures are generated to those from gas explosions, and the detonation velocity can vary widely but averages 2,000 m/s. It has not been established whether these events are true stable detonations or quasi-



detonations. Detonations occur more readily in narrow pipes, but a greater run-up distance is required than for gases with comparable  $K_{st}$  values.

There is some evidence that the addition of flammable gas, in amounts well below the lower flammable limit, can convert a non-detonable mixture to a detonable one.

Fangrat et al (in "Detonation structure in organic dust-oxygen mixtures", Archivum Combustionis, Vol 7, 1987) carried out experiments on dust/oxygen mixtures with a "weak" ignition source. Detonation velocities of 1,550-2,160 m/s were recorded.

#### Detonations in Mists

Mists (typical droplet diameter <10 $\mu$ m) can be detonable under confined conditions, although it is much more difficult to detonate a mist than a gas, and run-up distances for mists are much larger. In oxygen, hydrocarbon droplet with diameters upwards of 1 mm can be detonable. Mist detonation velocities can be up to 50% lower than the CJ value, hence the detonation pressure tends to be lower than for gases.

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## 2. MANAGEMENT

„EFFICIENCY OF MANAGEMENT IN MILITARY ORGANISATION”, <b>Claudio Edmon APOSTOL, Simona Florentina CREANGĂ</b>	124
„COMPARATIVE ASPECTS CONCERNING GERMANY AND JAPAN’ LOGISTICS” , <b>Dorel BADEA, Daniela COSMA</b>	131
„QUANTITATIVE ANALYSIS OF RISK-APPLIED IN THE MILITARY STRATEGY”, <b>Liviu-Stelian BEGU, Lidia MÂNDRU</b>	137
„THE FOUNDATION OF PERFORMANCE ASSESMENT – A WAY TO BRING SUCCES IN PRIVATE LIFE AND IN ORGANISATION DEVELOPMENT”, <b>Daniela BELU</b>	139
„THE FOUNDATION OF PERFORMANCE ASSESMENT – I. FEELING GOOD WITH YOUR SELF – A PROBLEM OF SPEAKING AND THINKING ACCORDING TO YOUR DEEDS”, <b>Daniela BELU</b>	148
„VOLUNTEERISM INVOLVEMENT OF CIVILIANS IN EMERGENCY SITUATIONS”, <b>Ana-Maria CAZAN, Ramona HENTER, Ecaterina UNIANU</b>	152
„THE EFFICIENCY OF MANAGERIAL COMMUNICATION IN ROMANIAN CREDIT INSTITUTIONS”, <b>Liliana Aurora CONSTANTINESCU, Camelia STEFANESCU</b>	158
„POINTS OF VIEWS CONCERNING THE BUILDING OF THEORETICAL FOUNDATION FOR A MILITARY LEARNING-ORIENTED KNOWLEDGE MANAGEMENT SYSTEM”, <b>Daniela COSMA, Dorel BADEA</b>	164
„GUIDELINES FOR MANAGEMENT OF QUALITY IN THE EUROPEAN HIGHER EDUCATION”, <b>Roxana ENACHE</b>	169
“ANALICALS ELEMENTS OF CUSTOMER SATISFACTION MANAGEMENT”, <b>Titus - Mircea FAUR</b>	174
„GEOPOLITICS - BETWEEN BLACK AND WHITE”, <b>Florin Eduard GROSARU</b>	179
„SOME ASPECTS OF THE DEVELOPMENT OF ENTREPRENEURSHIP CONCEPT”, <b>Ionica HOLBAN (ONCIOIU), Florin Razvan ONCIOIU</b>	183
„MOTIVATION AND REACTION TIME IN THE DECISIONAL PROCESS. INTELLECTUAL TRAINING – INCREASING THE EFFICIENCY AND EFFECTIVENESS OF DECISIONS”, <b>Elena-Simona INDREICA, Camelia TRUȚA</b>	187
„THE EUROPEAN ENVIRONMENT POLICY’S IMPACT ON ROMANIA”, <b>Romeo IONESCU</b>	191
„THE CHALLENGES OF THE COMMON TRANSPORT POLICY IN EUROPE”, <b>Romeo IONESCU</b>	196
„SAGGING AND INDUCED STRESS OF THE LIGHT-GAUGE SHEET SUBMITTED TO THE EXPANSION PROCESS”, <b>Laurentiu JITARU, Gabriela CRISTESCU</b>	203
„A FLEXIBLE TOOL MANAGEMENT STRATEGY FOR THE ADAPTIVE TOOL DEMAND RATE SIMULATION ANALYSIS”, <b>Camelia LIXANDRU, Traian GRĂMESCU</b>	207
„THE KONDRATIEFF WAVES AND THE ECONOMIC CYCLE”, <b>Ioana LOGOJAN</b>	212
„MATERIALS MANAGEMENT UTILIZING AUTOMATHICAL IDENTIFICATION TECHNOLOGIES”, <b>Virgil LUCANU, Tudor RISTOIU, Sorin LAZĂR</b>	218
„SOME ASPECTS ABOUT THE TOTAL QUALITY MANAGEMENT CONCEPT”, <b>Ioan MILOȘAN</b>	222
„MANAGER AND THE BURNOUT SYNDROME”, <b>Jaroslav NEKORANEC, Ivan VLČEK</b>	226

„MANAGING STRATEGIC RISK”, <b>Noris NICA</b>	<b>232</b>
„ASPECTS REGARDING ACTIONS OF THE OMUNITY POLICE IN CRISIS SITUATIONS. METHODS, TECHNIQUES AND MEANS OF ACTION”, <b>Ene NICOLAE</b>	<b>240</b>
„OPINIONS AND GROUNDS REGARDING THE ROLE OF COMUNITY POLICE IN DETERRING TERRORIST ACTIONS FROM PRECURSORY STAGE AND DURING TIMES OF SOCIAL CRISIS”, <b>Ene NICOLAE</b>	<b>248</b>
“THE NECESSITY OF CHANGES IN THE STRUCTURE OF FIRM CAPITALIZATION TO OVERCOME THE FINANCIAL CRISIS”, <b>Daniela OBREJA</b>	<b>254</b>
„CONSIDERATIONS FOR ENERGY MANAGEMENT IN FUTURE”, <b>Stelian PÂNZARU</b>	<b>260</b>
„NATO - CRISIS MANAGEMENT”, <b>Ilie PĂUN, Dorin TOHĂNEAN</b>	<b>265</b>
“AN EXAMPLE OF EXPERT SYSTEM USED IN ECONOMICAL FIELD”, <b>Elia PETRE, Florentina CHIRCU</b>	<b>281</b>
„MANAGEMENT CONFLICTS WITHIN THE INSTITUTIONS OF PUBLIC ADMINISTRATION”, <b>Ion PETRESCU, Stelian PÂNZARU</b>	<b>285</b>
„ESSENTIAL ISSUES IN APPLYING AUDIT STRATEGY”, <b>Ana PISLEAG</b>	<b>291</b>
„ENERGETICS STRATEGY OF ROMANIA IN THE FOLLOWING DECADE”, <b>Simona POPA, Mihaela CIOPI OPREA</b>	<b>296</b>
„THE IMPACT OF THE CURRENT GLOBAL FINANCIAL CRISIS ON THE FINANCIAL SYSTEM”, <b>Laura POPA, Camelia STEFANESCU</b>	<b>300</b>
„THE NECESSITY OF THE FORESIGHT ACTIVITY IN THE TROPICAL CONTEXT”, <b>Simona POPA, Mihaela CIOPI OPREA</b>	<b>304</b>
„LEAN, A MANAGEMENT TOOL, USED FOR HAVE AN COMPETITIVE PRODUCTION SYSTEM”, <b>Mariana C. RĂȘINĂ</b>	<b>308</b>
„MANAGEMENT AND COMPETITIVENESS OF PRODUCTION SYSTEMS, WITH THE PARTICULARITY OF PRODUCING MOLDS”, <b>Mariana C. RĂȘINĂ</b>	<b>314</b>
„FINANCIAL CRISIS, MORAL CRISIS OR SYSTEM CRISIS? IT IS POSSIBLE A CRISIS MANAGEMENT?”, <b>Marian RIZEA, Cristiana NEAMTU-RIZEA</b>	<b>320</b>
„INFORMATION MANAGEMENT AND CRITICAL INFRASTRUCTURES PROTECTION”, <b>Marian RIZEA, Daniela ENACHESCU</b>	<b>324</b>
„IMPLICATIONS OF THE SUSTAINABLE DEVELOPMENT FOR CONSUMERS BEHAVIOUR”, <b>Violeta SIMA</b>	<b>328</b>
„POSSIBILITIES FOR GROWTH OF THE ROMANIAN FIRMS COMPETITIVENESS BY BENCHMARKING METHODOLOGIES APPLICATION”, <b>Violeta SIMA, Ileana Georgiana GHEORGHE</b>	<b>335</b>
“INCREASING THE PRODUCTION QUALITY AS A RESULT OF CONSTRAINTS IMPOSED TO THE SUPPLIERS”, <b>Sorin-Dumitru ȘÎRBU</b>	<b>341</b>
„APPLICATION NEW TRENDS OF MANAGEMENT DEVELOPMENT TO MILITARY EDUCATION”, <b>Milan SOPÓCI, Pavel NEČAS</b>	<b>354</b>
„ETHICAL DIMENSIONS ON HACKING ISSUES”, <b>Alexandru STEFAN</b>	<b>351</b>
„LOGISTIC MANAGEMENT OF NATO RESPONSE FORCE OPERATION”, <b>Dorin TOHĂNEAN, Ilie PĂUN</b>	<b>358</b>
„REPRESENTATIONS ON THE MILITARY ENVIRONMENT”, <b>Camelia TRUȚA, Simona INDREICA, Ana-Maria CAZAN</b>	<b>365</b>

## EFFICIENCY OF MANAGEMENT IN MILITARY ORGANISATION

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**Abstract:** *The "military management" term has not been defined fully and comprehensively. The scientific literature defines it as only the "management of troops," which is not quite right, as the "military management" is a much wider category. To reveal the term under discussion, great importance is attached to the definition of its components, that is "military" and "management."*

*The "management" term was born and recognized as a generic category to characterize systematization of interaction of a certain number of elements or components of Nature, Society and Person.*

*The management term is used to define a kind of human activity intended to influence people, objects and activity processes deliberately and purposefully. Management is required when and where it is necessary to distribute and coordinate activities of a number of people.*

**Key word:** *military management, efficiency, influence, system.,*

The scientific literature subdivides management into different kinds according to various grounds, such as: a sphere of social activity, a structure of social relations, objects of management, character and volume of managed social events, etc.

If management is recognized as an influence, which is determined by qualities of society, reason, subjective factor, power, then it is advisable to classify management according to subjects of management, which both form and realize managing influence, as well as bear responsibility for the consequences. To our mind it enables achieving proportion and accuracy to determine kinds of management. According to the subject of management it is possible to determine six kinds, which are related to each other to a great extent: state management, where state is a subject; local management, which constitutes the lowest subdivision of state management; management, exercised by a proprietor (a owner, holder) to handle his property; social management, where institutionalized (legalized by laws, charters) social unions are a subject; group (collective) self-management, where groups of people, which control their behavior and joint activities in every step of social life freely

(according to their own views) but taking into account other people's interests and in accordance with the norms of culture and social coexistence are a subject; expedient behavior or action of a human being.

The analysis of the features characterizing a kind of management enables us to consider the state management to be a special kind of management. The following features of the state management stipulate it: the state power, the reference to the whole society and systematization. Managing influence under the state management is based on the state power, which supports and supplies it. The state management is a practical, organizing and controlling influence of the state (exercised by a system of its structures) on social and private activities of people in order to regulate, preserve or reform them based on its legal power. The "military" adjective is the second component of the "military management" term. It evokes everything associated with war and army, related with war and army. It is an essential feature, which helps us to distinguish military management from management in other spheres of human activity. We can be quite sure to assume that military management is applied to that part of society which is subject for planned or actual influence

exercised by the military management organs which constitute management subject in the military organization of the state.

The Supreme Commander-in-Chief, Defense Minister and military management organs of different levels are a subject of management in the military organization, and major part of the state military organization is an object of management in the conditions of peace. Under martial law or conditions of war, the whole of the military organization and other defense activity spheres where military management methods are applied, is to be an object of management.

Under conditions of peace it is fully referred to that part of the military organization of the state where the military service exists, the managing activity of the military management organs uses directive form of management, exercises the right to implementation of arms, military and special equipment to accomplish the missions defined by the Federal Law.

Under martial law or at wartime the sphere of military management is to be expanded by endowing the Armed Forces Supreme Commander-in-Chief and other military management organs with additional powers to use the Armed Forces; by introducing the martial law in the whole territory of Russia or in some of its parts; by announcing complete or partial mobilization; by introducing legislature of war time and its suspension; by forming and abolishing wartime military management organs. These powers are of temporary nature. Considering this fact, population, territory, economics, the whole system of social relations and institutions, which are organized in order to provide military security and defense of the country, can also constitute the object of management.

The "state management of the defense sphere" term can as well include management objects related to war and army but not covered.

We think the state management of the defense sphere consists of the expedient activity of the President of the Russian Federation, the Government of the Russian Federation and other state management organization in order to build up, prepare and

implement the military organization of the state, to organize its equipment with arms, military and special, to provide material resources and services, as well as to direct the Armed Forces and other forces activities when accomplishing the missions.

This definition of the state management of the defense sphere fully enables us to assert that military management is a specific kind of the state management. The fact that the military management possesses all the three qualities of the state management proves it.

The following qualities of this kind of the state management make it specific: military service, arms, military and special equipment and the right to their implementation to accomplish missions defined by the Federal Law. It enhances the practical side of the military activity to solve the organization and management problems of the military build-up, to provide its functioning under conditions of both war and peace and implementing in order to provide military security and defense of the country.

Being both an element and a function of a compound system of the military organization of the state, the military management is intended to form and exercise constant managing influence activities by the military management organs on all its subsystems (elements), which provides relevance to their designation and military security and defense of the country.

Military management being part of the military organization (military management system) depends on composition and structure of the military organization and consists of a number levels. To describe various aspects of the military management system it is necessary to determine the interface between the subject of military management (military management organs) and the managed object (managed objects of the military organization). As part of the military management system military management organs specially formed by the state determine the state-power character and mostly special legal form of managing influence of the elements of the military organization. This system gives privilege to the management subject, and the managed objects are to accept its decisions, actions and

transform them in the process of their own functioning.

Military management system has a number of levels. Namely: strategic (the highest, i.e. state, federal); operational-strategic (regional, territorial); operational and operational-tactical. Military management as a function is a continuous process of developing and realizing managing influence aimed at creation, operation and employment of military organization of the State.

The main goal of military management is to determine structure, composition, strength and support of military organization and its every element; to keep or change the achieved level of its status in accordance with mission and tasks to be accomplished; to regulate and keep activities mode; to transform timely its elements into a new position in accordance with the development and changes of the military-political and military-strategic situation.

Military management is designed mainly to determine missions and tasks of the development, functioning, training and employment of the state military organization and its elements; to exercise the whole range of authorities and functions of management in accordance with the state Law under conditions of war and peace.

Hence, it is evident that the idea of the military management is an execution of the expedient activities by the Supreme Commander-in-Chief and military management organs in order to build up and improve the state military organization, to overwhelmingly provide its functioning, to organize training and employment of the Armed Forces in accordance with their designation, as well as to direct the Armed Forces and other forces, military units and bodies to provide military security and defense of the country in accordance with the Federal legislature.

To give the theory of the military management a status of an independent branch of science, it is required to determine its role and place in the system of sciences, its object and perspectives of investigation, forms and methods of analysis.

Due to complex and diversity of management rules and armed struggle laws, complication of military build-up leadership and military organization training, functioning and many other factors, the theory of the military management has gained a status of a relatively independent branch of knowledge which combines achievements of many sciences, especially the science of management.

The lack of fundamental, integral theory of military management has remained one of the main problems of the military management. The contemporary stage of the development of the military science demonstrates the first steps of the theory of the military management as an independent branch of knowledge, which requires its own fundamental and applied aspects. Being part of the military art, the theory of the military management takes advantage of the achievements in the art of management.

To define the object of the military management theory, it is necessary to reveal its essence, idea and contents, to comprehend the designation of the military management system, which exercises managing influence.

To deal with these problems the theory of the military management is to work out scientifically proved practical recommendations based on objective laws and tendencies of management, the latest achievements of adjacent sciences and theories, the art of management first of all.

The main point is to discover and make reasonable use of functioning mechanisms of these laws and tendencies in different spheres of the military management, to work out and to implement scientifically proved principles of the military management.

Military management systems and their activities constitute an object of the military management theory.

The contemporary stage of the development of the military management theory demonstrates a complex of scientific statements which describe the main categories and definitions, tendencies and principles of management and the results of investigation of theoretical and practical functioning of the military organization and its components,

gives recommendations to effectively exercise management activities, to create and improve the military management systems.

But an integral theory of the military management as is required today, has been worked out in full yet.

At the stage of formation the military management theory takes advantage of the achievements of the main theories of the management art and other sciences taking into account the fact that it is practiced in armed struggle. But it wouldn't be correct to suppose that the military management theory only compiles facts of different branches of other sciences. The military management theory is connected with other sciences dialectically. Creatively implementing the achievements of other sciences, the military management theory is simultaneously aimed at solving new problems of management of the military organization elements both under conditions of peace and war.

Cognition and prognostication are the primary functions of the military management theory.

The cognitive function of the military management theory presumes to discover the essence and contents, the main categories and terms of the military management; to reveal and explain the main laws and tendencies of the military management; to describe and explain the main qualities and correlations of the components of the object at all historic stages of its formation and development; to prove the organizational structure of the military management system and its subsystems; to define the contents and stages of the organization of the military management system as a whole and of its each subsystem and level; to investigate the existing controversies in the military management and to work out recommendations to neutralize their negative consequences. The cognitive function of the military management theory is comprehensive and limitless like cognition itself.

The prognosticative function of the military management theory presumes to define and prognosticate tendencies and perspectives of further development of the military management processes and systems,

organizational forms and methods of the management, to forecast the emergence of new processes and phenomena in the management, to predict well in advance the occurrence of the military management problems, to find the possible ways of solving them beforehand. By accomplishing its cognitive function the contemporary theory of the military management strives to create a well-proportioned system of categories and terms, which must correlate and make up one chain.

The art of cognition presumes the ability to handle categories and terms. Categories and terms help to analyze the spheres of professional activity and constitute a language for communication. Knowledge of the categories and terms, art of handling them make up the cognition basis for the military management theory.

The categories of the military management theory compose its specific scientific language. It helps to determine clearly the essence of the management laws and tendencies, as well as the mechanisms of their functioning in the practice of the management activity, to formulate the principles of the management, to analyze the current status and perspectives of the development of the management bodies and means, to investigate the structure and methods of functioning systems of the military management, to evaluate their efficiency. They are used to connect the military management theory with other sciences.

There are categories and terms that need constant and grounded definitions. Among them are: the essence and contents of the military management, the essence and contents of the Armed Forces management, the essence and contents of the troops command and control, the system of the military management, the system of the Armed Forces management, the system of the troops command and control, the management activity, the management organization, the goal of the management, the missions of the management, the functions of the management, the methods of the management, etc.

The Armed Forces Management is designed to provide expedient activity of the

chief military command aimed at realizing the decisions of the Supreme Commander-in-Chief and the federal authorities to build-up and develop the Armed Forces, to provide their comprehensive combat readiness, to support all kinds of armed forces, to ensure leadership of the troops (forces) accomplishing missions in accordance with their designation under the conditions of peace, menace and during combat operations.

The Armed Forces Management (management activity) presumes to determine the aims and tasks of the management, to achieve consistency in their accomplishment by fulfilling concrete functions of the management, to implement reasonable management methods and to follow legal principles of the management.

Being the primary part of the management, the armed Forces management presumes organizational and executive activities of the Supreme Commander-in-Chief and the federal authorities to build-up and develop the Armed Forces, to provide their comprehensive functioning and training, to maintain their combat readiness for accomplishing designed missions under the conditions of peace. At war it presumes organizational and executive activities of the highest military-political and military-strategic authorities of the Russian Federation to direct the strategic activity of the Armed Forces and accomplishment of the missions in accordance with the plan of the Armed Forces employment and the decisions of the Supreme Commander-in-Chief.

The troops command and control presumes expedient activity of the commanders, headquarters and other bodies to maintain constant combat and mobilization readiness of the troops, to work out operations (combat actions) and to lead the accomplishment of the assigned missions by the troops (forces).

The troops command and control (management activity of the military management bodies) presumes to determine aims and tasks of the management, to achieve consistency in their accomplishment by fulfilling concrete legally assigned functions of the management.

The management of all components of the military organization is subjected to the

general laws and tendencies, has common categories, but at the same time the management of each element of the military organization has its peculiarities.

The structure of the military management theory has a basis, which is common for its components (theories of the management of separate elements of the military organization - the Armed Forces and their components, other troops, military formations and bodies).

It is composed of: the theory of the Russian Federation Armed Forces Management; the theory of the Russian Federation Armed Forces branches Management; the theory of the troops (forces) management; the theory of management of other components of the military organization.

The necessity of analyzing independent branches of the management is caused by investigating new tendencies reflecting the essence of the systems of higher levels, their aims, criteria, missions and functions. The tendencies and principles of the lower levels keep functioning in every component (subsystem) of a new system, but new tendencies reflecting correlation in the whole system acquire prevalence.

The military management theory is based on the following: categories and terms describing and revealing the essence, contents and peculiarity of the military management; laws, tendencies and principles of the military management; principles and methods of the leadership of build-up, training and employment of the state military organization, of operational equipment of the country territory, of equipment with armament, military and special material, of supply with material resources and services; principles and methods of the military management to maintain the forces combat readiness, to work out operations (combat actions) and to lead the accomplishment of the missions by the troops; principles and methods of organizing management systems, ways of their deployment and improvement; missions, functions, rights and responsibilities of the military management bodies, the adequate level of the personnel training; essence and principles of the management activity



organization; methods of evaluating the management efficiency.

There is another urgent problem to solve. Besides defining the basic norms of the military management theory, primary categories and terms, it is vital to work out well recognized definitions of the Russian Federation Armed Forces management theory, the Armed forces branches management theory, the management theory of other elements of the military organization.

Some of the terms of the management theory can be defined as follows:

The Russian Federation Armed Forces management theory is a system of scientific knowledge about the laws and principles of the management, the system, organizational forms and methods of the leadership of the Armed Forces at war and in peace. It comprises the theoretical basis and scientifically proved recommendations for the Supreme Commander-in-Chief, Defense Minister and military management central bodies how to direct the Armed Forces build-up and development, their comprehensive training and preparation for employment, to maintain combat and mobilization readiness of the troops (forces) at the adequate level and to provide comprehensive support, leadership of the mission accomplishment by the troops (forces) in accordance with their designation under the conditions of peace, menace and during the combat operations. It investigates the management processes and organizational structure, functioning and training level of the personnel of the Armed Forces military management central bodies in order to comply with their missions and designation.

Management are independent systems of scientific knowledge about the laws and principles of the management, the system, organizational forms and methods of the leadership of the Armed Forces branch at war and in peace. In accordance with peculiarities of an Armed forces branch they comprise theoretical basis and scientifically proved recommendations how to lead troops, forces, means and armaments assigned to them. They also investigate the organizational structure and functioning of the management bodies and other elements of management system of the

troops, forces, means and armaments in order to achieve the most efficient accomplishment of combat and special missions, as well as the objective correlations between the subject and the object of the management in the process of management of their routine activity, the adequate level of personnel training.

The troops (forces) management theory as the most well-developed one, is an independent system of scientific knowledge about the laws and principles of the management, the system, organizational forms and methods of the leadership of troops at war and in peace. It is composed of theoretical basis and scientifically proved recommendations for the military management bodies how to maintain combat and mobilization readiness of the troops, to work out operations and to perform leadership of the mission accomplishment by the troops (forces) at war and in peace. It investigates the process of management, the organizational structure and functioning of the management bodies and other elements of management system of the troops, forces, means and armaments in order to achieve the most efficient accomplishment of combat and special missions.

Similar to any other scientific theory, the military management theory investigates and analyzes its object from different, but correlated aspects.

The main aspects, which form a basis for investigating and analyzing the military management, are the following: political, organizational, economic, technical, social, psychological, legal and military itself.

## **CONCLUSION**

Thus, the military management theory is a system of scientific knowledge about the laws, tendencies and principles of the management, systems, organizational forms and methods of the management of the military organization as a whole and its elements. It includes the theoretical basis and scientifically proved recommendations how to lead and direct all spheres of the military organization, to lead the Armed Forces and troops (forces) at war and peace in order to achieve the most efficient accomplishment of the assigned missions by

the forces (troops), investigates the organizational structure of the military organization, the Armed Forces and troops (forces), determines the missions, functions, rights and responsibilities of the military management bodies, organization and methods of expedient activity in the process of their functioning, the adequate level of personnel training

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## COMPARATIVE ASPECTS CONCERNING GERMANY AND JAPAN' LOGISTICS

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*Abstract: Logistics is an integral part of our every day life. Today it influences more than ever a large number of human and economic activities. In a context of deep global competition, the optimization of logistics systems is more than inescapable. Effective logistics management requires good decision making in a wide variety of fields. We need to know how made the others from our aria (logistics). In this purpose, comparative studies of the dynamics of logistics management can be more than useful.*

**Key words:** logistics, comparative studies, intralogistics, green logistics

### What is logistics?

Logistics is the management which synchronizes such providing actions as procurement, production, sales, and distribution with demands. It aims to enhance corporate competitiveness and increase corporate value by realizing fulfillment of customers' satisfaction, cutback of unprofitable inventory and minimization of its transfer, and reduction of supply costs. To achieve those objectives mentioned above, collaboration of companies concerned is essential and development of logistics using supply chains is strongly required. Such providing actions as procurement, production, sales, and distribution were managed based on sector-specific evaluation indicators in the past. These optimum activities for individual sectors resulted in significant managerial losses including stock shortage, and excessive or bad inventory. Under the circumstances where synchronization of providing actions with trends for demands was required in order to eliminate such losses, logistics as management optimizing the entire providing actions developed. In logistics, all the providing actions function to synchronize with trends for demands. For management, logistics is required to contribute to gain in profits by cutting down supply costs, and the reduction of assets by lowering inventory. It is important to

assess it using ROA (Return On Assets) and/or others as the preliminary index/indexes. Accumulation of this kind of effort may establish such business models that could produce new demands from a logistics point of view.

### Logistics in Japan

In the past 50 years, Japan has evolved into an economic heavyweight and created a highly developed logistics system in spite of challenging geographic conditions. On one hand, such a system is necessary to offset the Japanese islands lack of raw materials. On the other hand, it is the foundation for expanding the positive growth of the export nation. Air transport, in particular, plays an important role here.

Japan's largest trade partner is the United States, with the highest export share and the second-highest import share. China, Korea, Australia and Indonesia also play a significant role [1]. The most important means of transport for freight in Japan are road transports and coastal shipping. The role of rail transports is almost non-existent. But this could change in the years ahead. Because harbor capacities on the West Coast

of the United States are limited, a portion of sea freight has been shifted to air transport in recent years. As a result of this shift, international air transports on trans-Pacific routes have climbed tremendously. Goods from other Asian countries are being increasingly imported by plane as well. Japan's ports are suffering from the effects of few investments in recent years, and they cannot compete with other harbors in Asia [2]. Compared with other industrial countries, Japan's distribution system is very complex. Most aspects of goods distribution in Japan are tightly regulated by the government. Joint distribution is typical - that is, competitors who make deliveries to the same businesses tend to use joint delivery capacities and trucks [3].

The logistics market in Japan has been extremely insular in the past. Today, though, it is opening up to international service providers. These providers are already successfully competing against Japanese companies in areas such as storage, distribution and complex contract logistics [2]. The postal market in Japan is the second largest in the world. Privatization has not yet occurred, but it is expected in the

near future. Despite decreasing growth rates, Japan remains an economic force in the Asia-Pacific region. The country's main manufacturing region lies in a triangle around the cities of Tokyo, Nagoya and Osaka on the island of Honshu. The heart of logistics activities is located here as well. In recent years, Japan's industry has focused more intensely on manufacturing in international locations. This has resulted in falling freight volume for Japanese logistics service providers. Faced simultaneously with stronger international competition, Japanese logistics service companies are trying to strengthen their position in sea, land and air transports by offering multimodal shipping provided by a single source. The most important domestic logistics service providers are Nippon Express, Yusen Air / Sea Service, Yamato Holdings and Sagawa Express [2]. International logistics service providers have expanded their position in Japan. Just about all international companies in the sector, including DHL, Schenker, UPS and FedEx, have invested in their Japanese networks in recent years [2].

In Japan was promoted Geen Logistics Comprehensive Programme (Fig.1)

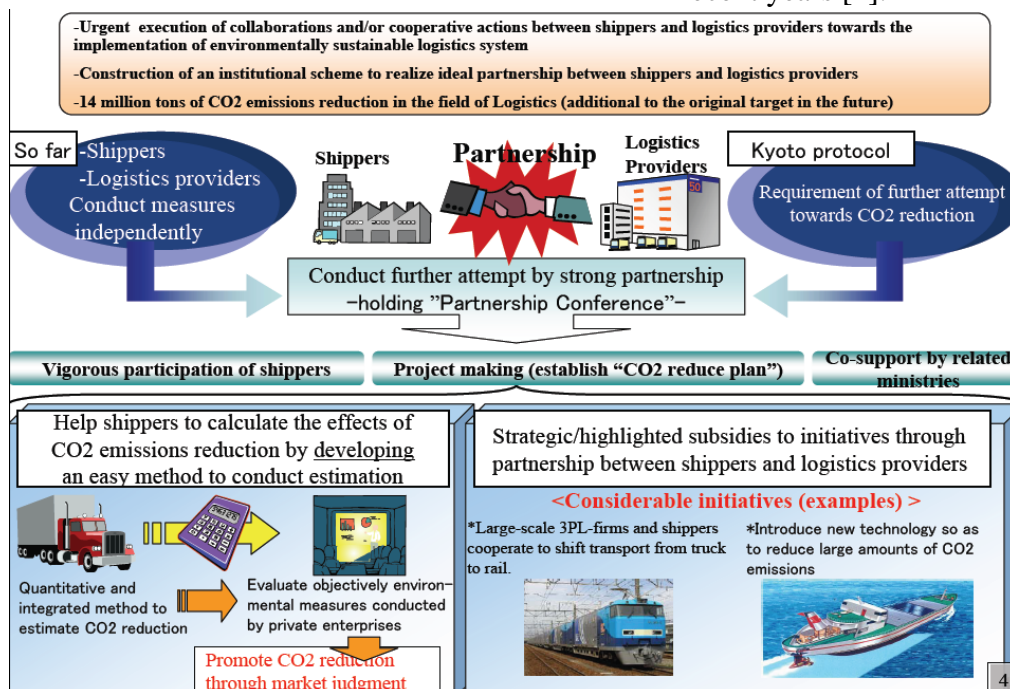


Fig. 1- Geen Logistics Comprehensive Programme

There are a lot of periodical publications on logistics in Japan. Monthly Logistics IT is the one that focus on ICT published since July 2000 by Unyu Shinbun Co., introducing various cases of logistics that make use of ICT. Logistics Information System Guide is also published annually by the company. Logistics studies in Japan are very important (Tab. 1).

According to a survey carried out by Nittsu Research Institute in August 2000, including 264 companies, 58% of companies, answered that logistics is not core competence of their companies. 20% said core competence, and 23% said they cannot conclude. In proportion to it, 52% of companies out of 153 companies answered they would like to outsource logistics and 41% said outsourcing is an interesting option. Only 6.5% said it is out of the question.

Accordingly, logistics divisions /affiliates of large corporations are seeking customers outside of their parent companies.

The Internet helps increase ASPs (Application Service Provider), thus facilitates SMEs to use IT at a low initial cost. According to a survey made by Sead Planning Co., 55 companies responded to the ASP-related questions. The results:

-ASP has just started and cannot forecast its future: Yes 50%, No 35%

-Japanese companies feel resistance to outsourcing: Yes 75%, No 15%

-ASP is suitable for eCommerce: Yes 45%, No 35%

- ASP will grow in a few years to come: Yes 90%, No 10%

**Tab. 1-Major researches in logistics.**

<b>Institutions</b>	<b>Fields</b>
Kanagawa University	<i>Chairman of Japan Society of Logistics Systems</i>
	<i>Application of Neuronal network and Fussy theory for various issues including logistics</i>
	<i>Logistics management</i>
Waseda University	<i>Leader of Neo Logistics study group</i>
	<i>Design of facilities and logistics</i>
Tokyo Institute of Technology	<i>Supply Chain Management</i>
Osaka Sangyo University	<i>Construction of logistics systems</i>
Tokyo University of Merchantile Marine	<i>Logistics engineering, Logistics sytem analysis, Logistics facility</i>
	<i>Increasing the accuracy of GPS</i>
	<i>Supply chains</i>
Hitotsubashi University	<i>Public systems especailly transportation and logistics</i>
Kyoto University	<i>City Logistics</i>
Nagoya University	<i>Simulation analysis of transportation-inventory system</i>
Ryutsu Keizai University	<i>Theory and practice of logistics systems</i>
Sophia University	<i>Supply Chain Management</i>
Nittsu Sogo Institute	<i>Theoretical approach to logistics</i>

I-mode is a very useful tool for e-logistics. Its application is growing very rapidly in logistics as well as e-business. Home delivery service has been well established in Japan, which gives a good infrastructure for the growth of B2C business, expanding the business from simple delivery to collect on delivery. International logistics is becoming more and more important. Integrated logistics covering foreign countries, connecting various means of transportation and different government and business procedures, constructed by means of ICT, is a key to success in global logistics business

### **Logistics in Germany**

Geographically, Germany is at the very heart of Europe – old and new. It's the continent's commercial hub, linking North and South, East and West. Germany shares borders with nine other European countries, making it the most "connected" state on the continent. North Sea ports facilitate brisk trade with the United Kingdom and Norway. And Baltic Sea shipping lanes carry cargo efficiently to the new EU states of Lithuania, Latvia and Estonia. The Benelux countries (Belgium, the Netherlands and Luxemburg) keep business booming on the western border. Looking south, Germany maintains strong commercial ties with France, Switzerland and Austria. Turning to the east, Germany has opened the gates to the fast-growing economies of central Europe. New EU members Poland (38 million consumers) and the Czech Republic are directly across the border. Just beyond lies Hungary, with Budapest only a 90-minute flight from Berlin. When it comes to European logistics, all roads lead to Germany.

When it comes to logistics, Germany is Europe's natural market leader. The EU's eastward enlargement has placed it at the very center of the European commercial map. Forty percent of all EU residents now live within a 500-kilometer radius of Germany. No other location can rival that for sheer logistical efficiency. Finally, while Germany is experiencing only modest economic growth in general, logistics-related sectors are leaping

ahead. Container traffic at ports in Bremen and Hamburg is picking up sharply as trade with the Baltic States expands.

With a volume of 150 billion euros, Germany's logistics industry constitutes a significant portion of the national economy. The sector, which includes about 60,000 companies, already accounts for 7.2 percent of German GDP, and it's growing faster than the economy as a whole.

Some 2.6 million people are now working in Germany's logistics industry. That's 7.9 percent of the entire labor force. And more jobs are being created in the sector every month. Analysts say logistics-related employment could expand in the country by as much as 20 percent. No other EU country even comes close to matching Germany in terms of market size. The logistics industry in France, Europe's second largest, is 50 billion € smaller. Contract logistics accounts for more than a third of the market in Germany, with the industrial segment out weighing consumer goods by a Logistics revenue by market segment (€bn)

Germany is a logistician's dream (fig. 2). Rightly famous for its engineering excellence, this is where the world finds innovative nuts-and-bolts solutions to satisfy its logistics needs. This is where machinery gets its logic, where technical skill is united with a quest for systematic efficiency. While these virtues characterize German engineering across the board, they are particularly pronounced in one fast-growing field: intralogistics. The term "intralogistics" describes everything involving internal logistics (including information flows) as opposed to external transport logistics. It concerns the management of material flows along the entire supply chain – from handling in the production process to distribution centers all the way to the point of purchase. Clients include industrial enterprises, wholesalers, retailers and government institutions.

Classification of occupations In the transport, storage, operatives sectors	Total employees	% of which in logistics	Logistics employees in absolute terms
Goods inspectors, sorting staff	167,113	100	167,113
Packaging and dispatch staff	306,312	100	306,312
Crane operators	22,396	80	17,916
Forwarding agents	108,034	100	108,034
Train drivers	43,968	20	8,794
Rail controllers	82,501	20	16,500
Other transport controllers, guards	23,786	20	4,757
Drivers	971,472	80	777,178
Inland waterway staff	7,966	90	7,169
Postal workers	136,466	7	9,553
Stock controllers, storekeepers	365,845	100	365,845
Transport machinery operators	74,749	80	59,799
Stevedores, removals staff	17,038	100	17,038
Warehouse and transport staff	564,353	100	564,353
Street cleaners, waste disposal staff	74,455	20	14,891
Air transport occupations	24,323	30	7,297
Wholesale and retail traders	579,229	30	173,769
Other goods movement occupations	3,085	15	463
<b>Total</b>	<b>3,573,091</b>		<b>2,626,780</b>

Source: Distel, Stefan, Vermessung der Logistik in Deutschland, PhD. Uni Nürnberg, Deutscher Verkehrs-Verlag Hamburg 2005, in print.

**Fig. 2-Logistics employee in Germany**

As sophisticated as it is broad, intralogistics encompasses manifold technologies across a range of logistics nodes. It incorporates lifting equipment manufacturers and warehouse technology firms, software developers and cutting-edge communications companies. Information technology plays an essential role. One can hardly overestimate the importance of intralogistics in Germany. To begin with, it's a critical part of operations for every major goods manufacturer. As in other countries, it's the backbone of business efficiency in supply and distribution. The need for this technology exists in all production-related industries from pharmaceuticals to cars and cosmetics. But if German industry is a major user of intralogistics, it's an even bigger producer. In 2003 Germany exported 7.5 billion euros worth of intralogistics technology, more than any other country in the world. Its closest competitor, Japan, exported just over half as much. The United States ranks third in this export segment. Within Europe, Germany controls roughly half the intralogistics market valued at more than 22 billion euros. France and England are the next most important players here.

Why perform a task yourself that others can tackle more efficiently? This classic outsourcing argument has become the driving force of the European logistics industry. Enterprises that formerly maintained their own inhouse shipping and receiving operations are now farming out that business to thirdparty specialists. Contract logistics is thus growing by leaps and bounds. Analysts reckon only 20 to 25 percent of the contract logistics market in Germany has been exploited so far. With the size of that market estimated at some 60 billion Euros, the business potential is obvious. The sector is expected to grow at an annual rate of 15 percent over the next few years. Growing confidence in contract logistics firms is reflected in the development of their creditworthiness. Banks have raised their ratings considerably, with bigger enterprises faring particularly well. The financial evidence is compelling: Compared to traditional freight companies, innovative logistics firms are performing much better in terms of both sales and return on capital.

Logistics is one of the key pillars of Germany's competitiveness as a business location, paving the way for added industrial value, the movement of goods and cooperation between companies. German logistics service providers enjoy a very sound international reputation. Their creativity, flexibility and know-how in the improvement of modern added-value processes are appreciated throughout the world. German innovations in logistics (particularly in telematics and navigation) are world class. Many scientific institutes in Germany are today working on the logistics innovations of tomorrow. And many universities and state higher technical colleges offer training and advance training programs in logistics.

### **Conclusion**

The main idea of this article isn't something new, but is a type who was little promoted in Romania. The Shinohara's dissertation explored (2006) a new field of study in the paradigms of logistics management and their evolution. General observations detected the existence of large differences of logistics practices between Europe and Japan, and that Japanese are apparently trying to tread the European path. Comparative studies were done on European and Japanese logistics management to find out what causes the differences and whether there can be a universal logistics paradigm to better manage expanding supply chains across borders. Empirical studies were done on the perceptions of practitioners in logistics. The study showed a typical bounded rationality of logistical decision makings, and revealed the fact that European logistics is mainly regulated by the paradigm of logicity and fairness, while Japanese logistics is by that of customer satisfaction and long-term relationship. The important finding was that the people on both sides had inner yearning for the opposite paradigm as a good catalyst

for better logistics management. Therefore, there will be simultaneous occurrence of Europeanisation of Japanese logistics management paradigm and the Japanisation of that of the European for the time being [4].

Cross-cultural management in logistics is a new area. In the field of logistics, the role of an intercultural perspective as a way of sensitising managers to cultural diversity and to the cross-cultural dimensions underlying business and organisational performance still seems incipient. Up to now, logistics management theories have concentrated on the technical and the organisational aspects of the subject, on the assumption that there is only one paradigm of the optimum logistics management. Operations and strategies are the main concern of the people as well as the computer systems to allow them to do more cost-effective and speedy management. However, human factor in logistics is as important as those elements when we give a thought to maintaining and improving the reliability of logistics in the total supply chains. Individual persons are different and separately bound by the cultures in which they have grown up or spent substantial period of time in their life.

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## QUANTITATIVE ANALYSIS OF RISK- APPLIED IN THE MILITARY STRATEGY

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### 1. INTRODUCTION

Quantitative analysis of risk represents one of the phases that have to be followed in order to evaluate risks that an organization may face while developing its business. This kind of analysis aims to numerical assessment of the probability and impact of each risk upon the organization's objectives.

For this purpose there are used several quantitative techniques such as the decision tree method and Monte Carlo simulation [1].

### 2. THE DECISION TREE METHOD

According to Project Management Institute, the decision tree is a diagram that describes the decisions took by the decider and the implications of choosing one or another of the available alternatives. It incorporates probabilities of risks to occur and the costs or rewards (benefits) of each logical path of events and future decisions [5].

By this method, there are represented random events and decisions, as the deciders perceive them.

For each probable future event (represented as a circle) is provided the action (represented as a square) that can be adopted by the decider, resulting a tree structure. Achieving a future event may involve the adoption of one or more paths to follow, the sum of the probabilities for these possible evolutions being equal to one [2].

The decisions are taken in conditions of uncertainty whereas the consequences of

choice depend on the probable events from the time 2, events to whom certain occurrence is not known exactly in time 1. Studies provide probabilities  $P(a)$  and  $P(b)$  for events  $E$  (with variants  $a$  and  $b$ ) to occur in time 2 (the sum of probabilities for each branch linked to a decision must be equal to 1 ( $P(a) + P(b) = 1$ ) [2]). Regardless of the choice made at this moment, the enterprise management will have to decide secondly in time 3 when it should opt for another alternative decision. The result of this second decision depends on the event in time 4 whose occurrence is uncertain in time 3. The three final consequences shall be denoted as  $r$ ,  $s$  and  $t$ . In case when in time 2, event „ $a$ ” took place, the probabilities to appear the consequences  $r$ ,  $s$  and  $t$  are  $p(r/a)$ ,  $p(s/a)$  and  $p(t/a)$ . If the event „ $b$ ” occurs, the probabilities will be  $p(r/b)$ ,  $p(s/b)$  and  $p(t/b)$  [4].

Therefore, applying the decision tree method, the decider may quantitatively evaluate the risk associated with each decision taken in conditions of uncertainty.

### 3. MONTE CARLO SIMULATION

Monte Carlo simulation represents a technique that performs a project simulation many times in order to calculate a distribution of likely results [5].

By this kind of simulation, risks associated with the events of a system under conditions of uncertainty may be evaluated. Typically, simulation techniques base on the development of a statistics and mathematics forecasting model. Experiments are conducted upon the built model since experimenting on a real model is too expensive or require a long time.

To understand how such a model can be build we shall illustrate a simple one related to investment appraisal and which shows a single relationship between two variables [6].

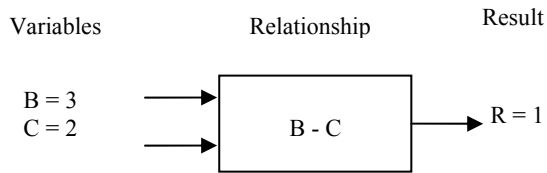


Fig. 2 Forecasting model [6]

where: B = Benefits  
C = Costs.

An efficient forecasting model has to include all relevant variables and to exclude all non-relevant ones using the correct relationships between them.

Within these experiments, questions of interest about business environment may get answers; i.e. the simulation model may reveal answers to “what if” questions (the so-called sensitivity analysis) [3].

To perform a simulation experiment, the following steps have to be taken:

- identify the problem which shall be the subject of experiment
- collect and process the primary data
- build the simulation model
- estimate the parameters for the analyzed system
- evaluate the system performances and test the parameters
- build the simulation algorithm
- validate the simulation algorithm
- plan and perform the simulation experiment
- analyze the data resulted from simulation
- take the decision regarding the analyzed system [1].

Applying Monte Carlo simulation before any real expenses offers the possibility not to incur substantial investment of human and financial resources until the preliminary

risk profile of the projects seems to be acceptable. This kind of simulation provides the necessary information that makes possible a more efficient allocation of resources and management of risk within the enterprise.

The study case of the paper is about the risk in the military strategy during the fight between two or more enemies.

Nevertheless, there are cases within the costs of risk analysis can be higher than the expected benefit likely to result with the help of this investigation and then such expense is not justified [6]. It is up to top management to decide which kind of expense to afford and which not.

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# THE FOUNDATION OF PERFORMANCE ASSESMENT – A WAY TO BRING SUCCES IN PRIVATE LIFE AND IN ORGANISATION DEVELOPMENT

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*Abstract (summary): : This paper has the purpose of transmitting information and ideas about the things that stand at the foundation of performance assesment destined to bring succes in private life and also in the organisation development. We find it oportune to emphasize the competence of young military students (future officers in the Infantry and Air Force) and civilians (future doctors) regarding the competence of applying ethics into management (reflecting emotional intelligence in dominating their own negative emotions and transmiting positive emotions to the others). We used as a measuring system the indicator: the Machiavellian attitude (the inclination to manipulate the others)..*

## INTRODUCTION

### I. Feeling good with your self – a problem of speaking and thinking according to your deeds

Whether we are or are not yet willing to admit, this is not about mere theoretical difficulties in the study of the phenomena specific of the management science, which might appear in the context of the scientific managerial practise when we approach such issues as:

1. **The issue related to the construction of the moral judgements** (the imperative need to apply, construct, update and re-apply the ethical codes in organizations);
2. **The frequent and sometimes intentional confusions between opinion and scientific fact** (the need to replace autocracy by authoritarianism);
3. **The mistaken use of the scientific information by Machiavellian or uninformed bosses** (the painful need to use the job specification and the individual performance assesment report in tandem as dynamic instruments);
4. **The issue of the risk of a too great closeness to the organizational evil**

(individual/group) **when the bosses get too close to look into the organizational evil.** There is no doubt that by avoiding or, on the contrary, tackling directly such issues as those mentioned hereinabove, these difficulties might make the bosses in an organization become the victims of the present.

The measuring instrument is an adapted version<sup>1</sup> of the Mach VI Scale test by Richard Christie and Florence Geis, which was first published in 1990 in "Studies in Machiavellism", New York, Academic Press.

We established three samples of 12 subjects each:

- SAMPLE 1 made up of infantry students,
- SAMPLE 2 made up of military students- navigating aviators from the Air Force,
- SAMPLE 3 made up of civilian students from the Faculty of Medicine.

The three samples of military and civilian students, as well as the results of applying the test “t”, (We compare the average from sample 1 to the average from sample 2/3 and apply test “t”/ By comparing the average with the norm of not using

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<sup>1</sup> Peter McMillan, Personality Tests, Aldo Press publishing house, 1996, pages 158, 159.

manipulation techniques, meaning being an upright person, in sample no.1/2/3, and apply test “t”);

The purpose of the survey was to check the following hypotheses:

- I. Not all subjects with Machiavellian attitudes are as well victims of manipulation (that is with a weak resistance to manipulation) or not.
- II. Are there in all three samples both subjects with Machiavellian attitude and upright ones or not.
- III. Can the subjects with Machiavellian attitudes be found to a greater extent in sample 3 than in the samples 1 and 2 or not.
- IV. Can subjects with greater competence as to applying ethics into management be found to a greater extent in sample 3 than in the samples 1 and 2 or not.
- V. Can the subjects with good resistance to manipulation be found to a greater extent only in sample 2 and are missing from the samples 1 and 3 or not.
- VI. Are there subjects with weak resistance to manipulation only in the samples 1 and 3 or not.

With an error risk of 20%, (20/100 =0.20), we conclude that the two environments from samples 1 and 2 not differ significantly. By observing the two environments we notice that the subjects from sample 1 are less ready to manipulate than subjects from sample 2 (1.08(3)<4.44).With an error risk of 20%,

(20/100 =0.20), we conclude that the two environments from samples 1 and 3 not differ significantly. By observing the two environments we notice that the subjects from sample 3 are less ready to manipulate than subjects from sample 1(1.08(3)<4.44).

With an error risk of 20%, (20/100 =0.20), we conclude that 50% of the subjects from sample no.1 present a slight tendency of using manipulation techniques, while the other 50% do not use manipulation techniques , because they are upright people. After observing the average and the norm we conclude that the subjects in sample no.1 are inclined towards manipulating others.(0<1.08(3))

With an error risk of 10%, (10/100 =0.10), we conclude that 83.3% of the subjects from sample no.2 have the tendency to use manipulation techniques, while the rest, representing 16.7% do not use manipulation techniques, because they are upright people. After observing the average and the norm we conclude that the subjects from sample no.2 are very inclined towards manipulating others.(0<4,33) With an error risk of 20%, (20/100 =0.20), we conclude that 25% of the subjects from sample no.3 have a slight tendency to use manipulation techniques, while the remaining 75% do not use manipulation techniques , because they are upright people. After observing the average and the norm we conclude that the subjects from sample no.3 are not inclined towards manipulating others. (-4.08(3)<0).

Sample 1- Score for Machiavellism/ resistance to manipulation, Table 4

Current subject no.	Score for Machiavellian attitude	Score for resistance to manipulation
1	-12 (upright person)	27 (average resistance to manipulation)
2	-5 (upright person)	21 (good resistance to manipulation)
3	-3 (upright person)	28 (average resistance to manipulation)
4	-3 (upright person)	27 (average resistance to manipulation)
5	0 (upright person)	20 (good resistance to manipulation)
6	0 (upright person)	22 (good resistance to manipulation)
7	+2 (uses manipulation techniques)	26 (average resistance to manipulation)
8	+4 (uses manipulation techniques)	36 (average resistance to manipulation)
9	+5 (uses manipulation techniques)	26 (average resistance to manipulation)
10	+8 (uses manipulation techniques)	33 (average resistance to manipulation)
11	+8 (uses manipulation techniques)	45 (weak resistance to manipulation)
12	+9 (uses manipulation techniques)	19 (good resistance to manipulation)

Sample 2- Score for Machiavellism/ resistance to manipulation, Table 5

Current subject no.	Score for Machiavellian attitude	Score for resistance to manipulation
1	-11 (upright person)	28 (average resistance to manipulation)
2	0 (upright person)	18 (good resistance to manipulation)
3	+1 (uses manipulation techniques)	30 (average resistance to manipulation)
4	+1 (uses manipulation techniques)	13 (good resistance to manipulation)
5	+4 (uses manipulation techniques)	18 (good resistance to manipulation)
6	+7 (uses manipulation techniques)	27 (average resistance to manipulation)
7	+7 (uses manipulation techniques)	22 (good resistance to manipulation)
8	+8 (uses manipulation techniques)	19 (good resistance to manipulation)
9	+8 (uses manipulation techniques)	22 (good resistance to manipulation)
10	+8 (uses manipulation techniques)	22 (good resistance to manipulation)
11	+9 (uses manipulation techniques)	26 (average resistance to manipulation)
12	+10 (uses manipulation techniques)	30 (average resistance to manipulation)

Sample 3- Score for Machiavellism/ resistance to manipulation Table 6

Current subject no.	Score for Machiavellian attitude	Score for resistance to manipulation
1	-6 (upright person)	27 (average resistance to manipulation)
2	-4 (upright person)	27 (average resistance to manipulation)
3	-5 (upright person)	30 (average resistance to manipulation)
4	-8 (upright person)	23 (average resistance to manipulation)
5	-8 (upright person)	28 (average resistance to manipulation)
6	-16 (upright person)	30 (average resistance to manipulation)
7	-5 (upright person)	26 (average resistance to manipulation)
8	-14 (upright person)	26 (average resistance to manipulation)
9	0 (upright person)	28 (average resistance to manipulation)
10	+1 (uses manipulation techniques)	35 (average resistance to manipulation)
11	+8 (uses manipulation techniques)	42 (weak resistance to manipulation)
12	+8 (uses manipulation techniques)	26 (average resistance to manipulation)

After analysing the achieved score, we could infer the manipulation techniques used by each subject of sample no. 1, explained in table no. 7.

Manipulation techniques used by the subjects from sample 1, Table 7

Current subject no.	Resistance to manipulation	Manipulation techniques used by the subjects
7	average	<ul style="list-style-type: none"> <li>- does not tell the others the true reasons of his/ her actions, unless this brings him/ her advantages;</li> <li>- tells the others what they like to hear in order to make them act according to his/ her will;</li> <li>- sometimes, the intention to punish somebody not only objectifies as bad deeds, but also as apparently good deeds which act as a treacherous revenge;</li> <li>- uses peoples' vices as a refuge when the right occasion arises;</li> <li>- uses force in order to make the others act according to his will; ???</li> <li>- lies using several excuses and expedients.</li> </ul>
8	average	<ul style="list-style-type: none"> <li>- does not tell the others the true reasons of his/ her actions, unless this brings him/ her advantages;</li> <li>- tells the others what they like to hear in order to make them act</li> </ul>

		<ul style="list-style-type: none"> <li>- according to his will;</li> <li>- the end justifies the means;</li> <li>- uses peoples' vices as a refuge when the right occasion arises;</li> <li>- uses force in order to make the others act according to his will; ???</li> <li>- in order to reach the desired hierarchical level, he/ she offends the pride, social status or susceptibility of the persons standing in his/ her way;</li> <li>- prefers to be rich and deceitful than poor and honest, the money being more important than honesty to him/ her;</li> <li>- uses his/ her own seduction in order to get what he/ she wants;</li> </ul>
<b>9</b>	average	<ul style="list-style-type: none"> <li>- tells the others what they like to hear in order to make them act according to his will;</li> <li>- sometimes, the intention to punish somebody not only objectifies as bad deeds, but also as apparently good deeds which act as a treacherous revenge;</li> <li>- uses peoples' vices as a refuge when the right occasion arises;</li> <li>- builds up his fame and even glory by wasting other people's goods, like money, prestige, image, mocking them, marginalising them, causing them all kinds of moral and material damages;</li> <li>- presents his dishonesty as a merit and labels his attitude as diplomacy; ???</li> <li>- lies using several excuses and expedients;</li> <li>- prefers to be rich and deceitful than poor and honest, money being more important than honesty to him;</li> <li>- uses his own seduction in order to get what he wants;</li> </ul>
<b>10</b>	average	<ul style="list-style-type: none"> <li>- does not tell the others the true reasons of his/ her actions, unless this brings him/ her advantages;</li> <li>- tells the others what they like to hear in order to make them act according to his/ her will;</li> <li>- sometimes, the intention to punish somebody not only objectifies as bad deeds, but also as apparently good deeds which act as a treacherous revenge;</li> <li>- uses peoples' vices as a refuge when the right occasion arises;</li> <li>- presents his/ her dishonesty as a merit and labels his/ her attitude as diplomacy; ???</li> <li>- lies using several excuses and expedients;</li> <li>- does not feel any remorse when he/ she is lying in order to yield advantages; ???</li> <li>- in order to reach the desired hierarchical level, he/ she offends the pride, social status or susceptibility of the persons standing in his/ her way;</li> <li>- uses his/her own seduction in order to get what he/she wants;</li> <li>- invents reasons appealing to emotions, avoiding to tell the truth, when asking somebody for help, in order to impress him/ her and to force his/ her hand.</li> </ul>
<b>11</b>	weak	<ul style="list-style-type: none"> <li>- does not tell the others the true reasons of his/ her actions, unless this brings him/ her advantages;</li> <li>- tells the others what they like to hear in order to make them act according to his/ her will;</li> <li>- sometimes, the intention to punish somebody not only objectifies as bad deeds, but also as apparently good deeds which act as a treacherous revenge;</li> <li>- uses peoples' vices as a refuge when the right occasion arises;</li> <li>- builds up his fame and even glory by wasting other people's goods, like money, prestige, image, mocking them, marginalising them,</li> </ul>

		<ul style="list-style-type: none"> <li>- causing them all kinds of moral and material damages;</li> <li>- presents his/ her dishonesty as a merit and labels his/ her attitude as diplomacy; ???</li> <li>- uses force in order to make the others act according to his will; ???</li> </ul>
12	average	<ul style="list-style-type: none"> <li>- does not tell the others the true reasons of his/ her actions, unless this brings him/ her advantages;</li> <li>- tells the others what they like to hear in order to make them act according to his/ her will;</li> <li>- sometimes, the intention to punish somebody not only objectifies as bad deeds, but also as apparently good deeds which act as a treacherous revenge;</li> <li>- uses peoples' vices as a refuge when the right occasion arises;</li> <li>- lies using several excuses and expedients;</li> <li>- in order to reach the desired hierarchical level, he/ she offends the pride, social status or susceptibility of the persons standing in his/ her way;</li> <li>- prefers to be rich and deceitful than poor and honest, money being more important than honesty to him;</li> <li>- uses his own seduction in order to get what he wants;</li> </ul>

After analysing the achieved score, we could infer the manipulation techniques used by each subject of sample no. 2, explained in table no. 8.

Manipulation techniques used by the subjects from sample 2, Table 8

Current subject no.	Resistance to manipulation	Manipulation techniques used by the subjects
3	average	<ul style="list-style-type: none"> <li>- sometimes, the intention to punish somebody not only objectifies as bad deeds, but also as apparently good deeds which act as a treacherous revenge;</li> <li>- uses peoples' vices as a refuge when the right occasion arises;</li> <li>- lies using several excuses and expedients;</li> <li>- prefers to be rich and deceitful than poor and honest, money being more important than honesty to him/her.</li> </ul>
4	good	<ul style="list-style-type: none"> <li>- tells the others what they like to hear in order to make them act according to his/ her will;</li> <li>- sometimes, the intention to punish somebody not only objectifies as bad deeds, but also as apparently good deeds which act as a treacherous revenge;</li> <li>- the end justifies the means;</li> <li>- uses peoples' vices as a refuge when the right occasion arises;</li> <li>- lies using several excuses and expedients;</li> <li>- uses his/her own seduction in order to get what he wants.</li> </ul>
5	good	<ul style="list-style-type: none"> <li>- tells the others what they like to hear in order to make them act according to his/ her will;</li> <li>- sometimes, the intention to punish somebody not only objectifies as bad deeds, but also as apparently good deeds which act as a treacherous revenge;</li> <li>- uses peoples' vices as a refuge when the right occasion arises;</li> <li>- lies using several excuses and expedients;</li> <li>- in order to reach the desired hierarchical level, he/ she offends the pride, social status or susceptibility of the persons standing in his/ her way;</li> <li>- uses his/her own seduction in order to get what he/ she wants.</li> </ul>
6	average	<ul style="list-style-type: none"> <li>- sometimes, the intention to punish somebody not only objectifies</li> </ul>

		<p>as bad deeds, but also as apparently good deeds which act as a treacherous revenge;</p> <ul style="list-style-type: none"> <li>- the end justifies the means;</li> <li>- resolves not to act morally; ???</li> <li>- uses peoples' vices as a refuge when the right occasion arises;</li> <li>- uses force in order to make the others act according to his/her will; ???</li> <li>- lies using several excuses and expedients;</li> <li>- prefers to be rich and deceitful than poor and honest, money being more important than honesty to him/her;</li> <li>- uses his/her own seduction in order to get what he/she wants.</li> </ul>
7	good	<ul style="list-style-type: none"> <li>- does not tell the others the true reasons of his actions, unless this brings him/her advantages;</li> <li>- tells the others what they like to hear in order to make them act according to his/her will;</li> <li>- sometimes, the intention to punish somebody not only objectifies as bad deeds, but also as apparently good deeds which act as a treacherous revenge;</li> <li>- presents his/her dishonesty as a merit and labels his attitude as diplomacy; ???</li> <li>- lies using several excuses and expedients;</li> <li>- in order to reach the desired hierarchical level, he offends the pride, social status or susceptibility of the persons standing in his way;</li> <li>- prefers to be rich and deceitful than poor and honest, money being more important than honesty to him;</li> <li>- uses his own seduction in order to get what he wants.</li> </ul>
8	good	<ul style="list-style-type: none"> <li>- tells the others what they like to hear in order to make them act according to his will;</li> <li>- sometimes, the intention to punish somebody not only objectifies as bad deeds, but also as apparently good deeds which act as a treacherous revenge;</li> <li>- uses peoples' vices as a refuge when the right occasion arises;</li> <li>- presents his/her dishonesty as a merit and labels his/her attitude as diplomacy; ???</li> <li>- lies using several excuses and expedients;</li> <li>- in order to reach the desired hierarchical level, he/she offends the pride, social status or susceptibility of the persons standing in his/her way;</li> <li>- prefers to be rich and deceitful than poor and honest, money being more important than honesty to him/her;</li> <li>- uses his/her own seduction in order to get what he/she wants.</li> </ul>
9	good	<ul style="list-style-type: none"> <li>- does not tell the others the true reasons of his actions, unless this brings him advantages;</li> <li>- tells the others what they like to hear in order to make them act according to his/her will;</li> <li>- builds up his/her fame creating a glory by wasting other people's goods, like money, prestige, image, mocking them, marginalising them, causing them all kinds of moral and material damages;</li> <li>- lies using several excuses and expedients;</li> <li>- does not feel any remorse when he/she is lying in order to yield advantages; ???</li> <li>- in order to reach the desired hierarchical level, he offends the pride, social status or susceptibility of the persons standing in his/her way;</li> </ul>



		<ul style="list-style-type: none"> <li>- uses his/her own seduction in order to get what he/she wants.</li> </ul>
<b>10</b>	good	<ul style="list-style-type: none"> <li>- does not tell the others the true reasons of his actions, unless this brings him/her advantages;</li> <li>- tells the others what they like to hear in order to make them act according to his/her will;</li> <li>- the end justifies his means;</li> <li>- resolves not to act morally; ???</li> <li>- uses peoples' vices as a refuge when the right occasion arises;</li> <li>- lies using several excuses and expedients;</li> <li>- prefers to be rich and deceitful than poor and honest, money being more important than honesty to him;</li> <li>- uses his/her own seduction in order to get what he wants;</li> <li>- invents reasons appealing to emotions, avoiding to tell the truth, when asking somebody for help, in order to impress him/ her and to force his/ her hand.</li> </ul>
<b>11</b>	average	<ul style="list-style-type: none"> <li>- sometimes, the intention to punish somebody not only objectifies as bad deeds, but also as apparently good deeds which act as a treacherous revenge;</li> <li>- uses peoples' vices as a refuge when the right occasion arises;</li> <li>- builds up his/her fame creating a glory by wasting other people's goods, like money, prestige, image, mocking them, marginalising them, causing them all kinds of moral and material damages;</li> <li>- uses peoples' vices as a refuge when the right occasion arises;</li> </ul>
		<ul style="list-style-type: none"> <li>- sometimes, the intention to punish somebody not only objectifies as bad deeds, but also as apparently good deeds which act as a treacherous revenge;</li> <li>- builds up his/her fame creating a glory by wasting other people's goods, like money, prestige, image, mocking them, marginalising them, causing them all kinds of moral and material damages;</li> </ul>
<b>12</b>	average	<ul style="list-style-type: none"> <li>- doesn't tell the true reasons of his actions to the others unless this proves useful;</li> <li>- tells the others what they want to hear in order to make them do what he wants;</li> <li>- the end justifies the means;</li> <li>- sets out not to act morally; ???</li> <li>- he/she uses people's flaws to get himself/herself covered when the time is right;</li> <li>- he/she finds it worthy not to be honest by labelling his/ her attitude as diplomacy; ???</li> <li>- uses force to make the people around him act the way he wants; ???</li> <li>- lies by using different excuses and tricks;</li> <li>- has no remorse about lying to someone in order to obtain advantages; ???</li> <li>- he/she uses his/her own capacity to seduce in order to get what he/she wants.</li> </ul>

The analysis of the score obtained outlines the techniques of manipulation applied by each subject of sample no. 3 presented in table no. 9:

Techniques of manipulation used by subjects in sample no. 3 Table no. 9

Subject item	Resistance to manipulation	Techniques of manipulation used by subjects
10	average	<ul style="list-style-type: none"> <li>- doesn't tell the true reasons of his/her actions to the others unless this proves useful;</li> <li>- tells the others what they want to hear in order to make them do what he/she wants;</li> <li>- sometimes the intention of punishing someone is materialized not only in bad deeds, but even in apparently good deeds that act as a treacherous revenge;</li> <li>- he/she uses people's flaws to get himself covered when the time is right;</li> <li>- lies by using different excuses and tricks;</li> <li>- the end justifies the means;</li> <li>- he/she uses his own capacity to seduce in order to get what he/she wants;</li> <li>- sets out not to act morally; ???</li> </ul>
11	weak	<ul style="list-style-type: none"> <li>- tells the others what they want to hear in order to make them do what he/she wants;</li> <li>- he/she uses people's flaws to get himself/herself covered when the time is right;</li> <li>- uses force to make the people around him act the way he/she wants;</li> <li>- lies by using different excuses and tricks;</li> <li>- the end justifies the means;</li> <li>- he/she uses his/her own capacity to seduce in order to get what he/she wants;</li> <li>- he/she finds it worthy not to be honest by labelling his/her attitude as diplomacy;</li> <li>- has no remorse about lying to someone in order to obtain advantages;</li> <li>- sets out not to act morally; ???</li> </ul>
12	average	<ul style="list-style-type: none"> <li>- doesn't tell the true reasons of his/her actions to the others unless this proves useful;</li> <li>- tells the others what they want to hear in order to make them do what he/she wants;</li> <li>- sometimes the intention of punishing someone is materialized not only in bad deeds, but even in apparently good deeds that act as a treacherous revenge;</li> <li>- he/she uses people's flaws to get himself/herself covered when the time is right;</li> <li>- lies by using different excuses and tricks;</li> <li>- the end justifies the means;</li> <li>- prefers to be rich and dishonest rather than poor and honest, money being more important to him/her than honesty;</li> <li>- he/she uses his/her own capacity to seduce in order to get what he/she wants.</li> </ul>

What differentiates respondents with low resistance to manipulation (respondent 11 from sample 1 and respondent 11 from sample 3), from the rest of the respondents, no matter what sample they are from, is the fact that they **use the manipulation techniques** listed below **in groups**, (which can be seen near the question marks in tables 7,8,9):

- "I make a merit of not being honest by labelling my attitude as diplomacy"
- "I use force in order to make people around me to act as I want them to"
- "I feel no remorse when I am lying to someone in order to gain certain benefits"
- "My goal is not to act morally."

At least two of the 4 manipulation techniques highlighted above have been applied in sample 2 by each of respondents 6, 11, 12, who show, all three of them, a average resistance to manipulation, like 50% of the upright respondents from samples 1, 2, 3.

## **II CONCLUSION**

Those of us who are blessed with a ruler's vocation must be both tolerant and

intolerant, rigid and flexible. An almost godly compassion is needed..

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## THE FOUNDATION OF PERFORMANCE ASSESMENT – I. FEELING GOOD WITH YOUR SELF – A PROBLEM OF SPEAKING AND THINKING ACCORDING TO YOUR DEEDS

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*Abstract (summary): : This paper has the purpose of transmitting information and ideas about the manipulation techniques used by subjects with a Machiavellian attitude in the three samples and their resistance to manipulation.*

Regarding the resistance to manipulation, it has been determined that, in sample no. 1, out of six subjects who do not use manipulation techniques, three subjects have an average resistance to manipulation, and the other three have a good resistance, whereas out of the 6 students who apply manipulation techniques 4 have an average resistance to the attack of other manipulative persons, one has a poor resistance and only one displays a good resistance (SAMPLE 1 made up of infantry students, SAMPLE 2 made up of military students- navigating aviators from the Air Force, SAMPLE 3 made up of civilian students from the Faculty of Medicine).

In sample 2, one subject of the 2 who do not use manipulation techniques has an average resistance to manipulation and the other one has a good resistance, whereas out of the 10 subjects who apply manipulation techniques, 4 have an average resistance to the attack of other manipulative persons and the rest of 6 subjects show a good resistance.

In sample 3 all 9 subjects who do not use manipulation techniques have an average resistance to manipulation, and out of the 3 subjects who use manipulation techniques, 2 have an average resistance to the attack of other manipulative persons and one has a poor resistance.

Regarding the manipulation techniques used by subjects with a Machiavellian attitude, it has been determined that the manipulation

techniques used in the three samples are distributed as follows:

**“I won’t tell the others the true reasons of my actions unless this proves useful”** is a manipulation technique used:

- in sample 1 – by 5 subjects out of 6 (subjects 7, 8, 10, 11, 12), and out of these 5, only one (subject 12) displays good resistance to manipulation;
- in sample 2 – by 4 out of 10 (subjects 7, 9, 10, 12), and out of these 4, only 3 (subjects 7, 9, 10) have a good resistance to manipulation;
- in sample 3 – by 2 out of 3 (subjects 10, 11, 12) and neither displays a good resistance to manipulation.

**“I tell the people around me what they want to hear in order to make them act the way I want”** – is a manipulation technique used:

- in sample 1 – by 6 subjects out of 6 (subjects 7, 8, 9, 10, 11, 12), and out of these 6, only one (subject 12) has a good resistance to manipulation, being, at the same time, the only one who uses manipulation techniques with such a resistance.
- in sample 2 – by 7 out of 10 (subjects 4, 5, 7, 8, 9, 10, 12), and of these 7, only 6 (subjects 4, 5, 7, 8, 9, 10) have a good resistance to manipulation;
- in sample 3 – by 3 out of 3 (subjects 10, 11, 12) and neither has a good resistance to manipulation;

**“Sometimes my intention to punish someone is materialized not only in bad deeds, but even in good deeds that act as a treacherous revenge”** is a manipulation technique used:

- in sample 1 – by 5 out of 6 (subjects 7, 9, 10, 11, 12), and out of these 5, only one (subject 12) has a good resistance to manipulation, being the only one who uses manipulation techniques with such a degree of resistance;
- in sample 2 – by 6 out of 10 (subjects 3, 4, 6, 7, 8, 11), and out of these 6, only 3 (subjects 4, 7, 8) have a good resistance to manipulation;
- in sample 3 – by 3 out of 3 (subjects 10, 11, 12) and neither displays good resistance to manipulation.

**“I use people’s vices to get myself covered when the time is right”** is a manipulation technique used:

- in sample 1 – by 6 out of 6 (subjects 7, 8, 9, 10, 11, 12), and out of these 6, only one (subject 12) has a good resistance to manipulation;
- in sample 2 – by 8 out of 10 (subjects 3, 4, 5, 6, 8, 10, 11, 12), and out of these 8, only 4 (subjects 4, 5, 8, 10) display a good resistance to manipulation;
- in sample 3 – by 3 out of 3 – (subjects 10, 11, 12), and neither has a good resistance to manipulation.

**“I use force in order to make the people around me do what I want”** is a manipulation technique used:

- in sample 1 – by 3 out of 6 (subjects 7, 8, 11), out of these 3, no one has a good resistance to manipulation (rather poor – subject 11);
- in sample 2 – by 2 out of 10 (subjects 6, 12) and out of these 2, neither (subject 6, as well as 12) has a good resistance to manipulation;
- in sample 3 – by 1 out of 3 (subject 11) and he does not have a good resistance to manipulation.

**“I lie by using different excuses and tricks”** is a manipulation technique used:

- in sample 1 – by 4 subjects out of 6 (subjects 7, 9, 10, 12), and out of these

4, only one (subject 12) displays a good resistance to manipulation;

- in sample 2 – by 10 out of 10 (subjects 3, 4, 5, 6, 7, 8, 9, 10, 11, 12), and out of these 10, only 6 (subjects 4, 5, 7, 8, 9, 10) have a good resistance to manipulation;
- in sample 3 – by 3 out of 3 (subjects 10, 11, 12) and neither displays a good resistance to manipulation.

**“The end justifies the means”** is a manipulation technique used:

- in sample 1 – by 1 subject out of 6 (subject 8), and he does not display a good resistance to manipulation;
- in sample 2 – by 4 out of 10 (subjects 4, 6, 10, 12), and out of these 4, only 2 (subjects 4, 10) have a good resistance to manipulation;
- in sample 3 – by 3 out of 3 (subjects 10, 11, 12), and neither has a good resistance to manipulation;

**“In order to reach the hierarchical level I want I will hurt the pride, social status or susceptibility of the persons who stand in my way”** is a manipulation technique used:

- in sample 1 – by 3 out of 6 (subjects 8, 10, 12), and out of these 3, only one (subject 12) has a good resistance to manipulation;
- in sample 2 – by 4 out of 10 (subjects 5, 7, 8, 9), and out of these 4, all (subjects 5, 7, 8, 9) have a good resistance to manipulation;
- in sample 3 - neither of the 3 subjects who manipulate use this manipulation technique.

**“I would rather be rich and dishonest than poor and honest, money being more important to me than honesty”** is a manipulation technique used:

- in sample 1 – by 3 out of 6 (subjects 8, 9, 12), and out of these 3, only one (subject 12) has a good resistance to manipulation;
- in sample 2 – by 6 out of the 10 subjects of sample 2 (subjects 3, 6, 7, 8, 10, 11) and out of these 6, only 3 (subjects 7, 8, 10) have a good resistance to manipulation;

- in sample 3 – by 1 out of 3 (subject 12), who does not have a good resistance to manipulation.

**“I use my own capacity to seduce in order to get what I want”** is a manipulation technique used:

- in sample 1 – by 4 out of 6 (subjects 8, 9, 10, 12), and out of these 4, only one (subject 12) has a good resistance to manipulation;
- in sample 2 – by 9 out of 10 (subjects 4, 5, 6, 7, 8, 9, 10, 11, 12), and out of these 9, only 6 (subjects 4, 5, 7, 8, 9, 10) have a good resistance to manipulation;
- in sample 3 – by 3 out of 3 (subjects 10, 11, 12) and neither has a good resistance to manipulation

**“I will build up my reputation and find it glorious to ruin other people’s goods like money, prestige, image by ridiculing, casting them aside, causing them all sorts of moral and material prejudice”** is a manipulation technique used:

- in sample 1 – by 2 out of 6 (subjects 9, 11), and out of these 2, neither has a good resistance to manipulation;
- in sample 2 – by 2 out of 10 (subjects , 11), and out of these 2, only one (subject 9) has a good resistance to manipulation;
- in sample 3 – neither of the 3 subjects who manipulate does not use this manipulation technique.

**“I consider it a virtue not to be honest by labelling my attitude as diplomacy”** is a manipulation technique used:

- in sample 1 – by 3 out of 6 (subjects 9, 10, 11), and out of these 3, neither has a good resistance to manipulation (but rather poor – subject 11);
- in sample 2 – by 5 out of 10 (subjects 7, 8, 9, 11, 12), and out of these 5, only 3 (subjects 7, 8, 9) have a good resistance to manipulation;
- in sample 3 – by 1 out of 3 (subject 11), and he does not display a good resistance to manipulation (rather poor).

**“I have no remorse about lying to someone in order to obtain advantages”** is a manipulation technique used:

- in sample 1 – by 1 subject out of 6 (subject 10), who does not have a good resistance to manipulation;
- in sample 2 – by 3 out of 10 (subjects 9, 11, 12), and out of these 3, only one (subject 9) displays a good resistance to manipulation;
- in sample 3 – by 1 out of 3 (subject 11), who does not have a good resistance to manipulation (but rather poor).

**“I make up reasons that move people and avoid telling the truth when I ask someone to help me in order to impress him / her and force his / her hand”** is a manipulation technique used:

- in sample 1 – by 1 out of 6 (subject 10), who does not display a good resistance to manipulation;
- in sample 2 – by 1 out of 10 (subject 10), who does not display a good resistance to manipulation;
- in sample 3 - neither of the 3 subjects who manipulate does not use this manipulation technique.

**“I set out not to act morally”** is a manipulation technique used:

- in sample 1 – neither of the 6 subjects who manipulate does not use this manipulation technique;
- in sample 2 – by 3 out of 10 (subjects 6, 10, 12), and out of these 3 only one (subject 10) displays a good resistance to manipulation;
- in sample 3 – by 2 out of 3 (respondents 10 and 11) and they both have a low resistance to manipulation.

What differentiates respondents with low resistance to manipulation (respondent 11 from sample 1 and respondent 11 from sample 3), from the rest of the respondents, no matter what sample they are from, is the fact that they **use the manipulation techniques** listed below **in groups**, (which can be seen near the question marks in tables 7,8,9):

- “I make a merit of not being honest by labelling my attitude as diplomacy”

- "I use force in order to make people around me to act as I want them to"
- "I feel no remorse when I am lying to someone in order to gain certain benefits"
- "My goal is not to act morally."

At least two of the 4 manipulation techniques highlighted above have been applied in sample 2 by each of respondents 6, 11, 12, who show, all three of them, a average resistance to manipulation, like 50% of the upright respondents from samples 1, 2, 3.

## **II Conclusion**

The persons with managerial skills are able to:

- be positive, dedicating more time to do what they want according to their dreams/ ideals, instead of marking time by trying to putting others in their place;
- to control stress and irritation;
- to resist to manipulation and intimidation from the people around them, identifying and solving issues at the core of this attitude;
- to negotiate conflict solving;
- to interpret and use non-verbal signals;
- to identify positive/ aggressive/ passive behaviour in others and in themselves;
- to refuse someone without feeling guilty;
- to use the feedback technique in order to convey to others their opinion about the good and bad things they do;
- to use paraphrases into communication in order to ensure that they understood what has been said;
- to control their own negative feelings.

On the whole, specialization/chronic stress/dependence/narcissism are part of the causes that have been scientifically proven to dilute the group's consciousness and dissipate the responsibility of its members respectively.

The means of correction that can and must be used as a response to the immature/irresponsible actions of groups are known or should be known by the holders of managerial positions in organizations. In practice, these employees must be seen as persons with the capacity of acting in real time within the organization, at the price of risking their own spiritual integrity in a face-to-face combat with the organizational evil, by accepting that:

- evil is opposed to life, nevertheless being a form of life;
- by trying to destroy evil we come to destroy ourselves spiritually, if not physically;
- man's life has its own purpose in the battle between good and evil;
- the hope that good will prevail gives one a reason for living;
- evil can be defeated through goodness;
- evil can be conquered only by love.

**The way of love is a dynamic balance of opposite poles, a painful creative tension of uncertainties, a difficult path between extreme actions.**

Those of us who are blessed with a ruler's vocation must be both tolerant and intolerant, rigid and flexible. An almost godly compassion is needed. It is not easy to embrace ugliness with the sole hope that, in an unknown way, it could turn into beauty. But the myth of the frog who turns into a prince remains. Love works in many ways. And none of them is foreseeable.

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## VOLUNTEERISM INVOLVEMENT OF CIVILIANS IN EMERGENCY SITUATIONS

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### **Abstract:**

*What are the causes of the low involvement? Is it the small number of volunteers participating in civil protection operations due to the lack of concern in others well-being? Or it is due to the lack of information regarding the possibilities one has in helping others in need? Are the civil protection institutions willing to involve civilians in their operations? Our study tries to answer these questions. Teenagers, high-school pupils and students, were questioned about their involvement in volunteerism activities, the reasons for their involvement or non-involvement, their willingness to become volunteers in civil protection operations. The information teenagers have on civil protection operations and their representation on the associated risks were also investigated.*

*The results of the investigation allow us to formulate suggestions regarding various ways of motivating and training civilians for becoming volunteers in emergency situations operations.*

**Key words:** *civil protection, volunteers' involvement, civil protection.*

### **1. THEORETICAL FRAMEWORK**

Since 2004 the National Management System for Emergency Situations has included the so called Volunteer Emergency Services. These services are organized by and subordinated to Local Councils. Prevention activities and management of emergency situations are the main responsibilities of the Services. Participation of Volunteer Emergency Services in civil protection operation is based on few fundamental principles. Active involvement of volunteers in the life of the community, fair recruiting of volunteers, written consent for participation as volunteer are some of these basic principles. The normative act that regulates the functioning of Volunteer Emergency Services stipulates that a person must be specialized in the field of the operation in order to be a volunteer for emergency situations.

As the legislative frame exists, one would expect that volunteers' participation in civil protection operations is consistent and

valuable. The natural calamities we confronted in the past years and the difficulties civil protection institutions encountered in managing these emergency situations proved that civilians' involvement as volunteers is far from being noticeable.

The study of volunteerism is a rather new development, partly because the volunteer role has only recently become fully institutionalized and partly because of a tendency to marginalize volunteer work as a leisure-time pursuit.

Volunteerism is a fundamental component of the civilian society. It brings to life the most noble aspirations of humanity, such as peace, liberty, safety, and justice for all. In this globalizing age, with endless changes, the world becomes smaller and smaller, more independent, more complex. From this point of view, volunteerism – at individual or group level – represents a way:

- to enhance and sustain values attached to community, to services rendered for the others;



- through which people can exercise their rights and responsibilities towards community members, at the same time learning and developing through out their entire life, actualizing their full human potential.

In spite of these, youth involvement in voluntary service is limited. What are the causes of this low involvement? Is the small number of volunteers participating in civil protection operations due to the lack of concern in others well-being? Or is it due to the lack of information regarding the possibilities one has in helping others in need? Are the civil protection institutions willing to involve civilians in their operations? These are some of the questions the present research wants to answer so that it can take advantage of these answers in future volunteer recruiting sessions.

Only a few studies have been conducted on prosocial development during young adulthood and even fewer focuses on volunteerism. Even though there has been an increase in volunteer studies especially in the last three decades [1], it is surprising that very little is known about youth volunteering, the social and psychological characteristics of volunteers, their motivation for volunteering or the psychological effect of volunteering [3]. The literature on youth volunteering focuses on two issues: the characteristics of volunteers: their personality and motivation, and the potential effects of volunteering, the analysis of: agents, social relatedness and moral-political development and awareness [4].

Public institutions have alternatively been seen as a way to promote active and engaged citizenship, to accelerate the personal growth of the young people in the programs, to build social capital in communities, and to meet critical social needs through public work. These four competing visions can and do coexist in practice, which helps to explain the widespread and enduring popularity of the idea of volunteerism involvement of civilians in emergency situations.

Statistic data show that, in Romania, volunteer actions called for or initiated by public institutions and involving volunteers in managing emergency situations is lower than

abroad. In other countries volunteers represent an integral part of these countries' workforce. In the United States, 44% of adults volunteer, providing the equivalent of more than 9 million full-time employees. Many organizations, particularly in the nonprofit sector, could not survive without this assistance. Concerned about having active volunteers, some organizations regularly assess volunteer satisfaction. A logical assumption underlying the assessments is that more satisfied volunteers will be more active and more likely to continue helping [2].

## **2. GOALS AND METHODOLOGY OF THE RESEARCH**

This research aims to identify the reasons and causes that generate teenagers' low involvement in volunteerism activities. Another goal is to identify teenagers' representations on the risk associated with voluntary service. We also aim to offer suggestions concerning civilians' motivation and preparation in order to become volunteers for emergency actions.

Our **hypotheses** are:

1. We assume that low involvement in voluntary service is caused by insufficient promotion about civilians' possibilities of intervention in emergency situations.
2. The lack of knowledge about the field of activity and about the possibilities of getting involved in emergency situations managed by public institutions is associated with low participation in voluntary service.
3. Civilians' involvement in emergency situations is dependent on the representations that subjects have on the role played by different public institutions in solving these problems.
4. We assume that volunteers' involvement differs with age, thus students are more interested in participating in volunteerism activities than high-school pupils.

### **Sample:**

Our research has 140 subjects, aged 15 – 30, from two different levels of the educational system: 69 from high-school and 71 from university. As gender concerned, the surveyed group is balanced (70 boys and 70 girls). As

concerning the educational field, the pupils come from two technical high-schools („Iosif Silimon” Technical College and „Mircea Cristea” Technical College); the students come both from humanistic and technical fields (the Faculty of Letters and the Polytechnic and Mathematics Faculties).

**Instruments used:**

Data were collected through questionnaire of attitudes and opinions concerning civilians’ volunteering and involvement in emergency situations. Teenagers were questioned about their involvement in volunteerism activities, the reasons for their involvement or non-involvement, their willingness to become volunteers in civil protection operations. The information teenagers have on civil protection operations and their representation on the associated risks were also investigated.

**3. RESULTS**

The data obtained were statistically processed with SPSS 14.0. We used various criteria for analyzing the data, the main ones being: the educational level, the educational field, and gender.

As concerning teenagers’ involvement in voluntary actions, the results show that most of the subjects questioned (93,8%) have never attended a volunteerism action and only 6,2% of them have taken part in any action of this kind. These results show that in Romania volunteer activities are very little valued by teenagers. Very few of them took part or, even more, would like to take part in such actions.

Teenagers participated in the following types of volunteer activities:

- car crashes;
- floods;
- arsons;
- campaigns against violence;
- campaigns against alcoholism;
- actions organized by the Red Cross;
- money donation.

The questioned teenagers were involved as volunteers in actions of civilian protection or emergency situations such as:

- donation of goods or money - 2,7%,

- active participation in saving human lives or goods alongside with ISU– 2,7%,
- Romanian Red Cross volunteer - 0,7%.

Other ways of getting involved identified in teenagers’ answers concern sustaining and promoting projects/activities against alcohol and violence by distributing flyers and posters. Actually, during the last years, we noticed a new trend in schools: to involve pupils in projects to fight alcohol and drug use, to fight smoking, to reduce sexual exploitation, child trafficking, child labour, to save national parks, to clean parks, to visit centers for old people or for the homeless or children hospitals. We also noticed the low participation to collaborations with public institutions in emergency situations.

None of the subjects was involved in organizing the collecting of donations.

Another important goal of the present paper is to identify the reasons for this low participation in emergency situations or civil protection actions. The reasons named by our subjects underline the lack of information among teenagers as concerning emergency situations where they could take part and help. The deficit of information can be divided into two groups: on one hand, lack of information about how civilians can take part in managing emergency situations and on the other hand, how public institutions should take part. Approximately 16,4% of the subjects do not want to get involved in such actions and 8% of them motivate this lack of information through the risks the effective involvement might bring about. Thus, our hypothesis about the deficit of information concerning voluntary activities offered to teenagers is confirmed (Chart no.1).

Chart no.1. The reasons for not getting involved as a volunteer in civil protection actions/emergency situations

	<b>Reasons for not getting involved</b>	<b>Percent</b>
1.	<i>I did not know how I could get involved</i>	33,6%
2.	<i>I did not know from whom to get information, although I wanted to get involved</i>	24,0%

3.	<i>I do not want to get involved</i>	13,0%
4.	<i>I was afraid because of the risks</i>	8,2%
5.	<i>I could not get involved</i>	5%
6.	<i>I can not help</i>	3,4%
7.	<i>I was too young to get involved</i>	1,4%
8.	<i>I did not know I could get involved</i>	0,7%
9.	<i>Such actions were not advertised</i>	0,7%

As concerning the intent of participating to voluntary actions in future, 52,7% want to do this, while 47,6% do not want to get involved. The distribution on educational levels is the following (Chart no. 2):

Chart no.2. The intent of participating to voluntary actions, distributed on educational levels

<b>Do you intend to get involved as a volunteer in actions of civil protection or managing emergency situation?</b>		
	<b>YES</b>	<b>NO</b>
<b>High-school</b>	49,27%	52,73%
<b>University</b>	54,05%	45,95%

Students are much more interested than high-school pupils in taking part in civil protection actions. This result is also confirmed by conclusions of other researchers, who also say that teenagers become more and more interested in voluntary actions as they grow. Late adolescence and young adulthood are key periods and voluntary commitment can assume specific meanings and characteristics as far as this period of life is concerned. Young adulthood is a crucial period for attitudinal and prosocial capacity development. Young adulthood sees a growth of prosocial behavior because of emerging interpersonal relationships, cognitive and emotive development and changes in social context. During this period of life key psychological dimensions crystallize and tend to remain stable throughout the course of adult life.

No significant differences were found between subjects of different gender as

concerning the intent of getting involved in actions of civil protection.

Civilians' involvement in managing emergency situations depends on the representations they have about the role different public institutions play in solving these situations.

The public institutions subjects trust most and alongside which they would volunteer are: the Police, the red Cross, followed by the Air Forces, the Army, the Firefighters, and the Gendarmes. The least desirable institutions for involvement are the Community Police and the Local Public Administration and, surprisingly, the Emergency Situations Office. Chart no.3

Chart no.3 Institutions alongside which our subjects would volunteer

	<b>Institutions</b>	<b>Percent</b>
1.	<i>Red Cross</i>	28,1 %
2.	<i>Police</i>	28,1 %
3.	<i>Air Forces</i>	22,6 %
4.	<i>Army</i>	21,9 %
5.	<i>Firefighters</i>	20,5 %
6.	<i>Gendarmes</i>	20,5 %
7.	<i>NGO</i>	10,3 %
8.	<i>Voluntary Service for Emergency Situations</i>	10,3 %
9.	<i>ISU</i>	7,5 %
10.	<i>Community Police</i>	5,5 %
11.	<i>Local Administration</i>	4,1 %

This result can be explained through the low visibility and less press campaigns to promote Emergency Situations Office's actions, although it was founded in 2004, aiming to prevent and manage emergency situations, to offer and coordinate human, material, financial, and any other resources necessary to regain the normal state. Institutions such as Police, Army, Air Forces, and Red Cross are mostly chosen for involvement in volunteer activities. This fact can be the base for actions of promoting activities offered by these institutions and of implementing recruiting and training programmes for civilian volunteers for preventing and managing emergency situations.

As concerning the assessment of civil implication in protection actions, most subjects consider that their involvement would bring about a better management of the emergency situations. (Figure 1)

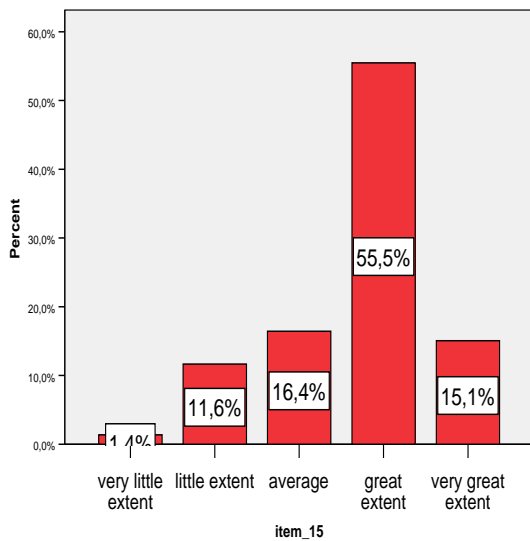


Figure 1 To what extent do you consider that volunteer involvement in civil protection actions would bring about a better management of the emergency situations?

So, we can say that our subjects think that civil involvement plays an important part in managing emergency situations by public institutions.

Involvement in emergency situations as a volunteer assumes the awareness of the risks associated to this type of activities. Another goal of this paper is the identification of the risks teenagers associate with voluntarism.

Most subjects accept the possibility of exposing themselves to risks such as minor injuries (75,3% of the subjects) and a fairly high percentage (38,4%) would take the risk of loosing material goods. Just a small number of subjects say they would not get involved in such actions or consider as a risk the possibility of worsening their material situation as a consequence of their involvement, probably because of the perception on heir own abilities to give first aid and on their competences to manage an emergency situation. (Chart no.4)

Chart no.4. Taken risks associates to involvement in managing emergency situations

	Risks associates to involvement in managing emergency situations	Procente
1.	<i>Minor injuries</i>	75,3%
2.	<i>Loosing personal material goods</i>	38,4%
3.	<i>Loosing life</i>	16,4%
4.	<i>Major injuries with life-long consequences</i>	11%
5.	<i>I would not offer to help in emergency situations</i>	6,2%
6.	<i>Worsening of the situation as a consequence of their involvement</i>	4,8%

The capacity of assuming these risks shows a high level of prosocial and civic spirit in our subjects. Trying to explain these results and the high self sacrifice capacity, we can rely on the theory of functional analyses, cited by Finkelstein [2]. According to functional analysis people volunteer in order to satisfy one or more needs or motives. The same volunteer work can serve different functions for different individuals, and the reasons for helping can change over time. We can identify six motives for volunteering: *Values* (to express values related to altruistic and humanitarian concerns for others); *Understanding* (to acquire new learning experiences and/or exercise skills that might otherwise go unused); *Social* (to strengthen social relationships and satisfy normative expectations); *Career* (to gain career-related experience and increase job prospects); *Protective* (to reduce negative feelings about oneself or address personal problems); and *Enhancement* (to grow and develop psychologically and increase self-esteem).

#### 4. CONCLUSIONS

Consider, if only for a moment, where we would be without volunteers in the Community hospice movement, pastoral care, disaster and emergency response, disability

services, and any number of other aspects of health, social and human services upon which so many rely. As we face this latest economic crisis, many are asking what the impact will be on services to vulnerable, sick, and marginalized populations. While there has rarely been a more critical time to invest in volunteering, the speculation is that governments, community leaders, public institutions will rely on volunteer management. Now is the time for volunteerism to step up and find its rightful place as a partner in preserving community life and caring.

The practical implications of this research are reflected in the contribution to increasing the awareness of the voluntary actions in communities. Both the voluntaries and the public institutions which want to get involved in recruiting and training volunteers for managing emergency situations have the common responsibility of:

- creating an environment where voluntary actions makes sense and contributes to reaching pre-established goals;
- defining criteria for volunteer participation;
- developing policies which to guide volunteers' activity in order to avoid exposure to risks or inappropriate intervention;
- offering protection against several risks to volunteers and people they are helping;
- offering volunteers free and adequate training, periodical assessments;
- assuring access for the civilians to voluntary actions, by overcoming physical, economical, social, and cultural barriers.

Citizenship can also be cultivated when individuals are empowered and made to believe that their engagement and participation can make a difference. Public institutions need to increase the appetite of volunteers for change and tends to attract young people interested in making a difference

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## THE EFFICIENCY OF MANAGERIAL COMMUNICATION IN ROMANIAN CREDIT INSTITUTIONS

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***Abstract:** The efficiency of managerial communication cannot be achieved without considering a number of main tendencies: consideration of psychological aspects in managerial communication; extensive means of identifying and eliminating interference noise in the process of communication; strong involvement of non-verbal communication in all managerial activities. For the manager of a credit institution, honest communication is the only thing capable of keeping communication pathways open so that management can be performed regardless of the style of communication.*

***Key words:** managerial communication style, efficient communication, communication transparent, communication environment*

### 1. Introduction

Managerial activity in credit institutions is a complex and continuous process of communication, which enables managers and the staff to discover and discuss fundamental or current issues, with the aim of improving performance. This necessitates an effort to discover and create on behalf of the executives. It is necessary to ensure a psycho-social environment whereby wholesale communication and rapid information are facilitated.

In management processes, communication is about perception, interpretation, evaluation and selection. After all, the issue of the manager's efficiency is raised not only by the communication itself, but also by its outcomes.

Whether directly or indirectly, the personnel of credit institutions is in permanent contact through professional activities or personal relations.

Communication enables the executives of credit institutions to make a participating contribution to any process. It is therefore a

fundamental aspect of credit entities and represents the main cohesive element for the members of the managerial team, by providing them with a means to understand and to make themselves understood to their employees. Enhancing the need to communicate well are: the growth in size of credit institutions, the complexity of the techniques employed, the numerous evaluations and calculations brought about by continuous reform in the banking system, the need to comprehensively oversee activities, evaluate risks and mitigate danger by attracting participative thinking.

Therefore communication acts not only as an integrating element, but also as a coordination and oversight mechanism capable of creating a human climate where performance and satisfaction is generated.

Nevertheless, the extent to which a high-performance communication system only generates satisfactory relationships and only attenuates unsatisfactory ones can be exaggerated.

Employees are motivated by the material rewards and the intrinsic stimulation derived from the work they perform. Their

motivation however depends on the responsibilities they are granted and the potential for fulfilment provided by the position they occupy, as well as on the hope that the rewards they will receive as a result of their efforts will match their wishes. The feelings of employees towards work and the rewards that come out of it are heavily dependent on their ability to communicate with executives or line managers and on the general quality of communication within the credit institution.

First and foremost, it is essential that good communication be established both ways, so that management can keep staff informed about the policies and plans which interest them and the employees can respond promptly by voicing their opinions regarding management proposals. Change cannot be managed correctly without understanding and interacting with these opinions.

## **2. Management through “high-performance communication”**

O characteristic of managerial practices in the 20<sup>th</sup> Century is the evolution of various theories of management, which flourish at one point only to fall into oblivion shortly thereafter. Among these is the theory of management through high performance communication. It is a model of approaching managerial issues that is based upon the following premises:

- the long-term needs and techniques of both management and staff are the same in any organisation. Management and staff ideas can be collected adequately to form a single conceptual framework;
- any divergence in opinion between management and staff is caused by misunderstandings due to unsatisfactory communication;
- work conflicts can be mitigated and solved through better communication.

The theory is attractive and to a certain extent it is valid. Its weaknesses lie in the fact that the premises are too general, particularly the idea that the main objectives of management and staff are necessarily

identical. Similar to paternalism, the theory of high-performance communication implies that a company can earn the loyalty of its people if it treats them well and keeps them informed. However, many of these people have reasons to split their loyalty to other directions, which are more important to them, and why not?

It does not follow that the communication system lacks importance if a company contains variations of points of view and different perceptions of loyalty. On the contrary, such situation require more high performance communication. Good communication attenuates such situations and facilitates future good cooperation. On its own, good cooperation cannot solve problems, and there are limits to the extent that communication strategies enhance reciprocity and commitment. But there is no doubt that management must keep staff informed of decisions that affect them and offer them opportunities to express their opinions. This is all the more necessary when new initiatives are thought up regarding work matters, and the performance of change management is heavily dependent on disseminating the management’s intentions to the staff and increasing the latter’s awareness of the likely impact of that change.

The communication behaviour of managers generates the communication climate specific to a credit institution and the results of that institution rely on that climate.

The functions of management cannot be optimally fulfilled without adequate communication because:

- foresight and planning cannot be done without stating and transmitting the plans and objectives to the various levels, without involving collaborators in decision-making through discussions and meetings;
- organisation also involves creating the relational framework for the receiving and transmitting of information, motivating, and so forth; all these are achievable only through communication;
- leadership and management are dependent on adequate communication, delegation of responsibilities, the creation of a

cooperation climate and the motivation of personnel;

- oversight and evaluation is performed through communication, for instance reviewing the performance of credit institution staff through formal evaluation systems, interviews and written reports.

### 3. Managerial communication styles

Efficient communication depends to a large extent on the manner in which it is performed. The style must be compatible with the scope and objective of communication, its intended recipient, the situation, the background and even the channels used. The style also has a strong impact on the communication climate within the credit institution. The manager of a credit institution communicates clear directives, which have to be expressed in a style befitting each message.

Although specialist literature presents a wide spectrum of communication styles, four styles can be encountered in credit institutions:

- blame;
- information – direction;
- persuasion;
- problem-solving.

Regardless of the style used by the management board, communication must always be transparent.

Transparency must be adequately weighted, as sometimes total openness is just as damaging as no openness.

For the manager of a credit institution, honest communication is the only thing capable of keeping communication pathways open so that management can be performed regardless of the style of communication.

The manager's ethic generates a certain personal image in front of employees, as well as an image for the credit institution in front of partners and clients.

### 4. Modern tendencies in managerial communication

Managerial communication must ensure first and foremost the implementation of the organisation's strategy while achieving

an optimal balance between resources and outcomes. These elements are difficult to determine and calibrate accordingly (fig. 4.1).

To determine the quantifiable outcomes we must consider the following factors which influence managerial communication (relationship 1)

$$MC = f[(F_K, P); V_I, R_I, M_I] \quad (1)$$

MC – managerial communication;

FK – factors known;

P – perturbations;

V<sub>I</sub> – value of issuer;

R<sub>I</sub> – responsibility of issuer;

M<sub>I</sub> – motivation of issuer.

$$F_K = f(F_1, F_2, F_3) \quad (2)$$

F<sub>1</sub> – avoidance of noise;

F<sub>2</sub> – active listening;

F<sub>3</sub> – feedback.

The quantifiable effects of managerial communication can be direct or indirect

$$E_Q = E_D + E_I$$

E<sub>Q</sub> – quantifiable effects;

E<sub>D</sub> – direct effects;

E<sub>I</sub> – indirect effects.

Quantifiable effects can be measured using the following indicators:

- Material savings ( $\Delta M$ )
- Annual time savings ( $\Delta T$ )

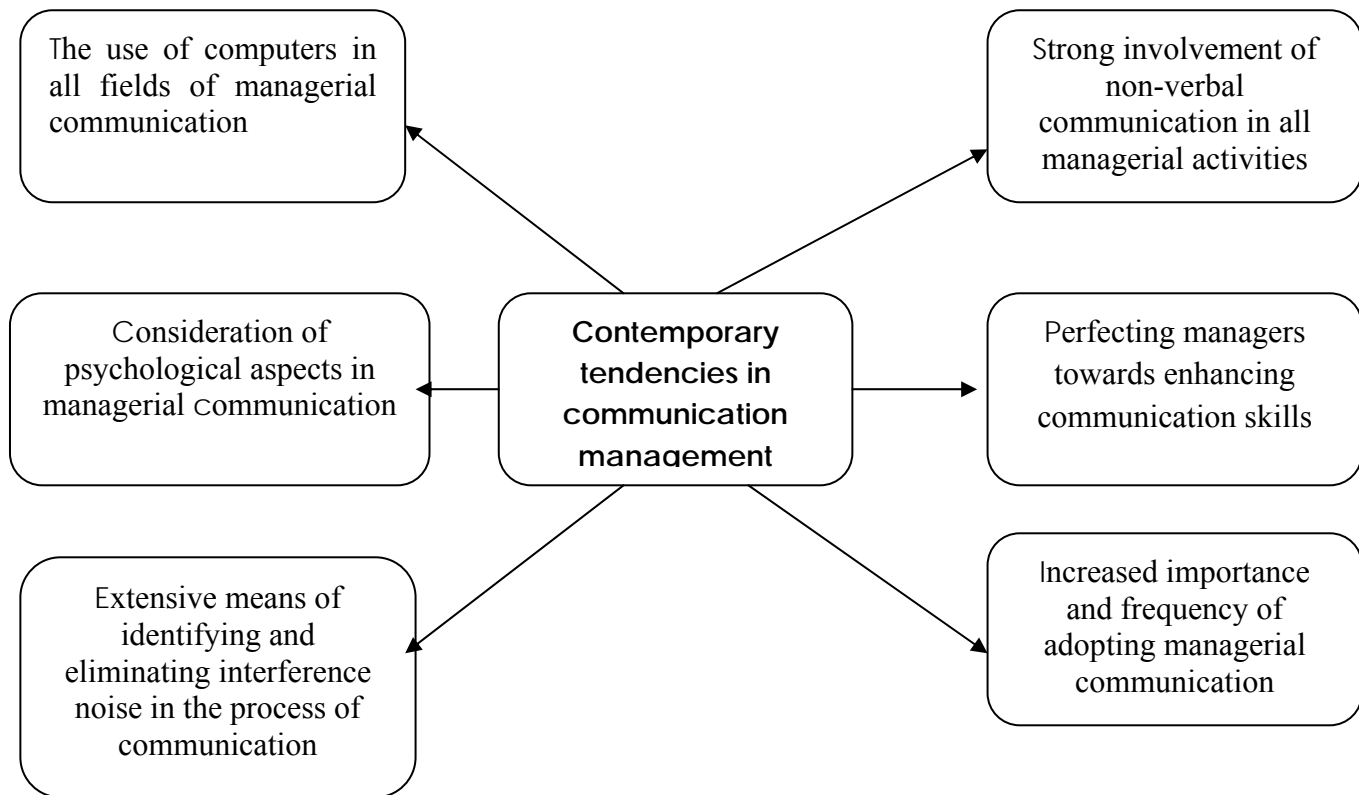
$$\Delta M = M_2 - M_1$$

$$\Delta T = T_2 - T_1$$

M<sub>1</sub>, T<sub>1</sub> = expenditure and time used in the case of efficient communication;

M<sub>2</sub>, T<sub>2</sub> = expenditure and time used when efficient communication is not a managerial concern – this will impact the duration of a meeting, the number of meetings in the period, duration of a dialogue, number of dialogues, number of managers required.





**Fig. 4.1. Contemporary tendencies in communication management**

The quantifiable indirect effects are harder to identify and are more generally approximated

These take the form of bonuses that effective communication leads to with regard to a number of economic and financial indicators (production, quantity processed etc.). The method of determining these effects cannot be exceedingly rigorous, as a number of qualitative elements which cannot be calculated cannot therefore be taken into account, while other improvements of a technical, structural or human nature are difficult to measure.

The majority of effects that stem from efficient managerial communication are unquantifiable. There is no activity within an organisation where communication styles will not have an impact.

As regards the unquantifiable effects, we must remember that good communication will:

- enable management to focus on the main aspects involved in achieving high performance;
- ensure a higher quality for the products and services that the organisation provides;
- contribute to enhancing the organisation's prestige and the consolidation of its position on the markets;
- enable the synchronisation of needs with the possibilities at hand, which will lead to an efficient correlation of the organisation's activities with economic entities upstream (suppliers) and downstream (clients);

- ensure that intervention is coordinated across the levels;
- facilitate the rapid and complete understanding of the message;
- enable the employees to be informed adequately of the mission, objectives, problems to solve and status of implementation;
- lead to better, more efficient management decisions;
- enhance order and discipline within the organisation.

Often unquantifiable effects are more important as regards the reaction within the organisation.

Managerial communication is a crucial instrument for a manager. It is difficult to offer solutions or blueprints for efficient communication since no two concrete situations are alike. Some managers communicate through generalities, others require and provide minute details.

There are however a number of specific criteria which will lead to efficiency or inefficiency in managerial communication (table 4.1)

<b>CRITERIA</b>	<b>Good application Efficient communication</b>	<b>Wrong application Inefficient communication</b>
<b>1. ATTITUDE TOWARDS COMMUNICATION</b>	<ul style="list-style-type: none"> <li>- will to communicate efficiently</li> <li>- creation of an atmosphere favourable to communication</li> <li>- awareness of partners</li> <li>- stimulation of communication counterparts</li> <li>- ensuring that the message is understood</li> <li>- following up on the use of the message</li> <li>- willingness to listen to different opinions without considering them opposition</li> </ul>	<ul style="list-style-type: none"> <li>- pseudo-communication</li> <li>- conformism</li> <li>- information, not communication.</li> </ul>
<b>2. COMMUNICATION ENVIRONMENT (means and forms of issuing a message)</b>	<ul style="list-style-type: none"> <li>- avoiding noise (anything that will interfere with the clarity of the message)</li> <li>- awareness of perturbations and re-directing them on the desired path</li> </ul>	<ul style="list-style-type: none"> <li>- acceptance of noise</li> <li>- wrongly conceived messages</li> <li>- inadequate communication means</li> </ul>
<b>3. ACTIVE LISTENING</b>	<ul style="list-style-type: none"> <li>- logical, analytical listening, no emotion</li> <li>- non-judgemental attitude</li> </ul>	<ul style="list-style-type: none"> <li>- immediate judgement of message</li> <li>- interrupting with own arguments</li> <li>- other preoccupations apart from the message</li> </ul>

4. FEEDBACK	- descriptive - direct - timely - usable	- assessment - imposed to the recipient
5. TRUST	- based on applying psychological and sociological principles	- based on preference
6. HUMAN RELATIONS	- professionally-oriented - materialised in independence, liberty, flexibility and negotiation	- based on desire to keep good relations - materialised in dependence, inflexibility, devotion and servitude

### 5. Conclusion

Within the management of credit institutions, communication and participation are of vital importance. The managerial decision depends on perfect communication and involvement between the manager and his staff, as well as between staff and clients for adequate adaptation and successful execution.

As far as the management is concerned, communication and participation in a credit institution consist primarily of interpersonal relationships. Experience shows that to lead is to communicate, first and foremost, to transmit ideas, feelings, decisions to staff, and to facilitate channels for response. At the same time, managerial activity and participation in credit institutions does generate among managers and staff strong feelings which can often be classed as emotional reactions rather than rational responses.

Managerial activity is a complex and continuous process of communication and involvement, through which the executives,

the staff and the clients of the credit institution become mutually acquainted and acknowledged, and through which information, opinions and feelings are shared and discussed.

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## POINTS OF VIEWS CONCERNING THE BUILDING OF THEORETICAL FOUNDATION FOR A MILITARY LEARNING-ORIENTED KNOWLEDGE MANAGEMENT SYSTEM

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### Abstract:

*One of the (tacit, explicit, implicit) knowledge definition is : the fact or condition of knowing something with a considerable degree of familiarity through experience, association or contact, the process by which the organization generates wealth from its intellectual or knowledge-based assets. The four modes of knowledge conversion (socialization, externalization, internalization combination) combined with two other strategic information processes (knowledge and decision making) create the “knowing organization” Theoretical perspectives on organizations, outlined in different horizons of information processing, bring into attention issues regarding the individual as a driving force of organizations’ transformation. It is obvious that, according to individuals’ quality, organizations may pass from the stage of functioning like mechanical ensembles to organizations based on knowledge, and consequently to organizations that process information through more performing means such as social sustainable development. This article makes some points of views concerning a theoretical foundation for the design of a military learning-oriented knowledge management system and contributes to knowledge management theory applied in military organisation.*

**Keywords:** *knowledge management systems, military organization controls, quality function deployment*

In a review of knowledge management literature, Schultze and Leidner (2002) suggest a definition of knowledge management as being the “generation, representation, storage, transfer, transformation, application, embedding, and protecting of organizational knowledge.” The authors note that research in knowledge management is a complex interdependency of collaboration (both in knowledge/information sharing and work), organizational memory, and organizational learning and stress that the social aspect of these characteristics implies a need for research methodologies beyond the traditional normative approach. Organizations have adopted knowledge management and organizational learning as concepts that may help them align themselves within a new competitive environment. A recent article by Zhang and Faerman (2003) indicates that although organizational learning has been

primarily a management issue and knowledge management is often considered an information technology issue, the two disciplines are beginning to merge with a mutual understanding of knowledge and its origins. However, it appears that neither has offered a comprehensive foundation on which to build (Zhang and Faerman 2003). An interdependency of knowledge management and organizational learning is apparent in much of the literature (Alavi 2000, DiBella and Nevis 1998, Simon 1957, von Bertalanffy 1950). Thus, a knowledge management system must both manage and expand organizational memory. A knowledge management system with a strong organizational learning foundation is believed to increase an organization's potential for effective action (Alavi 2000, Davenport and Prusak 1998, Grant 1996, Pfeffer and Sutton 1999). A learning foundation is one that

facilitates organizational knowledge creation. This learning is dependent on a dynamic, yet accurate organizational memory that is easily accessible and contains multiple perspectives. Additionally, learning systems must provide for information acquisition and sharing, as well as knowledge transfer and integration. The architecture on which to base this process should include features for facilitating information/knowledge acquisition, discovery, and sharing as well as supporting codification, storage, and management of explicit knowledge. However, little has been done to establish a theoretical foundation on which to build a learning-oriented knowledge management system. Crossan, Lane, and White (1999) argue that organizational learning research is rich in understanding but lacking in theory; they further argue that knowledge management adds to the understanding of organizational learning but does not properly emphasize the acquisition and reuse of organizational knowledge (Crossan, Lane, and White 1999). They suggest five premises of organizational learning: 1) that organizational learning must be concerned with new knowledge acquisition and creation, 2) existing knowledge must be reused, 3) learning must work on all levels within the organization, 4) learning must have a social orientation, and 5) an understanding of the interaction of cognition and action is critical.

Recent research suggests that practitioners have a definite sense of what a knowledge management system should provide. For instance, firms in Tiwana's (2001) study indicate that their knowledge management needs include capturing, storing, and retrieving intellectual assets, quickly finding pertinent information, and facilitating information/knowledge sharing. Practitioners in a more recent study (King, Marks, and McCoy 2002) include as major issues the ability to use a system for strategic advantage, the ability to verify both the relevancy and legitimacy of organizational memory components, and the ability to maintain organizational memory currency. Four necessary abilities of a knowledge management system emerge when the above

practitioner concerns are synthesized. First, a knowledge management system must be able to handle storing and retrieving explicit knowledge in a dynamic organizational memory environment while facilitating organizational learning. Second, the system must be able to provide its users with confidence in the organization's memory through facets such as verifying accuracy, maintaining currency, and encouraging growth. Third, the system must be able to discover and retrieve useful information. Fourth, the system must encourage interactivity between organizational members. Support for these activities must be addressed during the design of a learning-oriented knowledge management system.

In a learning-oriented knowledge management system, the information gathering/hypothesis generating phase is an ongoing phase that performs the actions necessary to update the existing knowledge base, detect an opportunity or need, develop hypotheses regarding relationships of newly discovered information, and define a desired state that may be a goal or direction recognized as possible after analysis of new information. The knowledge creation phase is responsible for analysis of the hypotheses and the desired states, utilizing any one or more of the five inquirers implicit in the system, adding to the knowledge stores as knowledge is created. A decision maker is then able to use the results of the analysis from either previous phase, in combination with that individual's tacit and experiential knowledge, to choose an action that will begin the movement from the current state to the desired state, which is in essence a decision support step.

The design of the LOKMS includes data management, support for organizational learning and adaptation, and generating information that is applicable to the problem at hand, is accurate, is timely, and conveys multiple perspectives. The design method for the LOKMS is the procedures necessary to guarantee management, applicability, accuracy, timeliness, inclusion of multiple perspectives, and support for organizational learning. The ability to produce the design

product is handled collectively by the different components (fig.1). These components are derived not only from the design of the

LOKMS, but also from the meta-design of the inquirers themselves.

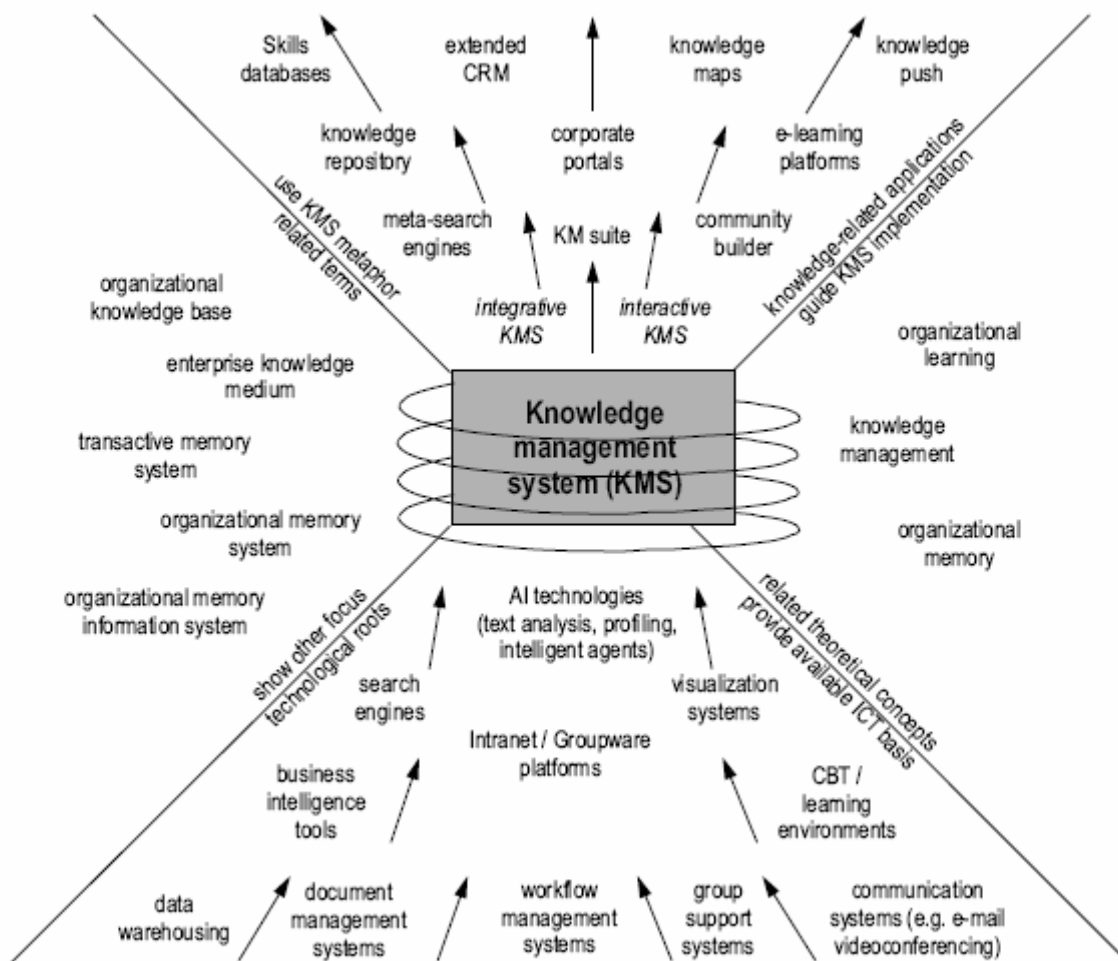


Fig.1-Technological roots and influences of KMS (Maier, R., 2002)

The Army Knowledge Management Principles are organized around the main tenets of knowledge management: people/culture, process, and technology working together to facilitate knowledge sharing. The challenges the Romanian Army and the national security community are facing cut across missions in the modern battlefield, organizational boundaries, and uncertain and rapidly changing political and military environments. The 21st century Revolution in Military Affairs is predominantly characterized by a rapid pace of technological change and the required transformation in doctrine and organization. The new warfare highlights the rising importance of

having a knowledge advantage over adversaries. New technologies have resulted in increasingly dynamic, unpredictable and complex operations that require people to filter and analyze information from multiple sources. Sense-making, problem solving and decision-making are more complex and more essential in military situations than ever before, expertise, and interoperability are also important factors in a military organization's ability to attain knowledge superiority. Command and control is taking on new dimensions, and the role of military personnel is evolving into that of 'knowledge worker'. The application of KM principles and techniques in the mili-

tary context could affect both how new military technologies are employed for the knowledge advantage, and how Romanian Forces and military doctrine will evolve. The authors advance a conceptual framework for the application of QFD to optimising knowledge management, in the field of military education, for the land forces officers in Romania. QFD is a method for defining design qualities that are in keeping with customer expectations and then translating those customer expectations into design targets and critical quality assurance points that can be used throughout the production/service development phase. By focusing resources on the key elements resulting from the real requirements of the modern society and the modern battlefield, on the qualitative standards specific to higher education, on the real needs of the expressed by students, graduates, teachers, training personal and military staff it can be determined whether simple improvements of the knowledge management system are sufficient or a new information system is needed to increase the efficiency of the transformation process in all military higher education institutions have undergone. The preparation of our plan was a complex and delicate exercise. Like any therapy, our methodology had to be based on a precise and exact diagnosis of the LFA knowledge management. The latter was indispensable in the process of planning: it made possible to take stock of the state of the knowledge management in our academy, and identify problems through a detailed and critical analysis in order to be able to propose solutions. The diagnosis (result of QFD anal In other words, a isy) enabled the identification of needs, which the plan, through the definition of new strategies, the crating of the knew management system architecture , the testing, the validating is supposed to meet. The definition of objectives, the choice of theoretical models and proper software decisions were based on objective data, which did not only give an idea of the functioning of the military knowledge management system, but also helped in planning the new architecture, testing and validating the integrated MKMS. The

important phases described and analyzed in our paper are: *Understanding the context* an audit of the current knowledge management provision and includes an analysis of all relevant information All the analyses developed during this phase have been done based on the seven phases introduced by Blitz QFD. Gathered the voice of our customer. Went to *gemba (students and teachers and researchers needs of information , data bases , data mapping, software , modelling and simulation military mission abroad, applications, operational units etc.)* Analyzed the Verbatims. (Structured the Military professionals needs to be educated. What is their structure? What do officers think about their needs? Define the Needs Structure. What needs are missing, unstated, or implied? Prioritized the Needs (Hierarchy process). Which are the most important needs in the context of the modern knowledge management? Why? Deployed and Prioritized Needs. What do we have to do in order to meet their needs, what do they have to study in order to be prepared for the new requirements of the military career, wat software and technology is missing to accomplish the objective? Analyzed [only] important relationships in detail using multidimensional analysis. For example: high-value items, high value tasks, or high-risk items.

The performed questionnaires focused on two fundamental elements: Information has also been gathered through direct observations, interviews, focus-groups and field work. Consideration has also been given to the possibility that the respondents might not have been aware of, or could have misinterpreted their own as well as the organization's needs. We have consequently formed a work group of military science, management of organization, decision theory, marketing and operational research specialists whose task was to draw up the architecture of a modern MKMS from the education institutions concerned. This sets the

context for future KMS planning that will best support student learning. *Planning and resourcing* involves an audit of the current knowledge management made using and includes an analysis of all relevant information to build up an understanding of the learner profile. This sets the context for future curriculum planning that will best support student learning. *Implementation* (involves interpreting the Academic quality, the Essential Learning Standards and the post-compulsory frameworks to create a management system that has a clear focus on what is to be learnt, how learning will occur and how it will be assessed. Consideration is given to organisational structures and resourcing that account for student diversity) *Continuous monitoring* (this phase involves monitoring student learning on a continual basis as the knowledge management system is being implemented. *Evaluation and review* (this phase involves the evaluation of the MKMS and resulting student outcomes at key points resulting from the customer requirements in time.

„Nicolae Bălcescu” LFA is an education institution at the service of the Land Forces and the Romanian Army that has as a purpose the formation, specializing and professional development in the branch of the active and reserve military personnel, capable of insuring, according to the positions they prepare for, the management of accomplishing specific tasks during peace time, crisis situations and war, on the national territory or within the multinational structures.

To achieve this aim, at the level of the Academy headquarters and of the comprising and subordinated centres there is a preoccupation for the implementation of the Emergency Decree no. 75 / 12.07 2005 concerning the insurance of education quality. This preoccupation is influenced by the teaching and non-teaching personnel understanding of the fact that the Academy

represents a very important link of the educational system for the formation for the first appointment, specializing in the branch and professional development of the military personnel, that the training. Simulation contributes to ensuring holistic educational development, coherence in the development of sub-sectors, and a better understanding of the implications of particular policies and strategies, by facilitating the projection of pedagogical and institutional inputs, as well as the financial resources which these imply.

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# GUIDELINES FOR MANAGEMENT OF QUALITY IN THE EUROPEAN HIGHER EDUCATION

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**Abstract:** *The main results, guidelines and recommendations are:*

- *There will be European standards for internal and external quality assurance, and for external quality assurance agencies.*
- *European quality assurance agencies will be expected to submit themselves to a cyclical review within five years.*
- *There will be an emphasis on subsidiarity, with reviews being undertaken nationally where possible.*
- *A European register of quality assurance agencies will be produced.*
- *A European Register Committee will act as a gatekeeper for the inclusion of agencies in the register.*
- *A European Consultative Forum for Quality Assurance in Higher Education will be established.*

**Key words:** *educational management, management of quality, higher education*

## 1. Introduction

Quality assurance in higher education is by no means only a European concern. All over the world there is an increasing interest in quality and standards, reflecting both the rapid growth of higher education and its cost to the public and the private purse. Accordingly, if Europe is to achieve its aspiration to be the most dynamic and knowledge-based economy in the world (Lisbon Strategy), then European higher education will need to demonstrate that it takes the quality of its programmes and awards seriously and is willing to put into place the means of assuring and demonstrating that quality. The initiatives and demands, which are springing up both inside and outside Europe in the face of this internationalisation of higher education, demand a response. The commitment of all those involved in the production of these proposals augurs well for the fulfilment of a truly European dimension to quality assurance with which to reinforce the attractiveness of the EHEA's higher education offering.

However, some fundamental principles should permeate the whole work:

- the interests of students as well as employers and the society more generally in good quality higher education;
- the central importance of institutional autonomy, tempered by a recognition that this brings with it heavy responsibilities;
- the need for external quality assurance to be fit for its purpose and to place only an appropriate and necessary burden on institutions for the achievement of its objectives.

## 2. The Bologna Process

The EHEA is to be achieved by creating a common structure (consistent and compatible systems and processes) for higher education and training which is sufficiently flexible to allow national requirements to be met. There is a corresponding process for further education called the Copenhagen process.

Two significant recent developments in the Bologna Process are the adoption in 2005 of *'Standards and Guidelines for Quality*

*Assurance in the European Higher Education Area'* (Bologna Standards and Guidelines) and *'The framework of qualifications for the European Higher Education Area (Bologna Framework)'*.

The Bologna Standards and Guidelines are contained in a report to Bologna Ministers entitled *'Standards and Guidelines for Quality Assurance in the European Higher Education Area'* developed and drafted by ENQA through its members and in cooperation with EURASHE, ESIB and EUA. (ENQA is the European Association for Quality Assurance in Higher Education; EURASHE is group of national and professional associations of colleges and polytechnics and individual Institutions; ESIB is the students group and EUA is the European University Association. These four bodies meet regularly as the E4-Group. ENQA coordinates E4-Group meetings which include representation from the European directorate-general of Education and Training.)

The main recommendations in the ENQA report on Standards and Guidelines include:

*There will be European standards for internal and external quality assurance, and for external quality assurance agencies.*

*European quality assurance agencies will be expected to submit themselves to a cyclical review within five years.*

*There will be an emphasis on subsidiarity, with reviews being undertaken nationally where possible.*

The current focus of the Bologna Process is on

- *implementation of the standards and guidelines for quality assurance;*
- *implementation of the national frameworks for qualifications;*
- *the awarding and recognition of joint degrees, including at the doctorate level;*
- *creating opportunities for flexible learning paths in higher education, including*
- *procedures for the recognition of prior learning.*

There follow some observations on the Bologna process:

- Significant progress has been made, there is widespread support for the process and we

now have some of the main tools for exchanging information about the quality and standards of higher education programmes. What is still lacking at this early stage is practical expertise and know-how in using those tools consistently so that the decisions made are repeatable. This will come in time provided various communities of practice candidly share experiences and stakeholders remain open to change.

➤ This lack of practical experience also applies at the programme level where the switch to learning outcomes and a student centred approach will take some years to embed. The new learner centred approach will not happen by *fiat* but by individuals and institutions changing their approach to teaching and more important to assessment. This new approach also requires that external quality agencies adapt their methods to encourage focus on outcomes and the 'value added' to learners.

➤ HEIs and External Quality Assurance Agencies will generally be able to comply with the Standards and Guidelines for quality for Quality Assurance in the European Higher Education Area. How much transparency this will actually create and whether it will be sufficient to engender the trust required to encourage acceptance of quality and accreditation decisions at face value remains to be seen. One suspects that supplementary instruments such as mutual accreditation/QA agreements might be required.

➤ It is by no means clear that the classification by the non-specialist of qualifications using the Bologna Framework will lead to repeatable decisions. The problem is that the learning outcome statements are open to a broad interpretation unless one is aware of the context in which they were developed. The best way to address this is to contextualise the framework by publishing examples of Cycle 1 and Cycle 2 programme outcomes in the main disciplines. The work of the Tuning Educational Structures in Europe group which is expressing outcomes for individual disciplines will be very valuable in this respect.

The European Parliament published a recommendation on 'further European cooperation in quality assurance in higher education' in 2006 (EC 2006). It recommends *inter alia* that Member States encourage the establishment of a European Register of Quality Assurance Agencies and

- 'encourage all higher education institutions active within their territory to introduce or develop rigorous internal quality assurance systems, in accordance with the standards and guidelines for quality assurance in the European Higher Education Area adopted in Bergen in the context of the Bologna Process';
- 'encourage all quality assurance or accreditation agencies active within their territory to be independent in their assessments, to apply the features of quality assurance laid down in Recommendation 98/561/EC and to apply the common set of general standards and guidelines adopted in Bergen, for assessment purposes. These standards should be further developed in cooperation with representatives of the higher education sector. They should be applied in such a way as to protect and promote diversity and innovation';
- 'enable higher education institutions active within their territory to choose among quality assurance or accreditation agencies in the European Register an agency which meets their needs and profile, provided that this is compatible with their national legislation or permitted by their national authorities';
- 'allow higher education institutions to work towards a complementary assessment by another agency in the European Register, for example to enhance their international reputation'.

### 3. National legislation

- Law No. 75 / July, 12th 2005, that regulates quality assurance in education;
- Secondary legislation: OMEdC (ministerial orders) specific to the pre-university / higher education system.

### 4. QA Guidelines in Romania

- The guidelines supported by the Ministry of Education and Research and the specific strategies for their implementation contribute to the ongoing assessment, assurance, control and improvement of quality in education.
- Funding for QA in education comes from public sources, particularly on the basis of quality.
- Learning institutions must function so as to satisfy public trust through the quality of their activities, while education becomes a public good.
- The guidelines of quality assurance for Romanian education are permanently correlated to the actions supported at the European and world level.

### 5. Specific concepts of the QA system in Romania

- *The quality of education* is the total number of features of a study program and of its provider, through which the beneficiaries' expectations, as well as quality standards are assured.
- *The assessment of educational quality* is constituted by the multi-criteria based examination of the extent to which an organization providing education and its program reach the reference standards.
- When quality assessment is supplied by the same organization providing education, it turns into an *internal assessment*.
- When quality assessment is supplied by a national or international agency, it turns into an *external assessment*.

### 6. Quality assurance in education ...

- Quality assurance is realized through a set of actions aiming at developing the institutional ability to establish, plan and implement Study programs which help beneficiaries confide in the fact that the organization providing education achieves all quality standards.
- Quality assurance reflects *the ability of an organization providing education to offer learning programs, according to the asserted*

*standards* and it is thus promoted so as to lead to the ongoing improvement of educational quality.

➤ *The improvement of educational quality* requires ongoing assessment, analysis and corrective action from the organization providing education, based on selecting and adapting the most suitable *procedures*, as well as on the selection and implementation of the most relevant *reference standards*.

### **7. The internal assessment of quality – Quality Assurance at institutional level**

➤ At the level of each organization providing education in Romania, *a commission for quality assessment and assurance is established*.

➤ The organization providing education develops and adopts the strategy and functioning rules of the commission for quality assessment and assurance.

➤ The organization's leader is directly responsible for the quality of provided education.

➤ The commission for quality assessment and assurance is made of 3 to 9 members. Its operational management is assured by the organization's leader or by a designated coordinator

### **8. The internal Quality Assurance**

➤ After having obtained the temporary functioning authorization, the organization that provides education implements the mechanism of internal quality assurance and writes reports on the internal assessment of educational quality which are sent each year to ARACIS.

➤ After having received the accreditation, the annual reports of internal quality assessment are sent to ARACIS, answering the agency request or its own initiative. It then asks for a new external assessment.

ARACIS is an independent public institution, of national interest, which possesses juridical personality and its own budget. Its location, internal structure and functioning rules and regulations are established by the Government, as ARACIS suggested. ARACIS is a self-financing institution.

### **Conclusions**

The examination of methodologies demonstrates that:

- the agency's processes and results reflect its mission and goals of quality assurance;
- the agency has in place, and enforces, a non-conflict-of-interest mechanism in the work of its external experts;
- the agency has reliable mechanisms that ensure the quality of any activities and material produced by subcontractors, if some or all of the elements in its quality assurance procedure are subcontracted to other parties;
- the agency has in place internal quality assurance procedures which include an internal feedback mechanism; an internal reflection mechanism; and an external feedback mechanism in order to inform and underpin its own development and improvement.

Almost all countries have made provision for a quality assurance system based on the criteria set out in the Berlin Communiqué and with a high degree of cooperation and networking. However, there is still progress to be made, in particular as regards student involvement and international cooperation. Furthermore, we urge higher education institutions to continue their efforts to enhance the quality of their activities through the systematic introduction of internal mechanisms and their direct correlation to external quality assurance.

We adopt the standards and guidelines for quality assurance in the European Higher Education Area as proposed by ENQA. We commit ourselves to introducing the proposed model for peer review of quality assurance agencies on a national basis, while respecting the commonly accepted guidelines and criteria. We welcome the principle of a European register of quality assurance agencies based on national review. We ask that the practicalities of implementation be further developed by ENQA in cooperation with EUA, EURASHE and ESIB with a report back to us through the Follow-up Group. We underline the importance of cooperation between nationally

recognised agencies with a view to enhancing the mutual recognition of accreditation or quality assurance decisions.

We commit ourselves to upholding the principle of public responsibility for higher education in the context of complex modern societies. As higher education is situated at the crossroads of research, education and innovation, it is also the key to Europe's competitiveness. As we move closer to 2010, we undertake to ensure that higher education institutions enjoy the necessary autonomy to implement the agreed reforms, and we recognise the need for sustainable funding of institutions.

The European Higher Education Area is structured around three cycles, where each level has the function of preparing the student for the labour market, for further competence building and for active citizenship.

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## ANALITICALS ELEMENTS OF CUSTOMER SATISFACTION MANAGEMENT

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SEAL MAKER ROMANIA

**Abstract.** *Improving quality and customer satisfaction has received considerable attention in recent years. This study examines construction in terms of customer satisfaction and quality. A framework is developed to evaluate the dynamics of customer satisfaction and quality. An empirical analysis is conducted to explore customer satisfaction in analytical elements. Results indicate that the need for contractors to improve performance relates mostly to new elements, handover procedures... For a contractor, the main benefit of high customer satisfaction is the opportunity to remain a customer's potential partner in the future.*

Customer satisfaction is a function of perceived quality and disconfirmation— the extent to which perceived quality fails to match repurchase expectations. Customers compare the perceived performance of a product (service, goods) with some performance standard. Customers are satisfied when the perceived performance is greater than the standard (positively disconfirmed), whereas dissatisfaction occurs when the performance falls short of the standard (negatively disconfirmed). Additionally, there is an extensive difference between the loyalty of *merely* satisfied customers and those who are *completely* satisfied. Customers who are just satisfied find it easy to switch suppliers when a better offer comes along.

We must understand customer expectation levels concerning quality. We must understand the strategy for customer service quality and we must understand the measurement and feedback cycles of customer satisfaction.

The customer is the person or unit receiving the output of a process on the system. In fact, it is worth emphasizing that a customer can be the immediate, intermediate, or ultimate customer. Also, a customer may be a person or persons, or a process or processes.

Customer satisfaction, however, is when the customer is satisfied with a product/service that meets the customer's needs, wants, and expectations. To further understand customer satisfaction, we must take a deeper look at the levels of specific satisfaction. We must also recognize that there are levels of customer satisfaction that, in a sense, define the basic ingredients of quality. There are at least three levels of customer expectations about quality.

Profit in business comes from repeat customers; customers that boast about your project or service, and bring friends with them'. Deming's words have never been more pertinent than in business today, where companies are scrambling for customers in a depressed economic climate.

Building customer satisfaction is the analytical logical step in a chain that leads from product and process quality towards a complete mutually-beneficial relationship of loyalty and trust between customer and supplier.

It is difficult to keep in mind the fact that a quality focus has not always been a given. We are now surrounded by various quality models (six sigma, ISO 9000, the excellence model etc) and it is easy to adopt them as an end in themselves, forgetting who is supposed to be at the heart of these initiatives - the customer.

Customers have benefited hugely from the emphasis that quality now has in industry but traditional methods of ensuring consistent product and process quality are no longer enough. Most organisations now have a quality focus - so how do businesses stand out from the crowd? The potential answer is to redefine what is meant by quality, and to redefine it in terms of what the customer wants.

What is important to customers? Product quality? Process quality? The quality of the relationship? All of these are important, but only as a means to an end from the customer's point of view. What the customer is interested in is results. Customers don't buy quarter-inch drills; they buy quarter-inch holes. are a new concept in analytical elements of customer satisfaction management. It does not matter how good your drills are, or even how well you service and maintain them. If a competitor comes up with a better and cheaper way of making quarter-inch holes customers will be lost. This is why it is so important to constantly strive to find out what customers' priorities are.

Internally-focused quality was a differentiator 20 years ago. Now, moving the focus to customers is the source of differentiation, and it is this differentiation from competitors that leads to customer loyalty.

Why is customer loyalty valuable to a business? The most immediate manifestation of loyalty (although it can also arise from a lack of alternatives) is repeat business or retention. It has been shown by the American Consumer Association and others that it costs somewhere between five and 20 times more money to attract a new customer than it does to keep an existing one.

What accounts for this difference? A number of factors normally play a part:

- almost all of the cost of acquiring customers (marketing costs and the costs of establishing a relationship) fall in the first year of a relationship;
- the base profit of sales is usually constant over the whole course of a relationship - but will not normally begin to offset customer acquisition costs until some time into the relationship, often in the second year;

- the longer customers stay with you and the more loyal they are the more likely they are to try new products, as you cross-sell and they come to think of you as a trusted supplier and their first port of call;
- long-term customers tend to be cheaper to service, as they have come to understand how you operate and know what to expect;
- loyal and satisfied customers will recommend you to others - a huge benefit since referral customers are free (in terms of acquisition costs) and research has also shown that referral customers are the best customers, since they tend to have a similar profile to your existing loyal customers;
- in the long term a loyal customer base will be prepared to pay a price premium for the perceived benefits that you offer over competitors. Customers have been shown to evaluate relationships in terms of the value that they receive and loyal customers will trust you to provide good value.

The key is to understand the value of customers to your business based on the whole lifetime of their relationship with you, rather than on the traditional 'transactional' approach. Perhaps the most famous example of this in action is the company, where employees were encouraged to treat the customer not as someone buying a product.

Concentrating on the relationship rather than each individual sale also allows an organisation to swallow very high acquisition costs, since it can be confident that these costs will be recouped in time.

So what is the lifetime value of a customer? For the new generation of companies, it depends strongly on your market. So how do you calculate it?

There are at least two possible approaches. A good starting point, particularly if the aim of the exercise is to grab attention and focus the organisation on the importance

of customer loyalty, is to use a 'back of the envelope' approach. Although simplistic this will give you a guide, and usually makes an impact. You can estimate any of the figures that you do not have exact data for. This is how the company did their calculations:

Customer lifetime value = average customer lifetime x average purchases per year x cost of purchase.

The alternative is to calculate the detailed course of an average customer lifetime. You should really discount the final profit figures to give the net present value of these future profits, but the results are still impressive. The results can vary widely depending on the market, but they have been shown to work in all sectors, for service organisations and for manufacturers.

A few companies have managed to build robust statistical models linking key components of the value profit chain that is central to relationship-based thinking. The value profit chain represents the linkages that have been proved to exist between the way management treats employees, the way employees treat customers and business success. Each model represents a value equation (which in the case of customers can be interpreted more or less straightforwardly as a 'what you get for what you give' trade off). The customer value equation:

Value = (Results + Process) + (Customer access costs + price);

A customer survey is the tool for assessing where you are positioned against this equation, and ideally should also include elements of competitor analysis in order to understand your standing in the market.

In order to be successful it is essential to differentiate yourself from your competitors. Purchasing decisions are essentially a question of value for money, so you must differentiate yourself either on price or on benefits conveyed to the customer (or both). Price is often the default choice but it dooms you to commoditisation. If you can persuade customers that you are offering them the best solution tailored to fit their needs, at a fair price, then you will have a much more profitable and loyal customer base.

The first link in the value profit chain is between employee value and customer value, and this is no coincidence. Abundant research indicates a link

between how employees feel and how they behave towards customers, and this inevitably has a significant role to play in how satisfied customers are. The first step towards customer focus is internal -you must deliver value to your employees. Once you have a workforce that is firmly aligned behind the organisation's strategy, and engaged enough to deliver the service your customers require, a firm customer focus becomes relatively easy to implement, and you will see swift rewards.

Throughout the whole of this process an essential foundation is regular, reliable measurement upon which to base decisions, and to serve as a basis for setting priorities and sharing best practice.

Customer satisfaction measurement is at the heart of the value profit chain, and represents the tool by which internally-focused quality models can begin to look at organisations the way the customer sees them. In time the value profit chain will ensure that satisfying customers today will create satisfied shareholders tomorrow.

The strategy issue is also a very important element of customer satisfaction, primarily because it sets the tone for the appropriate training, behavior, and delivery of the specific service. There are four items that the strategy for service quality ought to address:

- *Customer service attributes.* The delivery of the service must be timely,

accurate, with concern, and with courtesy. One may ask why are these elements important? The answer is that all services are intangible and are a function of perception. As such, they depend on interpretation. In addition and perhaps more importantly, service by definition is perishable and if left unattended, it can spoil on the organization.

The services attributes can be used to signify the importance of service. This is caring, observant, mindful, friendly, obliging, responsible, and tactful. These characteristics are the most basic attributes of customer service and without them, there cannot be a true service of any kind. They all depend on interpersonal skills, communication, empowerment, knowledge,



sensitivity, understanding, and some kind of external behavior. For example, *caring* will show that, indeed, you are interested in what the customer will have to say. You may spend time with a customer to find out the customer's real needs, wants, and expectations. It is not unusual to tell a customer that you may not be able to help, even at the expense of losing the sale. Furthermore, you may go as far as suggesting the services of someone else or some other company.

- You must be *observant*. In most cases when dealing with service-related

items, observations may contribute more to satisfying the customer than direct communication. Pay attention to body language and mannerisms and, if necessary, listen between the lines. Always try to be a step ahead of the customer. Anticipate the customer's action. Actively listen for what the customer is communicating, but also—and, perhaps, more importantly—listen for what the customer is *not* communicating.

- You must be *mindful*. Remember that you and your organization exist

to satisfy the customer. Without the customer's need, you do not have a job and the organization does not have a service to provide. The customer has a choice and, as such, if you or the organization does not recognize the urgency, sensitivity, uniqueness, expectations, and influence that the customer has, you will not be successful in satisfying the customer.

- You must be *friendly*. Friendliness does not mean being a pest. Offer

guidance and information, and let the customer know you are there to help. If necessary, provide feedback to assist the customer in making a decision. If you do provide feedback, be truthful. For example, in a retail industrial products, someone walks into your department, walks around, picks up some products, and tries it on. As a salesperson, you may advise the customer about fit and answer any questions that the customer may have.

- You must be *obliging*. Patience is the key word to customer satisfaction.

Sometimes customers do not know what they want. They are making up their minds as they go along. You are serving as the guinea pig for their decision. As such, accommodating them may make the difference between a satisfied and an unsatisfied customer, or the difference between a sale and a walkout. When obliging the customer, do not hesitate to educate the customer as well.

- You must be *responsible*. You are the expert. The customer is looking

to you to provide the appropriate information in a clear, concise, and easy-to-understand manner. Don't try to make the sale at all costs. This may backfire. What you are trying to accomplish is to develop a relationship where your expertise can indeed help the customer.

- You must be *tactful*. In any service organization, and in any service

delivery, there are going to be problems between you and the customer. Do not panic. Tactfulness is the process by which the conflict may be resolved. Your focus is to satisfy the customer and, as such, you should try to identify the problem, analyze it, and then resolve it in the most expedient way.

Being tactful does not mean that you have to give in to the customer all the time. What it does mean is that you act in a composed, professional manner and communicate to the customer in a way that is not threatening or demeaning. Being tactful means you are willing to listen and exchange information with the intention of resolving the conflict.

It means you have a way of presenting the facts and information in a nice and nonintimidating way. It means listening patiently, thinking before speaking, and listening to what the customer says without interruptions.

Notice that cost is not an attribute that will make or break service and/or satisfaction. In service especially, cost is equated with value. That is not to suggest that high cost is prerequisite to good service or vice versa. We simply suggest that one must continue to

generate more value for the customer but not give away the house. It is indeed a very delicate balance.

*Approach for service quality improvement.* The basic question one must be able to answer is *why bother with service quality?* The answer is in a threeprong approach. The first is cost, the second is time to implement the program, and the third is the customer service impact. Together, they present a nucleus for understanding and implementing the system that is responsive to both customers and organization for optimum satisfaction. For example, the hydraulic and pneumatic systems are working on the notion of sensuous industrial applications. Basically, the application itself gives you a kind of delight and surprise just opening the door, hearing the sound, pressing the accelerator. Everything is being thought through *now*, almost emotionally.

*Develop feedback systems for customer service quality.* The feedback system one chooses will make or break the organization. Make sure not to mix the focus of customer satisfaction and marketing. They are not the same. The focus of customer service and satisfaction is to build loyalty, and the focus of marketing is to meet the needs of the customer profitably. Another way of saying it is that marketing's function is to generate customer

value profitably, whereas the purpose of customer service and satisfaction is to generate repeatability, recognition, and overall satisfaction of the transaction.

The concern here is to make sure that a goal exists (a reporting system for measurement is appropriate and useful for the particular service) and to reach the reward of service quality. The question then becomes how to develop a system that is responsive to the customer's needs, wants, and expectations. To answer these concerns, look to the customer for answers. The value of the information must be focused in at least the following areas:

- To know what customers are thinking about you, your service, and your competitors
- To measure and improve your performance
- To turn your strongest areas into market differentiators
- To turn weaknesses into developmental opportunities—before someone else does
- To develop internal communications tools to let everyone know how they are doing
- To demonstrate your commitment to quality and your customers.

## GEOPOLITICS - BETWEEN BLACK AND WHITE

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**Abstract:** *In present days, the territorial conflict generates conflicts of ideas, different perceptions of the conflict issues and not the truth. Geopolitics in present days offer the leader the necessary tools for decision making, in addition to the ideas and perceptions existing at a large social level.*

**Key words:** *Geopolitics, Past, Present.*

“...The war has to be assessed based on five fundamental factors: moral influence, atmospheric conditions, land, the commander (authority) and the doctrine [...] There is no general who has not heard of these five points. Those who master them **win**; those who do not master them are **defeated**”, said Sun Tzu more than 2500 years ago, in the first treaty on the ‘art of war’ from the history of mankind. And precisely the history of mankind has shown us clearly that nature is the perpetual winner, that nature is the great leader of “*homo sapiens*” and, implicitly, of its political actions. In essence, from ancient times, both exceptional military leaders and outstanding politicians have been guided in their actions by personal perceptions on the issues we now call geopolitics; when these issues have been ignored, the sole result of their actions has been failure.

Geopolitics has been, is and will always be present in the actions of mankind, as it shows us the only pertinent general view of the world and more precisely, on the world’s political configuration.

Far from attempting an analysis or an explanation of the notion and concept of geopolitics, this paper tries to formulate a question and a few answers on the goal, usefulness and use of geopolitics within the larger context of its issues, aimed towards explaining the close relationship between geography and politics.

So, on what side on **good** and **evil** do we find geopolitics? Is geopolitics the scientific base for explaining facts and events entwined in a unitary whole with the goal of offering a global vision within space and time limits and can it offer a scientific forecast of future actions?

OR is geopolitics just a smokescreen, a motivation for contradictory official actions or an instrument of political actions from the supreme authority, specifically in the use of force and “*unorthodox means*” in the achievement of goals which are many times expansionist and against human kind?

This paper is by no means trying to support “*conspiration theories*”; instead, keeping in mind Descartes’ motto “*I doubt, so I think; I think, so I exist*”, this paper tries to formulate possible answers through the power of examples offered by moderns history.

### 1. PAST

At the end of the 19<sup>th</sup> century, after the end of the great colonization and conquests, the United States of America enjoyed geographical advantages which had only potential strategic value, as their economic force was not able to support the exploitation of their potential and value. Also, US had no naval force – commercial and especially military – capable of taking control of the vast expanse of water surrounding their territory and to dominate the region.

Alfred MAHAN (1840-1914), admiral of the American navy, notices all these achievements and advances the idea that the new continental state has to become a maritime power. The basis of this requirement derives from the fact that the US of the time fulfilled two of the three necessary conditions (in his opinion) to become a great maritime power: 60% of its borders were sea borders as no immediate powerful neighbor. The third condition referred to the existence of a naval capacity and a high potential of the maritime fleet.

This condition has been fulfilled by the US during president Roosevelt's term, as he was the one to put in practice Mahan's idea to build a powerful link between the largest water areas of the world, the Pacific and Atlantic oceans, through the Panama Canal. Its existence raised the problem of its security, vital to the US, which led to the necessity and finally the creation of a naval superiority both in the Caribbean and Eastern Pacific.

Thus, the Hawaii archipelago becomes a vital strategic point for US's defense against an attack from Asia, attack which in 1940 became a reality, as it was perpetrated by a stronger force. In that moment, Mahan's predictions became reality.

A contemporary of Mahan, the English Sir Halford MACKINDER (1861-1947), refines the geopolitical ideas of the American admiral. Thus, in the 1904 paper named "*The Geographical Pivot of History*", he extends the concept of "*maritime power*" and transforms it into "*ocean power*", as opposed to the concept of "*continental power*".

The central topic of the paper is that universal history and world politics have been strongly influenced by the huge space within Eurasia, named "*HEARTLAND*" and the domination of this space means the basis for any attempt to dominate the world. For the control of the Heartland, he considered the Eastern Europe as having a key role. "*He who rules Eastern Europe rules the Heartland. He who rules the Heartland rules the Island of the World. He who rules the Island of the World rules the World...*" says Mackinder in his work.

In this context, he sees a danger to Great Britain generated by a potential union between the continental powers on the axis Germany – Russia – China and he recommends that his country leads an intelligent policy with the particular purpose of preventing the formation of Berlin-Moscow axes.

In the context of the beginning of a century, when Great Britain symbolized the ocean power and a great Russia a large typical continental power, Mackinder realizes that his country may become inferior to the newly born continental power, the Soviet Union, so he suggests a close collaboration between the US (as a continental-size country, with the advantage of a deep defense), Great Britain (as a large Malta) and France (as the compulsory bridge head, essentially maintain and defend).

Considering these theoretical approaches, let us remember the events that took place at the beginning of the 20<sup>th</sup> century, which culminated with the two world wars. The formation of the two initial axes: London-Paris, joined shortly by Washington, versus Berlin-Rome-Tokyo-Moscow, with the latter joining quickly the first axes, serves as a confirmation of Mackinder's geopolitical theories, strengthened by the events following the second world war. The events we live today serve as a confirmation that the struggle to control the key element – Eastern Europe has still not ended.

In this context, a short incursion into the "dark side" of geopolitics is needed; this dark side is generally related to the prolific German geopolitics between the two world wars and especially to the ideas of an emblematic personality named Karl HAUSHOFER.

Social-Darwinist in conception, Haushofer considered himself the intellectual follower of the fathers of geopolitics: Swedish Rudolf KJELLEN and German Friedrich RATZEL, but his geopolitical analysis came much closer to the geographic determination of history, centered on Eurasia, of the American Halford MACKINDER.

Haushofer's theory regarding the insurance of the preservation of the existence of the state-organism, through the occupation of a suitable space through ethnic dissemination (Volk), racial dissemination (Blut) and cultural

dissemination (Kultur) has been viewed by specialists and strengthened by some pertinent testimonies as the basis for Adolf Hitler's "Main Kampf" – the doctrine of the Nazi regime.

Thus, the concepts he promoted in relation with "expansion towards East", which were intended to ensure the creation of a compact German "cultural space", gave Hitler an ideological base and have underlined his policy of territorial conquest. At the same time, he rejected violently the attack on the Soviet Union, considering it a severe mistake, idea based on powerful geopolitical arguments.

Still, Haushofer undertook the responsibility of inspiring and implementing Germany's hitlerist foreign policy; as he was aware of the prejudices on the subject, he tried to exonerate geopolitics in a last paper before his death named "Defense of German Geopolitics", by showing that the nature of the geopolitical approach was to guide the practical policy, to avoid the errors, to signal in time constraints and tendencies not taken into account by the politician and not to dictate to the politicians the way of action.

Obviously, the entire work of Haushofer contributed to the development of the German geopolitics and is not limited to the few concepts and ideas taken out of their context and which inspired the doctrine of the Nazi German foreign policy. It is only appropriate to consider Haushofer's geopolitics in a purely scientific manner, in accordance with the space and time context of its generation and to acknowledge the fact that geopolitics is not confined to the limits of the German geopolitics.

## 2. PRESENT

The Cold War has transformed the world into bipolar world. This bipolar organization is visible through: a geopolitical bipolarity, an ideological bipolarity and a psychological bipolarity, has generated an intense rivalry between the capitalist and socialist blocks; this rivalry has polarized the attention of the whole world, being promoted as an ideological conflict covering practically the geopolitical

behavior of the two main blocks. The geopolitics during the Cold War has been isolated in the dungeon of the denial of knowledge, under the motivation of the "role" played by it in the Nazi doctrine, but also due to its capacity of unearthing political truths which, under the mask of the perpetual East-West conflict, have been hidden to the public outrage. In this way, all direct or covert armed interventions both by the US and the USSR (and their respective allies) in countries from Central and South America, South and South East Asia, Asia Minor, Africa and even in countries from the same block, gained ideological connotations

The end of the Cold War also led to large geopolitical achievements, such as: the collapse on an empire built with three hundred years ago, named in the moment of the collapse the USSR; the choice of a new development path by the former members of this empire and, not the least, the reunification of Germany and the emergence in the Central Europe of the most powerful state of the continent, named "the economic locomotive" of the European Union.

"Few changes – notes the American political analyst Zbigniew BRZEZINSKI – have ever taken place in such a short period of peace."

The 90's brought the collapse of communism and together with it a new extreme provocation for the geopolitics through the need to solve the problem of the new world order, with all its implications. This context brings in front the reality that the US dominate clearly all the areas which form the characteristics of a superpower: military, economic and cultural. There is a short way from this to the proclamation by George Bush of a new world order with a sole superpower, the US, which comes after almost five decades of bipolarization.

This situation does not appear to be the result of a thorough evaluation and was not based on a profound realism; after all, "any balance has at least two scales". As proof, we have the serious warning of Henry KISSINGER: "The novelty related to the new international order to be born is that, for the first time, the US can neither retreat from the

*world nor dominate it*". Let us not forget that the *Heartland* is completely dominated by Russia that, even if it goes through a period of weakness, must not be forgotten; on the contrary, it has to be taken very seriously.

Remembering the start-of-the-century idea, Saul COHEN - former president of the American Geography Association - claims that the present world is made of a geopolitical hierarchy depending on: the global geographical spaces (*realms*) - maritime and continental -, regions, nation-states and sub-national units. An integrative role is played by the *gateways*, expanses with small or medium countries (*territory and population*) which link two important trade routes, most often maritime routes. The most important gateway is considered by the author the one involving countries from Central and Eastern Europe and stretches from the Baltic Sea to the Adriatic Sea. Of no lesser importance are the gateways in the Caribbean area - as link between North and South America, the Middle East area between the Mediterranean Sea and the Red Sea, the Hong Kong area and the North Indian area. A closer look to the geographical locations of these gateways on the world map, correlated with an analysis of the international events shows the importance given to these gateways by the world powers. Starting from Afghanistan, Chechnya, Georgia, continuing with the former Yugoslavia, Albania and ending with Lebanon, Iraq and Palestine, the numerous armed conflicts, combined with the encouragement of the loss of national identity and the perpetual ethnic and religious clashes support the idea that in these areas the geopolitical influences have not been yet settled.

### 3. A POINT OF VIEW

"*Despite the absence of a unifying, commonly perceived threat, geopolitics has not disappeared as an element of international politics*", considered Henry KISSINGER in relation to the current state of geopolitics in the area of human knowledge. The present geopolitics does no longer have the same characteristics it had decades ago. "*The new geopolitics*" focuses on the international life,

leaving the traditional area of the country's political life. In this respect, the Romanian geographer Ion CONEA defines geopolitics as "*the science of the world political environment*".

This new direction derives from the fact that today the behavior of the states is directly influenced by what is happening in their immediate neighborhood and on the international stage as a whole, through the global economic processes, trade, informational and financial flows. No one can live in isolation, no matter how powerful they might be. Also, in present days, the economic life joins, at a certain degree, the military forces, the commercial tools (*capital*) join the fire power and market penetration joins military bases. There are still conflicts between states, but they are economic conflicts and not territorial conflicts.

In present days, the territorial conflict generates conflicts of ideas, different perceptions of the conflict issues and not the truth. Geopolitics in present days offer the leader the necessary tools for decision making, in addition to the ideas and perceptions existing at a large social level.

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## SOME ASPECTS OF THE DEVELOPMENT OF ENTREPRENEURSHIP CONCEPT

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### **Abstract:**

*Recent entrepreneurship research is characterized by ambiguity about the content of the concepts entrepreneur and entrepreneurship.*

*The aim of this paper is to provide an historical review for defining the concept of entrepreneurship. This interest in entrepreneurship has also had an impact on the academic world and the study of this concept has become one of the most popular fields of research in management studies.*

*Throughout history we have seen many important examples of entrepreneurial activities.*

**Key words:** *entrepreneurship, knowledge, globalization, capital.*

Historically, entrepreneurship is one of the oldest activities in society and are mentioned for the first time by the ancient Greeks, the philosopher Xenophon, (approx. 430-354 B.C.) who recognized the adventurous and opportunity seeking activities of overseas merchants.

Entrepreneur was originally a French word and it appeared for the first time in the 1437 Dictionnaire de la langue française, where three definitions of this concept are listed. The most common meaning was „celui qui entreprend quelque chose”, referring to a person who is active and achieves something. This word has been a part of French language since the 12th century and often in connection with brutal war-like activities. Other French authors referred to the entrepreneur as someone who is tough and prepared to risk his own life and fortune. However, their roles were not clearly defined because in some cases they were responsible for the whole undertaking.

During the 14<sup>th</sup> and 15<sup>th</sup> centuries it simply denoted a person who undertook a certain task.

At the beginning of the 17<sup>th</sup> century the risk taking component became more apparent, and an entrepreneur was understood as a person who took risks. The typical entrepreneur was thus a person that was contracted by the state to perform specific services or to supply the state with certain goods. The price was fixed in the contract, and the entrepreneur assumed the risk of making a profit or loss.

For a long time no similarity to the French entrepreneur concept existed in the English language, but the term was undertaker and even adventurer. According with Dictionary of the English Language from 1755 the entrepreneur was definition like a person who seeks occasion of hazard and puts himself in the hand of chance. The word undertaker was probably a more commonly used concept even though the meaning was not quite clear and thereby came closer to the concept of protector, the owner-managers of big businesses. As time went by the concept became more broadly defined and came to represent situations where one person engaged in projects involving risk where the profit was uncertain.

By the mid 18<sup>th</sup> century, changing productions, social relations, and a new way of

thinking began to emerge. These changes also affected the intellectual and academic environment.

There were a number of economists who maintained a certain amount of interest in entrepreneurship.

One of them was Jeremy Bentham. In his reasoning the entrepreneur was no more than an individual who undertook certain tasks on contractual terms. John Stuart Mill has been recognized as the person who established the word entrepreneur for a more general use than that attributed to it by economists. Say's entrepreneurship theory starts by dividing industrial development into three distinct activities: research that is conducted by researchers for the purpose of generating knowledge, adjustment of this knowledge to usable products via entrepreneurs, and the production that is performed by the workers. Also, Say did not take the view that the entrepreneur was only a coordinator of the means of production, he was the one who carried out these activities at his own risk.

Alfred Marshall considered the entrepreneur as a multifaceted capitalist, and in the equilibrium of a perfectly competitive market, there was no place for entrepreneurs as generators of economic activity. According to Schumpeter, entrepreneurs are characterized by the desire to found private kingdoms, the will to conquer, and the joy of creating, or in more modern parlance: the desire for power and independence, the will to succeed, and the satisfaction of getting things done. Thus, Schumpeter diverges from the assumptions of both classical and neo-classical economists who tended to equate utilitarian rationality with capitalism. He predicted a decline in the economic importance of the entrepreneur because he considered would be one of the major forces in the transformation from capitalism to socialism. Schumpeter's ideas were developed at the Research Center in Entrepreneurial History at Harvard University founded by Arthur H. Cole in 1948.

John Maynard Keynes did not go into detail regarding entrepreneurship a central role in economic development. In comparison with Schumpeter, Keynes' reasoning had a

much more profound effect on economic debate, which may be due to the fact that he was more normative and emphasized, to a greater degree, the state's opportunities to influence economic development. Entrepreneurship was just a variable dependent upon economic factors, such as availability of capital, labor, material, and entrepreneurial activities would emerge more or less spontaneously when economic conditions were favorable.

The end of the 19<sup>th</sup> century heralded a transition in economic science from macroeconomic considerations to a greater focus on microeconomic ones. This new focus was dominated by a theory of equilibrium where individuals were either producers or consumers and where the search for equilibrium became the most important aspect of economic analysis and the entrepreneur was overlooked. So, he can be considered as an agent of change, who transforms resources into useful products and services.

The interest in entrepreneurship was clearly visible in the 1990s and it seems to be related to the turbulence of the new changes resulting from rapid technological advances and the globalization of world trade. We can identify several new phenomena which appear to have emerged that triggered new opportunities for entrepreneurship like: transformed industry structures, technological development, information became more accessible, i.e.. These circumstances have meant that societal interest in entrepreneurship have remained high and that the subject has featured prominently on the political agenda in many countries.

At the beginning of the 20<sup>th</sup> century, there was already an extensive theoretical base around the concept of entrepreneur and entrepreneurship. However, even if certain common ground existed when it came to the way entrepreneurship was viewed by the early authors, it is difficult to identify a consensus that would enable us to speak of a theory. Furthermore, the entrepreneur was still regarded as being on the periphery of economic analysis.

Entrepreneurship has a long tradition within economics, but it is difficult to identify any uniformity regard the use of definitions. Practical, economists were the first to attempt to



endow the concept of entrepreneurship with greater scientific meaning.

There are ambiguity about the content of the concepts entrepreneurship. Different studies have used many various definitions. For example, Morris found 77 different definitions in a review of journal articles. Some common definitions for entrepreneurship are :

- Act of innovation that involves endowing existing resources with new wealth-producing capacity (Drucker 1995);
- Process by which individuals pursue and exploit opportunities irrespective of the resources they currently control (Stevenson 1985);
- The creation of organizations, the process by which new organizations come into existence (Gartner 1988);
- Way of thinking, reasoning, and acting that is opportunity driven, holistic in approach, and leadership balanced (Timmons 1997);
- About how, by whom, and with what consequences opportunities to bring future goods and services into existence are discovered, created, and exploited (Venkataraman 1997).

However, there has been a lack of consensus among entrepreneurship researchers regarding what should form the focus of studies on the entrepreneurial process. Two different streams of interest can be discerned: the emergence of new organizations and the emergence of opportunities.

The view of entrepreneurship as the emergence of new organizations has found expression in two international projects: The Entrepreneurship Research Consortium (ERC) and the Global Entrepreneurship Monitor (GEM).

Sankaran Venkataraman and Scott Shane are the exponents of a definition that focuses on the emergence of opportunities. Accordingly with them, entrepreneurship is not a fixed characteristic that differentiates some people from other, but rather a tendency of certain people to respond to situational cues of opportunities. Neither does entrepreneurship require, although it can

include, the creation of new organizations, and entrepreneurship can occur in different contexts, such as existing organizations.

To conclude, the rapid development of entrepreneur concept within the field has had some adverse effects. For example, concerns have been raised in respect of :

1. the problem of defining entrepreneurship and the uncertainty in the domain of entrepreneurship: some definitions are related to entrepreneurship as a societal phenomenon, while others are related to the need to define entrepreneurship as a scholarly domain. Davidsson argues that we need to distinguish between „entrepreneurship as a societal phenomenon” and „entrepreneurship as a scholarly domain”. Following the reasoning of Davidsson the definition of entrepreneurship as a societal phenomenon is inadequate for entrepreneurship as a scholarly domain because we can identify a number of fundamental approaches to defining entrepreneurship: entrepreneurship as a function of the market; entrepreneurship as an individual, and entrepreneurship as a process.
2. entrepreneurship research gradually changed from being a topic within economic science, becoming a part of behavioral science, before finally moving into the area of management science.

However, today the efforts to attain coherence by unified entrepreneurship research are open to questions like: What are the contribution of entrepreneurship research? How to remove the difficulties in defining core concepts? What makes entrepreneurship research unique?

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## MOTIVATION AND REACTION TIME IN THE DECISIONAL PROCESS. INTELLECTUAL TRAINING – INCREASING THE EFFICIENCY AND EFFECTIVENESS OF DECISIONS

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**Abstract:** *Within the competences profile of aviators the ability to make efficient and effective decisions often in uncertain conditions and under time pressure is a particularly important decision. In an experiment on intrinsic motivation made several years ago we elaborated conditional model in which were specified two factors involved in decisional process: choice and reaction time. The interference between the component of this model direct us to the idea of intellectual training which refers to stimulating motivation and creativity in order to increase the efficiency and effectiveness of decisions. In this paper we will present only the arguments for a specific intellectual training for future aviators.*

**Key words:** *motivation, decision, reaction time, intellectual training.*

### 1. INTRODUCTION

At almost every step taken one must make a decision (either for taking an action or for solving a problem) and, consequently, to make a choice. A set of internal factors (personal values, interests and emotions, abilities, behaviors, self-image and so forth) and external ones (family' and friends' influences, educational level, the characteristics of situations one must face of) influences our decisions. Later on, some decisions are considered as being good and as bringing satisfactions, while other decisions are regretted.

We all need the ability to make decisions in our everyday lives, but there are several professions in which this ability is very important as part of the competencies profile.

In the aviator's competencies profile a special place is occupied by the ability to make efficient and effective decisions sometimes in difficult situations and under time pressure (that are decision under risk and decision under uncertainty).

In an experiment conducted several years ago, in which we aimed to increase intrinsic motivation, we build the conditional model – taking then into account the factor choice and

the importance of reaction time in the decisional process. The conditional model [3] includes the following aspects: item's difficulty level, involvement in task, work time, self-image, will, personality type, intrinsic motivation, the initial level of the ability, the final level of the ability, self-affirmation, satisfaction, performance and aspiration level.

The interference between conditional model's elements conducted us to the idea of intellectual training, stimulating motivation in order to increase the efficiency and efficacy of decision.

### 2. INTRINSIC MOTIVATION AND DECISIONAL PERFORMANCE

Analyzing things from a psychogenetic perspective makes easier the understanding of the complex maze of psychic and social motives. People's configuration of behaviors motives is never a simple one and never reduced to only one motivational type. This assumes a network of complex psychological states, permanently linked individual and collective purposes and activities, all socially oriented.

Therefore, for a correct understanding of the motivation concept, one must keep in mind a relatively big number of personality and social variables.

Social motivation and motivation for learning are the two major dimensions of motivation specified in the psychological literature [6]. Nevertheless, motivation can take various forms (primary and secondary motivation, intrinsic and extrinsic motivation, positive and negative motivation). In the proposed intellectual training our primary purpose was that of developing intrinsic motivation (epistemic curiosity, interests, aspiration for performance, satisfaction for things well done, the need for self-affirmation and self-actualization) necessary for the decisional process. In the context of the proposed model the stimulus situation transforms into variables that generate activism and are considered to be internal motivational agents. These agents are permanently influencing the performance in solving the items (that are specific problem in which the subject must make a decision).

During the intellectual training we take into account the solution for every task-item, writing down subjects' level of success (performance); the items way of construction facilitates performance and progress. The accomplished performances are energy sources for higher levels of aspiration, for taking to a higher level the ability to propose new purposes and the ability to fulfill through voluntary effort much more demanding tasks. The high performances will become sources for intrinsic motivation.

### 3. FEW ASPECTS OF THE DECISIONAL PROCESS

What are decisions? Decisions assume elaborating alternative strategies and choosing one of them (A. Rădulescu, 1983); decisions are the specific form in which resources are involved in an action (Mintzberg, 1996), an affirmation that shows the involvement on a specific line of action (Power, 2000), the result of deliberate activities for choosing one line of action (F.G. Filip, 2002).

Several types of decisions are met in the psychological literature [2]:

*Planned decisions* – are the repetitive and routine, easy to make decisions. The high appearance frequency of a certain situation determines the decider to elaborate rules and procedures based on the principles of time saving, simplifying the decisional process, and making more efficient the decisional activity, which will help him solve the situation.

*Unplanned decisions* – are decisions made in unforeseen conditions, situations in which there are no anterior established procedures.

*Decisions under certainty* – are decisions made when we know all the alternatives and their consequences; this type of decisions are made when the deciders know for sure what are the alternatives and what will be the results for each alternative.

*Decisions under risk* – are decisions made when we have incomplete information so probabilities, results, and costs must be calculated; deciders have the possibility to calculate the probability that certain events will produce, as well as their results, and then to select the appropriate alternative.

*Decisions under uncertainty* – are decisions made when we lack information so that the objective determination of probabilities and of the results is difficult.

The decisional process refers mainly to choosing from multiple alternatives an operational way of solving a situation or a problem [2]. This process includes the following stages [7]: to identify and define the problem, to formulate alternative solutions, to evaluate the alternatives solutions, to choose the best solution, to implement the decision, to evaluate the consequences, and feed-back.

The behaviors adopted by individuals when solving a problem differ by several criteria:

1. *The duration of the solving process.* Sometimes the steps are very quickly taken (giving the impression of spontaneous solving and of lack of a process), other times there are necessary longer periods of time for finding the solution.

2. *The nature of the problem.* Real life problems have several specific characteristics: a) their purpose is not easily defined; b) the

uncertainty about the correct solution is greater; c) there are an infinite number of relevant criteria; d) the decision involves non-logical processes.

3. *The degree of problems' elaboration.* There are well defined problems (which are easily solved through algorithmic strategies) and poor defined problems (for their solving much information is needed and the deciders use heuristic strategies).

4. *The difficulty level of the problems:* a) reproductive – non-creative problems; b) demonstrative – explicative problems; c) heuristic – creative problems; d) inventive – creative problems; e) optimization problems.

5. *The specificity of the cognitive processes involved in finding the solution:* finding a pattern through analogy; manipulating objects or symbols – through transforming; arranging in a specific manner – types of substitutions.

6. *The specificity of subject's task:* problem solving assumes a strictly specialization and a constant process; finding problems assumes a diversifying specialization and flexible cognitive structures.

*The difficulty level of the items* used in the intellectual training is related to the task complexity – it will progressively grow as well as the individual working rhythm; the move to the following step will be done according to planning but only after the subject solved with success the task. The subject has always an option, he can choose between two or more task that must be solved.

#### 4. REACTION TIME IN THE DECISIONAL PROCESS

According to J.B. Carroll, psychological time can have a constructive or a destructive influence on intrinsic motivation [6]; every act appears in a time sequence having an external task as starting point and an established result as final point. When the subject is not motivated, the time necessary for doing the task might be reduced which will prevent the subject to reach the desired result. We must immediately find out what was the cause of the subject's lack of motivation and then the task will be again completed, in the same

conditions, but only after the cause was eliminated (If the factor influencing the motivation is one of great importance then the items must be revised according to the factor's characteristics). The subject who must make a decision will be much more motivated if he can perform the task in a personal rhythm as the motivation grows directly with the factor choice. Because an aviator must have the ability to make efficient decision under time pressure, the intellectual training aims to increase the individual rhythm of item solving and, consequently of making a decision.

During the intellectual training the following aspects will be observed and registered: the blocking time; estimated time ( $T_a$  – the duration of time in which the task is expected to be performed); accommodation time (increasing the effort level); execution time ( $T_r$  – the real duration of time in which the task is solved); finishing time (reducing the effort level).

If the value of the  $T_a - T_r$  difference is negative, then we can talk about an underestimation of the self-esteem; if the difference is positive, then we confront with an overestimation of the self-esteem. If the value of the difference is close to zero then subject's self-esteem is based on a real self-image which is extremely important.

#### 5. CONCLUSIONS

When making a decision, performance (efficiency and efficacy) is closely related with motivation, abilities level, and task involvement (which presumes the understanding of the task). It also depends on the quantity, persistence, and direction of the effort. The rapport between motivation and performance is not always a one to one rapport (because there are factors which can reduce the performance even if motivation is high), but the rapport between performance and motivation is at least one to one rapport (a high performance is always based on a high motivation).

If the aspiration level increases then the effort will consequently lead to success in solving the items. It is not about encouraging

the subject to obtain maximum of result with minimum of effort, but about stimulating success even when failure appears (returning to the complete item that was failed and solving intermediate items). Here the variable called by us task involvement which is part of the conditional model interfere. Task involvement assumes taking a very important step before solving the item that is choosing the item alternative according to its difficulty. The positive result turns into a success and the negative result into a failure only in connection with individual's motivational structures. From this point of view success and failure differ from reward and punishment: the firsts are intrinsic to behavior and reflect the finish of the action, while reward and punishment are extrinsic, being ulterior added to the fulfilled action. When failure is met the subject must return to the item and solve it by pieces that are adapted to his characteristics. We must keep in mind that the subjects consider them not having the ability to succeed in the proposed field; our task is to evaluate first their level of competence and then build the item bank so it can lead to success.

Both the process and the motivational aspect involved in an activity or a learning task do not have a linear trajectory but fluctuation created by the internal or external barriers that interfere between the subject and the purpose. No matter if the reasons that start or support the activity are internal or external those obstacles can be surpassed only through voluntary effort (which is entirely based on intrinsic motives). Therefore, the feeling of success is greater if the subject can perform on difficult tasks at which the chances to succeed or to fail seems to be equal.

If the fear of failure is greater then the subject will expect less rather than to face deception.

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## THE EUROPEAN ENVIRONMENT POLICY'S IMPACT ON ROMANIA

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**Abstract:** *The paper begins with the analysis of 6<sup>th</sup> Environment Programme. This programme is focuses on four domains. We analyse this programme in connection to Kyoto Protocol.*

*More, we analyse the seven European environment strategies under the 6<sup>th</sup> environment programme: air quality, land protection, use of the pesticides, maritime environment protection, offals, urban environment and environment and health under SCALE. So, we analyse the basic ideas of the SCALE strategy.*

*A distinct part of the paper deals with the impact of Rio Conference on the environment policy under the idea of sustainable development. We talk about the principles of the Rio Conference and the sections of the 21<sup>st</sup> Agenda.*

*As a result, the European environment policy is focuses on the decrease of pollution. In 2020, the E.U. will generate offals greater with 45% than in 1995.*

*Further on, the paper presents the instruments of environment policy implementation: legislative, technical and economic-financial.*

*The environment policy in Romania started as a distinct area in 1990. In 1992, was implemented the first National Environment Strategy, as well.*

*More, in 2003, was elaborated a Report about the progresses of the Romanian environment policy.*

*Romania succeeded to finish the adhering negotiations in 2004, under Chapter number 22-Environment protection.*

*For the beginning, the paper deals with the institutional framework of the Romanian environment policy. We talk about the role of the Ministry of Agriculture, Forests, Waters and Environment, the Ministry of European Integration and the Romania's Parliament. More, we analyse their connections to other public agencies and committees.*

*The next step is to analyse the European programs which support environment policy in Romania: PHARE, ISPA and LIFE. More, we talk about the 21<sup>st</sup> Agenda and the Global Environment Facility.*

*Another part of the paper is focuses on pro and anti European environment policy opinions. This policy is considering a major success of the Member States. There are more than 100 laws connected with environment protection starting from 1986.*

*On the other hand, some specialists describe the discrepancy between environment legislation and its effects. A possible reason of this can be the insufficient financial supports, including the LIFE programme.*

*We conclude that the European environment policy represents the point of the lance for the Europeanization of the continent.*

*E.U. signed more than 30 international environment agreements and has an important role in international negotiations connected to environment protection.*

*More, E.U. has environment agreements with Russia, the Mediterranean countries and the developing countries, as well.*

*The paper uses a lot of statistical data from the Eurostat and European Commission, as well. These data are present as diagrams, maps and other characteristic instruments for a better analysis.*

*The legal framework is give by the European Commission's directives, Action Programmes and White Papers.*

*We use specific studies and an important foreign bibliography, including specific internet sources.*

**Key words:** *pollution standards, offal's management, sustainable development, environment policy, ecologic goods.*

In 2002, the European Parliament and the European Council adopted the 6<sup>th</sup> Environment Program till 2010. This new program is divided into four great domains:

- ✓ the climatic changes;
- ✓ the nature and the biodiversity;
- ✓ the health and the environment;
- ✓ the preservation of the natural resources and the offal's management.

According to the climatic changes, the E.U. supports the achievement of the Kyoto Protocol (1997), which asks for a decrease of the pollutant emissions with 8% during 2008-2012. As a result, the E.U. introduced a decrease pollution scheme in the Member States.

The European Commission uses the present specific legislation about the biodiversity and the directives about the air and the water pollution standards.

In order to preserve the environment health, the European Commission introduced new standards about the pollutant substances, the phonic pollution, the pesticides and the risk management of the new chemical substances use.

The Commission proposes a decrease of 20% of the toxic wastes till 2010 using taxes on the resources use and policies which promote the integrate production.

This Action Program recognised the importance of the implementation and monitoring the actual legislation.

Moreover, there are very important the market stimulations in order to encourage the firms and the consumers to adopt the best practices (the European Eco-management and Audit Scheme) [1].

The 6<sup>th</sup> Environment Program develops seven environment strategies:

- ✓ the air quality: is a strategy initiated in 2001, under the slogan "Clean Air for Europe" and it covers a set of recommendations about the elimination of the pollution's effects on the human health;

- ✓ the soil protection: is a strategy based on the European Commission's communication "Towards a thematically strategy for soil protection". It is for the first time when the soil pollution problem is independent treated;

- ✓ the pesticides use: is regulated by the project "Towards a thematically strategy for pesticides use under a sustainable development" (2002). This project established specific objectives, like: the minimisation of the risks in using pesticides on the health and environment, the improvement of the control on the pesticides use and distribution, the decrease of the active noxious substances by replacing them with more secure alternatives and the support for the ecologic agriculture;

- ✓ the preservation and the protection of the maritime environment: till 2002, the European Commission proposed the use of the seas under the sustainability and the maritime ecosystems preservation, including the oceans, estuaries and costal areas depths;

- ✓ the waste recirculation and processing: these regulations were implemented in 2003, under the report cost-efficiency;

- ✓ the urban environment: is focused on the urban transport, the sustainable urban management, the buildings and the urban architecture;

- ✓ the environment and the health (SCALE): represents the latest environment strategy, which analyses the connection between the pollution, the environment changes and the human health [2].

At global dimension, the sustainable development under the environment restriction became essential after the World Environment and Development Commission Report-"Our Common Future" (1987). This report demonstrated that the social and the economic elements determined directly the environment protection. As a result, the environment degradation can be estimated as a product between the population dimension, the GDP and the pollution intensity.

The Rio Conference introduced the concept of durability, which is achieved under the respect of 27 principles.



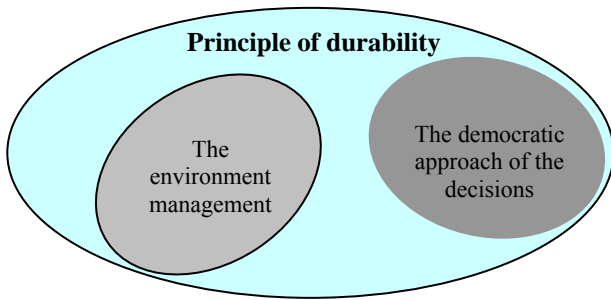


Figure no. 1: The Principles of the Rio Declaration

The E.U. presents a specific environment policy. The control of the water pollution is considered the jewel from the crown of the European environment policy. This control is based on three directives: the environment standards for every water categories (drinking water, water for irrigations and water for fish breeding), the standards which control the dangerous substances emission and those which are focused on a greater security of the water resources.

The restrictions connected to the air pollution are less firmly than those connected to the water pollution. In 2001, was adopted a new strategy - Clean Air for Europe – which was focused on the air pollution decrease. On the other hand, the Kyoto Protocol wasn't signed by the great industrialised countries, excepting Russia (2005).

The E.U. generates 2 billion tones of wastes every year. 40 million tones of these wastes are not controlled. As a result, the E.U. will try to decrease the waste with 20% during 2000-2010 and with 50% till 2050. Moreover, the E.U. signed the Basel Convention-Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal- which is applied across the OECD, the E.U. and Liechtenstein.

The phonic pollution has a maximum limit of 60 Ldn dB(A), according to the European Environment Agency. The monitoring of the phonic pollution is focused on the auto vehicles, the airplanes, the show centres and the equipment which is used outside the building.

The European environment policy is based on three instruments: legislative, technical and economic-financial.

The legislative instruments include the directive, the regulations and the decisions which compose the common environment protection aquis.

The technical instruments cover quality environment standards and the Best Available Technologies (BAT) [3].

The main financial instruments of the environment policy are represented by the LIFE program and the Cohesion Fund.

Romania adopts the environment protection as a distinct component of the national policies in 1990. In 1992, was elaborated the first official document which established the national specific objectives.

Still 2000, the Romanian environment policy developed according to the European Commission's strategy under the Agenda 21.

In 2002, began the adhering negotiations about the Chapter no.22. In the same year, the European Commission elaborated a special document in order to support Romania and Bulgaria in their adhering efforts and to grow the financial assistance for them.

The main actual institutional actors of the Romanian environment policy are: the Ministry of Environment, the Ministry of the Agriculture, Forests and Rural Development, the Ministry of the European Integration and the Romanian Parliament.

During 2007-2013, Romania will spend 8.6 billion Euros on the environment projects. This money will come from the European Funds and they will be invested into the ecologic goods, the regenerate energy systems, the wastes and the waters management. The investments in ecologic goods and fabrication equipments in Romania will cover 125.7 million Euros. Moreover, 1.7 billion Euros will be allocated to the rail infrastructure improvement.

Till 2013, the wind mills and the sun panels will become more and more, as a result of an investment of 191.5 million Euros for the regenerate energy. Other 250 million Euros will finance the energetic management [4].

Important sums will be allocated to the wastes and water management, as well. Some billion Euros will be spend in order to promote the biodiversity, to protect the nature and to

implement the integrate projects for the urban and the rural regeneration.

The actual Romanian Government program 2009-2012 includes the environment protection in a special chapter (XIX). The objectives of the Government under the environment framework are the following [5]:

- ✓ the growth;
- ✓ the decrease of the environment infrastructure disparities between Romania and the E.U.'s average;
- ✓ to decrease to natural disasters risks and to grow the citizens security;
- ✓ to preserve the biodiversity and the natural patrimony;
- ✓ to introduce the sustainable development principles into the educational system and to support the research connected to the clean technologies;
- ✓ to grow the environment institutions transparency degree in their relation with the citizens;
- ✓ the limitation of the negative effects of the climatic changes;
- ✓ the support for the environment investments and initiatives using the economic and the fiscal instruments;
- ✓ the efficient use of the natural resources;
- ✓ the enlargement of the international partnership.

The same program establishes 14 specific action directions. The first one is the life and environment quality and it is focused on the correlation between the environment and the public health policies. As a result, there will be elaborate and implement a national action program for the environment and the health which will be especially financed in the critical areas.

The second direction is focused on the waste management and the localities' sanitation. A specific instrument is the National Waste Management Plan during 2009-2013. Moreover, the environment infrastructure financing will be correlated using the Environment Sector Operational Program. Romania will try to grow the use of the urban waste and the industrial inert waste in the construction and the transport infrastructure.

Another direction defines the access to the sure drink water sources. This implies the build of the new drink water networks.

The climatic changes and the energetic efficiency represent constraints which ask for the progressive decrease of the gases emissions according to the Romania's commitments.

The economic and fiscal mechanisms of environment infrastructure supporting and stimulating are very important, as well.

In order to obtain a better institutional capacity, a legislative coherence and the decentralisation, the local public administration will retrieve some components and responsibilities under the environment protection program.

The same program asks for a natural resources sustainable management and the biodiversity preservation.

Other direction is that connected to the air quality, the radioactivity and the noise.

An interesting direction is the improvement of the urban environment, which is based on the enlargement of the green areas, the urban planning and the elaboration of the Urbanism Regulation on the ecological principles.

In order to have a health alimentation, the Romanian government will support the ecological agriculture, the natural fertilizers and a strict control of the genetic changed organisms, as well.

In connection to the above direction, is the limitation of the negative effects of the dangerous chemical substances, under the European specific regulation.

The government program talk about the efficient use of the natural resources, as well. Moreover, it proposes the introduction of the environment themes in the educational curriculum, the promotion of a national campaign for ecological education and the support for the clean technologies.

At least, the same program is focused on the prevention and the elimination of the natural calamities' effects and for the growth of the citizens' security.

The European environment policy is considered as a major success of the Member States. More than 100 regulations were

adopted for the environment protection still 1986. Moreover, there were developed systems for the environment information harmonisation and for the specific initiative monitoring.

On the other hand, some specialists consider to great the difference between the environment bushy legislation and its effects on the environment protection.

Moreover, the progresses of the European environment policy have to be analysed in connection to their causes. Such a cause of a minor impact on the environment is the environment funds deficiency. These funds are less than 1% from the European budget.

The main financial instrument for the environment protection is LIFE Program. On the other hand, the European Investment Bank offers financial assistance for the environment programs in the Member States. The Member States support the environment protection programs with their own funds and with the funds which come from the environment taxes.

The implementation of the environment policies can create a conflict with other common policies because the economic growth, the industry development of the CAP can lead to a pollution growth, as well.

The environment policy is implemented using the directives which are approved by the European Commission. But their effective implementation is made by every Member State as well as it wish. As a result, more directives aren't implemented or they are incorrect implemented.

In 2005, the European Justice Court recognised the E.U.'s right to ask the Member States to impose important penalties to those which pollute the environment. As a result of the Aarhus Convention (1998), the private persons are integrated into a training, monitoring and punishment process connected to the environment problems. The European citizens must be informed and consult about the environment legislation and they can prosecute the polluters [6].

The latest two enlargements of the E.U. represented an example of successful environment management, because the 12 new Member States were compelled to adopt the

environment acquis before their adhering. The same condition is available for the actual candidate countries. Moreover, the candidate countries have to participate to the European Environment Agency and to the European Information and Observation Network (EIONET).

However, the European environment policy has important effects on the industrial and institutional levels.

On the other hand, this policy becomes an independent force which is able to influence the public opinion and the economic policy in the E.U.

During its existence, the environment policy was promoted and modified, because it is considered as a top lance of the Europeanization.

On the other hand, the E.U. is a part of the international environment conventions still 1970. Nowadays, it is signatory of more than 30 international environment conventions and has an active role in the environment protection global and regional negotiations [7].

Moreover, the E.U. has bilaterally and multilateral environment agreements with Russia, the Mediterranean countries and the developing countries, as well.

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## THE CHALLENGES OF THE COMMON TRANSPORT POLICY IN EUROPE

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**Abstract:** *For the beginning, the paper deals with the process of transports' liberalization, connected to every type of transport and every Member State and according to the enlargement process.*

*We talk about the European transport strategy and the White Paper of the Transports which establish the future evolution of the European transports still 2010.*

*A distinct part of the paper deals with the trans-European networks connected to transports, telecommunications and energy.*

*Other part of the paper analyses road transports starting from the acquis which implies social, technical, fiscal and insurance specific regulations. We analyse all these regulations. More, we talk about the trans-European road network. The European Commission adopted an action plan which will be able to improve road security to 50% during 2003-2010.*

*The last part of the paper deals with TEN-T and its impact on the European economy. We talk about the legal specific framework and the necessity of a public-private partnership in order to finance the projects connected to the TEN-T.*

*We conclude that the European Transport Policy is most different than other common policies because it has an internal and an external dimension, as well.*

*The European Transport Policy is influenced by the negotiations with the International Maritime Organisation and the International Organisation of Civil Air Lines.*

*We use specific studies and an important foreign bibliography, including specific internet sources.*

**Key words:** *infrastructure network, transports aquis, agglomeration tax, the traffic volume, the transport licences, the European Management System, sustainable mobility, public-private partnership.*

### 1. THE GENERAL FRAMEWORK

The importance of the integrated transport structures was recognised by the Rome Treaty, but the progresses achieved still the end of the '80 were not enough.

The White Chart from 1985 supported the freedom of the services and established the common directions for the European transport policy. These directions were approved by the European Council, which adopted an action plan based on the infrastructure development, the decrease of the frontiers' controls and formalities and the improvement of the transport security.

The Single Market represented a new stimulus for the transport policy. The adopted measures for the transports' liberalization were adapted to the specificity of the every transport way, according to the particularities of the international services and the coasting.

At the end of 2002, the White Chart of the common transport policy future development realised an integrated approach for the different types of transports based on the sustainable mobility. That means the transports' organisation as well as the energy consumption, the type of transport and the transport routes and conditions to become optimal. The action plan was focused on the transport quality improvement using the integrated systems based on the new technologies which are able to protect the

environment and to support the competition according to the social standards.

The Green Chart (1995) improved the fiscal transport policy by considering the taxes as one of the most efficient ways of the governments to influence this sector. The new informational and communication technologies support lead to new modern informing, radio-navigation and telecommunications services. More, the European Commission supports a European strategy connected to the satellite global navigation system.

In September 2001, the new White Paper, named "The European Transport Policy: the time of the decision", tried to find a new equilibrium between the economic development and the transport quality and security. As a result, the objectives of the present transport policies are the following:

- ✓ the rail transports improvement and the maritime and naval transports promoting until 2010;

- ✓ the transport tax system according to the real costs. These costs include the collateral costs connecting to the environment damages, traffic agglomeration and accidents;

- ✓ the efficient and security transport systems.

These objectives will be covered by specific measures, like:

- ✓ passengers' rights promoting using the protection passengers measures connected to the different transport ways. These measures cover the passengers urban transport, as well;

- ✓ the ruttier security improvement, which will be able to decrease to 50% the deadly accidents until 2010;

- ✓ the agglomerations' prevention by promoting the multiple transport types under a new Marco Polo program. More, the taxes harmonization for the rail transports' combustible, as well;

- ✓ the build of a new infrastructure network under the trans-European networks;

- ✓ the growth of the E.U.'s participation to the international organisms like the International Maritime Organisation (IMO) or the International Civil Aviation Organisation (ICAO).

The common transports policy (the articles number 70-80 from the European Treaty) establishes the basic rules for the international transports in the Member States. More, it establishes the conditions in which the non-residents transporters can operate in the Member States (Article no. 71.1), the measures connected to the transports security improvement (Article no. 71.2) and the elimination of any discrimination under different discriminating (Article no. 75).

The transports aquis is formed especially from the secondary legislation which covers hundreds of regulations, directives and decisions.

Under the Amsterdam Treaty, the transports policy is based on the co-decisions, after the Economic and Social Committee and the Regions Committee's consulting (the Article no.251). This procedure covers the whole road, rail and fluvial transports. The maritime and air transports are object of the international agreements. As a result, the European Council decides with majority votes its procedures, according to the Article no.80.

The European Council adopts unanimity decisions, after the European Parliament and the Economic and Social Committee's consulting, for the special cases which affect the life conditions, the labour and the transports facilities.

In order to support the free movement of the persons, the capitals and the goods, the E.U. established and developed trans-European networks for transports, telecommunications and energy (the Articles no. 154-156). These networks cover the road, the fluvial, the rail and the space networks, like the trans-European satellite navigation system.

According to the Article no.156, the Economic and Social Committee and the Regions Committee have to be consulted in order to adopt the principles, the measures and the projects connected to the trans-European networks.

An important element consists in the European Commission's transport infrastructure

taxation, which has to cover the pollution costs, the travel time cost and the infrastructure costs, as well [1].

The economic theory considers that the transport infrastructure use has to be made under the restriction of the equity between the price and the marginal cost. More, the price has to cover the externalities connected to the accidents, the air, soil, water and sound pollution and the agglomerations.

## 2. THE ROAD TRANSPORTS

The specific aquis implies social, technical, fiscal, security and environment regulations. The most important ones are those about the admission to the transporter profession, the regulations about the dimensions and the mass of the vehicles, about the passengers' transport and the transport inside a Member State.

The European Commission introduced a fix agglomeration tax, as in the figure no.1 [2].

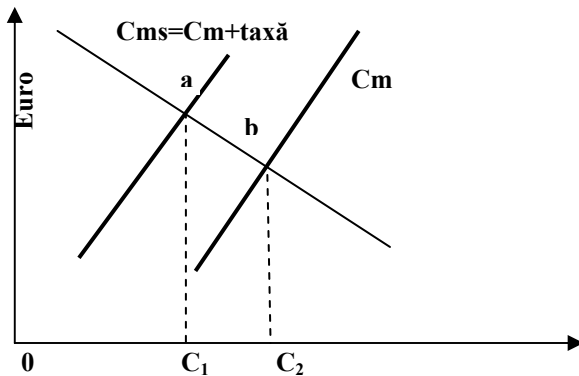


Fig.1: The transports' price, including the agglomeration costs

The road transporters paid the marginal costs ( $C_m$ ), which grow the traffic volume. On the other hand, the agglomeration decreases the rhythm of the courses. The transport costs limit the number of the courses to  $C_1$ .

A transport tax of  $ab$  dimension (in the figure no.1) will decrease the traffic volume to  $C_2$ , as in the figure no.2.

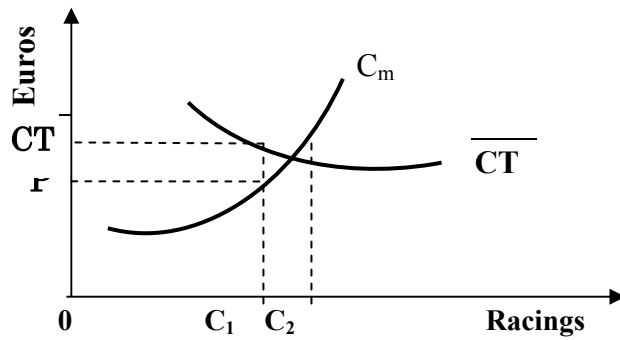


Fig.2: The evolution of the average and marginal transport costs

According to the figure no.2, the European Commission recomnaded, as equilibrium condition,  $\overline{CT} = P$ .

The most developed road networks are in the U.K. and Holand.



Fig.3: The trans-European road network

In the latest 10 years, the trade exchanges development with the ex-comunist countries supports the adoption of some semnificative transport reforms.

The costs of the road transports grow up, as a result of their environment impact and of the longer transport distances. As a result, some restrictions were implemented connected to the national borders' transitation by the camions and their dead weight. The bilateral agreements about the transport licences supported the decrease of the road transports' efficiency.

The road passengers' transports operate under the regulation about the use of the catalisators which decrease the environment poluution.

### 3. THE RAIL TRANSPORTS

The ratio of the rail transport in the total transport activity decreases from 21% in 1970, to 6% in 2008.

The importance and the development of the rail transport are more different between the Member States [3].

Table 1: The European road transport

Country	Km. rail way	Transported goods/ 1000 mill. tones kilometers	Transported pasengers/ 1000 mill. passengers kilometri
Austria	5643	15.6	2.73
Finland	5836	53.4	0.46
Belgium	3472	7.4	0.82
Denmark	2324	1.9	-
France	31589	53.4	10.4
Germany	37536	71.4	14.5
Ireland	1919	0.5	-
Italy	16108	21.6	5.4
Holand	2808	3.5	1.42
Portugal	2813	2.2	0.56
Sweden	10799	18.9	1.46
Spain	12319	11.6	5.06
U.K.	16984	18.4	7.5

A comparison between the E.U. and the U.S.A. shows us that the American rail transports are more development that the European ones.

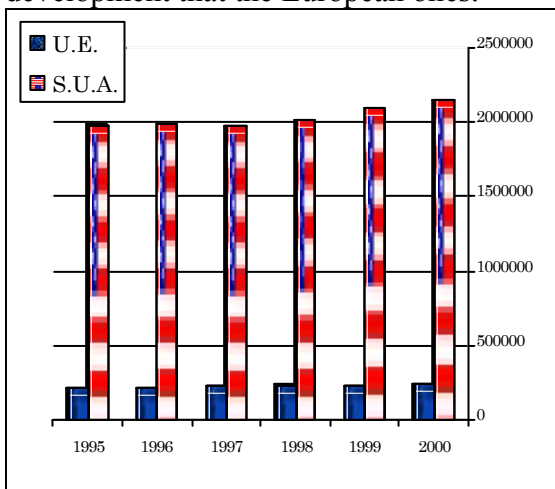


Fig. 4: The rail transports in the E.U. and the U.S.A. (mill. tones-km)

The same situation has the rail passengers' transport, as in the table no.2 [4].

Table 2: The rail passengers' transport (mill. pasangers-km)

Country	1995	2000	2008
E.U.-25	315536	345003	350384
E.U.-15	268194	304899	307657
Belgium	6757	7732	8259
Czech Rep.	8005	7299	6597
Denmark	4888	5537	5745
Germany	70977	75404	71366
Estonia	421	263	177
Greece	1568	1886	1836
Spain	15313	18571	19480
France	55563	69571	73227
Ireland	1291	1389	1628
Italy	43859	47133	45957
Cyprus	-	-	-
Latvia	1373	715	744
Lithuania	1130	611	498
Louxeburg	287	332	357
Hungary	8441	8693	10531
Malta	-	-	-
Holand	13000	15400	15500
Austria	9628	8206	8301
Poland	26635	24093	20749
Portugal	4840	3632	3683
Slovenia	595	817	749
Slovakia	4200	2870	2682
Finland	3184	3405	3318
Sweden	6839	8301	9100
U.K.	30200	38400	39900
Bulgaria	4693	3472	2598
Romania	18879	11632	8501
Turkey	5797	5832	5204
Island	-	-	-
Norway	2300	2857	2491
Switzerland	11712	12835	12109

The European Commission plays an esential role in the European rail integrated system's implementation.



Fig.5: The trans-European rail networks  
 Nowadays, the European Management System for the Rail Traffic is implementing and it covers all the Member States. The most important routes covers by this system are: Rotterdam-Genova, Napoli-Berlin-Stockholm, Anvers-Basel-Lyon, Sevilla-Lyon-Torino-Ljubljana, Dresda-Vien-Budapest and Duisburg-Varsaw.

**4. The fluvial transports**

These transports are very important for the continental Europe and they realise conections between the Mediteranean Sea and the North Sea and between the West and the East of the Europe, as well.

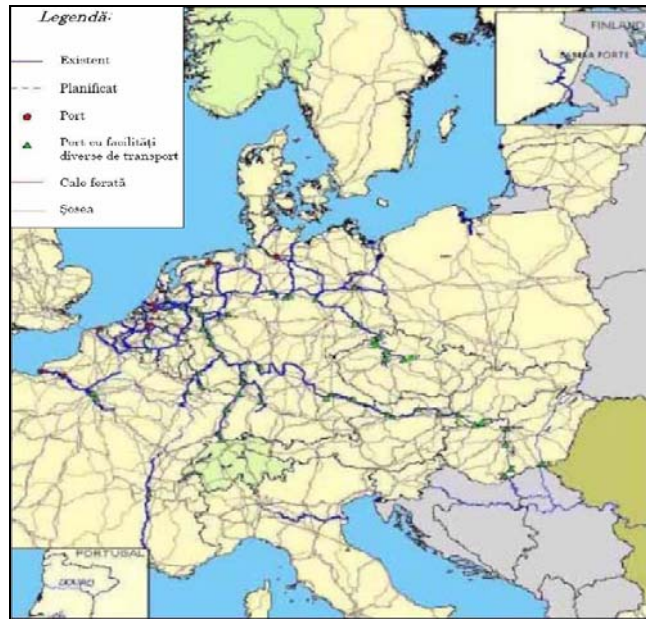


Fig.7: The fluvial transports' networks

The European fluvial transports network is efficient, the pollution is little and the energy consumption/tone-km represents 1/6 from the road tranports consumption and 1/2 from the rail transports consumption.

More, the number of the accidents, ambuteiajes, and noice and air polutuion are 7 times little that in the road transports.

**5. THE AIR TRANSPORTS**

**6.**

The European air transports face to the greatest number of specific regulations according to the bilateral and the international specific agreements.

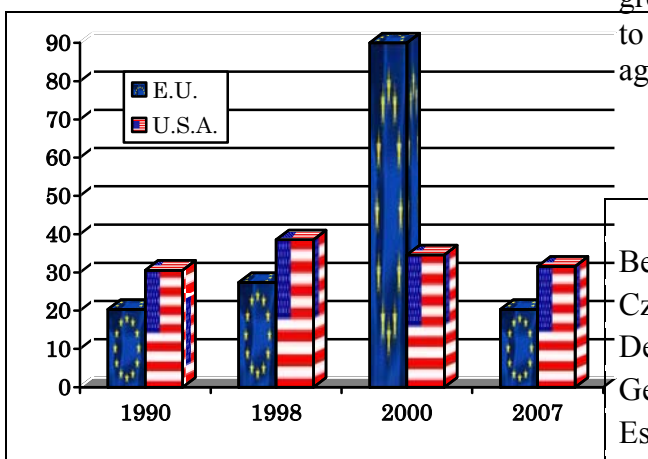


Fig. 6: The fluvial goods transports in the E.U. and the U.S.A.

Table 3: The evolution of the air goods transports (thousands tones)

Country	1996	2000	2001	2007
Belgium	449	-	584	-
Czech Rep.	-	-	36	34
Denmark	-	-	12	10
Germany	1877	2554	2441	2525
Estonia	-	-	5	4
Greece	73	156	-	-
Spain	281	479	577	564
France	1058	1282	1535	1643
Ireland	39	86	79	49
Italy	475	551	-	506
Cyprus	-	-	32	31



Latvia	-	-	5	7
Lithuania	-	-	15	14
Luxembourg	281	501	510	550
Hungary	-	-	45	46
Malta	-	-	12	12
Holland	1084	1268	1217	1279
Austria	98	130	115	127
Poland	-	-	43	-
Portugal	101	178	152	149
Slovenia	-	-	7	7
Slovakia	-	-	5	7
Finlanda	-	111	96	96
Sweden	200	-	-	-
U.K.	1657	2336	2153	2203
Bulgaria	-	-	11	14
Romania	-	-	16	16
Turkey	-	-	208	257
Island	5	-	-	-
Liechtenstein	-	-	-	-
Norway	-	133	127	
Switzerland	-	419	440	328

Island	1	-	-	-
Norway	-	7	8	8

But the European air transports industry is lead by the American companies:

Table 5: The most important world air companies (2007)

Company	Mill. Passengers-km	Company	Mill. Passengers-km
American Airlines	195775	Lufthansa	88570
United Airlines	176118	Singapore Airlines	74171
Delta	164165	Southwest	73035
Northwest	115891	Air Canada	69404
British Airways	100787	US Airways	64404
Air France	98095	Qantas	63946
Continental	95492	KLM	58595

After the terrorist actions from 2001, the European Parliament approved new rules in order to improve the airplanes' security, in 2006.

Table 4: The evolution of the air passengers transports (mill. passengers)

Country	1996	2000	2001	2007
Belgium	13	20	22	-
Denmark	13	-	-	-
Germany	76	92	99	97
Greece	18	22	25	-
Spain	57	76	81	-
France	49	60	66	66
Ireland	9	15	16	17
Italy	31	39	44	-
Luxembourg	1	2	2	-
Holland	28	37	40	39
Austria	11	13	14	14
Portugal	10	12	13	-
Finland	-	7	8	8
Sweden	12	15	16	16
U.K.	105	133	143	143

The most important European airport is Heatrow (London), which covers an average of 67 million passengers every year. Other important airports are: Charles de Gaulle-Paris (6.1% from the all passengers), Frankfurt (5.6%), Amsterdam, Madrid and Ruzyne (Praha).

## 7. THE MARITIM TRANSPORTS

The European trade fleet covers 35% from the world fleet. The development of this type of transport is connected to the imports' growth, especially of the crude oil and oil goods.

Table 6: The evolution of the maritime goods transports (mill. tones)

Country	1997	2000	2001	2007
Belgium	162	179	174	174
Czech. Rep.	-	-	-	-
Denmark	124	97	94	94
Germany	213	243	246	246
Estonia	23	40	40	45
Greece	101	128	113	111
Spain	271	235	315	326

France	305	337	318	319
Ireland	36	45	46	45
Italy	459	447	445	458
Cyprus	7	7	7	7
Latvia	51	52	57	52
Lithuania	16	23	21	24
Luxembourg	-	-	-	-
Hungary	-	-	-	-
Malta	3	4	7	6
Holland	402	406	406	413
Austria	-	-	-	-
Poland	51	48	46	48
Portugal	55	56	56	56
Slovenia	7	9	9	9
Slovakia	-	-	-	-
Finland	75	81	96	99
Sweden	150	159	153	155
U.K.	558	573	566	558
Bulgaria	-	-	20	20
Romania	32	25	28	33
Turkey	138	141	128	127
Island	5	5	5	5
Liechtenstein	-	-	-	-
Norway	270	200	195	190
Switzerland	-	-	-	-

## 8. CONCLUSIONS

The E.U. is based on an extended transport network.

The facilities of the air, road, rail and maritime transports grew as importance and quality.

Some Member States made important investments in their transports' networks. We talk about Spain, Greece, Portugal and Italy.

The common transport policy is more different from other common policy because it has an internal and an international dimensions. It had successes connected to the competition regulation and greater specific markets efficiency. More, the common transport policy supports the growth of the E.U.'s influence in its negotiations with the International Maritime Organisation or

the International Civil Aviation Organisation, as well.

Across the E.U., the transports policy faces to the infrastructure investments' financing and to the correct dimension of the social and environmental costs for every type of transport.

On the other hand, the projection of the European transport networks needs a long period but the transport infrastructure operates only a few decenius.

The latest enlargements of the E.U. redimension the European transports policy. As a result, the trade exchanges transform the transports into a vital service for an efficient European economy.

The implementation of the trans-European networks represents an indispensable catalizator for a sustainable mobility for the goods, the persons and the energy across the E.U. [5].

The E.U. has 26 priority projects with the deadline 2020. They cover 220 billion Euros and are connected to [6]:

- ✓ 2010- the connection between the harbours and the terestrian transports;
- ✓ 2012- the implementation of the national interconnected high speed rail networks;
- ✓ 2015- the development of the rail network for the goods transport across the Central Europe.

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## SAGGING AND INDUCED STRESS OF THE LIGHT-GAUGE SHEET SUBMITTED TO THE EXPANSION PROCESS

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**Abstract:** The expansion of the sheets is the technological process by which goals are created in plane sheet. It is the result of some notches combined with the expanse and the inflexion of the material. The values of the specific deformations respectively the stress determined experimentally to the applied forces are closed to the values of the specific deformations respectively the stress that appear during the expansion process.

**Key words:** sheet, stress, deformations, expansion

### 1. INTRODUCTION

The expansion of the sheets is the technological process by which goals are created in plane sheet. It is the result of some notches combined with the expanse and the inflexion of the material.

The sheet is submitted to an expansion process that suffers shape modifications, respectively of the positions of different points on its surface against the positions that used to have before expansion. The study of the efficiency of the use of this type of materials in structures with ecologic properties is part of the project IDEI-1239/2007, funded by the Education, Youth and Innovation Ministry of Romania.

### 2. TESTS CONDITIONS

The purpose of this work is to study the progress of the stress that appear during the process of elongation of the material submitted to the process of expansion.

The experimental tests have been achieved in a steel test tube OL 52 with the following dimensions:

- Length  $L=115\text{mm}$ ;
- Width  $W=50\text{mm}$ ;
- Thickness  $T=1.5\text{mm}$ ,

5 electro resistive sensitive devices 6/120LY11 type were fixed on its surface, in the measure points, as per fig. 1 [2].

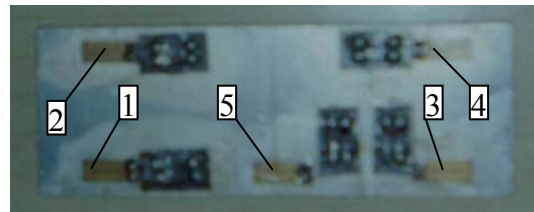


Fig. 1 Steel test tube with electro resistive sensitive devices applied on its surface

The dimensions of the test tube were set according to the shape of the blade used to the expansion, respectively for the fixing of the test tube that complies with the supporting conditions in the expansion process.

In order to achieve the determinations, it was necessary the use of a device of the test tube support. This device is presented in the fig. 2 [2].

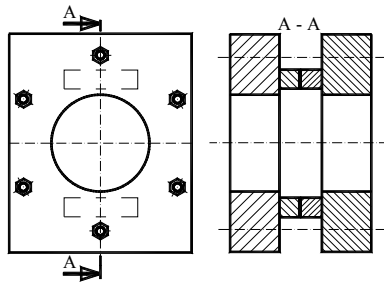


Fig. 2 Device of test tube support

The support device prepared for the experimental determinations is presented in the fig. 3.



Fig. 3 Support device prepared for the achievement of the experimental determinations

The device presented in the fig. 3 is mounted in the test installation presented in the fig. 4 [2].

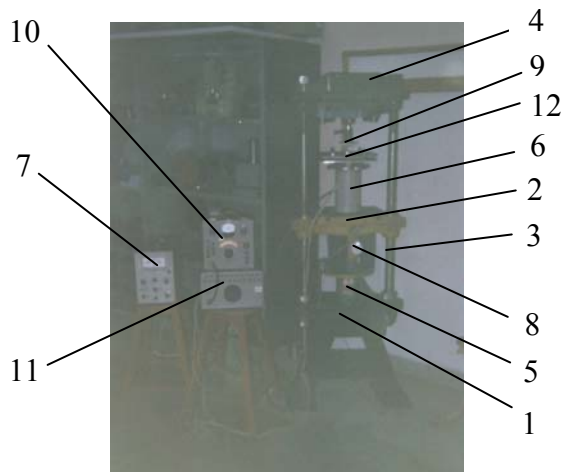


Fig. 4 Test installation

The components of the installation are:

- 1- fixed support table
- 2- mobile table

- 3- guidance columns
- 4- mobile support table
- 5- hydraulic jack
- 6- force cell HOTTINGER BALDWINMESTECH type C
- 7- measure amplifier
- 8- comparator
- 9- claw- superior blade for the force application
- 10- amplifier stress gauge
- 11- commutation box
- 12- support device

The experimental determinations consisted in applying some forces that fluctuate slow, continuous, progressive, and linear and without shocks on vertical direction, above the test tube presented in fig. 1, in the right of the electro resistive sensitive device no. 5. The application of the force is made with a puncher type “Claw-superior blade” that has the angle  $\gamma=0^\circ$  [1] and it is presented in the fig. 5.

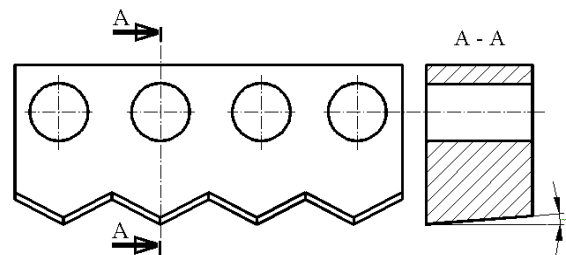


Fig. 5 Puncher type “Claw-superior blade”

### 3. Experimental determinations

The values of the deformations and the values of the stress determined for each electro resistive sensitive device, further to the application of the force by the puncher type “Claw-superior blade” are presented in the table 1 [3], [4]. These values have been interpolated by spline functions of order 3, giving a clear image of the variation of those parameters.

Tab. 1 Experimental data

TER 1		
Force F [daN]	Relative deformation	Stress $\sigma$ [N]

	$\varepsilon$ [ $\mu\text{m}/\text{m}$ ]	
0	0	0
7.25	195	409,5
12.5	430	903
25	540	1134
37.5	760	1596
50	850	1785
75	1000	2100
112.5	1465	3076,5
135	1760	3696
TER 3		
Force F [daN]	Relative deformation $\varepsilon$ [ $\mu\text{m}/\text{m}$ ]	Stress $\sigma$ [N]
0	0	0
7.25	175	367,5
12.5	425	892,5
25	540	1134
37.5	755	1585,5
50	855	1795,5
75	985	2068,5
112.5	1475	3097,5
135	1770	3717
TER 2		
Force F [daN]	Relative deformation $\varepsilon$ [ $\mu\text{m}/\text{m}$ ]	Stress $\sigma$ [N]
0	0	0
7.25	205	430,5
12.5	410	861
25	540	1134
37.5	600	1260
50	890	1869
75	1160	2436
112.5	1675	3517,5
135	1850	-
TER 4		
Force F [daN]	Relative deformation $\varepsilon$ [ $\mu\text{m}/\text{m}$ ]	Stress $\sigma$ [N]
0	0	0
7.25	190	399
12.5	385	808,5
25	550	1155
37.5	600	1260
50	890	1869
75	1165	2446,5
112.5	1680	3528

135	1890	-
TER 5		
Force F [daN]	Relative deformation $\varepsilon$ [ $\mu\text{m}/\text{m}$ ]	Stress $\sigma$ [N]
0	0	0
7.25	- 270	- 567
12.5	- 585	- 1228,5
25	- 2000	-
37.5	- 3870	-
50	- 4900	-
75	- 6390	-
112.5	- 6850	-
135	- 7350	-

#### 4. Theoretic calculation

The study of the stress that appear during the elongation process of the material submitted to the expansion, have been already analyzed also with the software of finite element, NASTRAN. Besides the values of the stress, there is presented spatially also the condition of the test tube deformation, on which acts on the half of its width, a force linearly applied, with a value of 135 daN.

This study with finite element was achieved for a scheme with identical dimensions with test tube ones, where it has been studied the fluctuation of the stress by means of the sensitive devices. The scheme was digitized with 20notches on each length of the plate and with 10 notches on each width. The strains applied to the notches form the width where were added the three displacements and two rotations, and the third rotation, as per axe y it is considered existent.

The values of the stresses and the deformation determined by NASTRAN program presented in the fig. 6 [2].

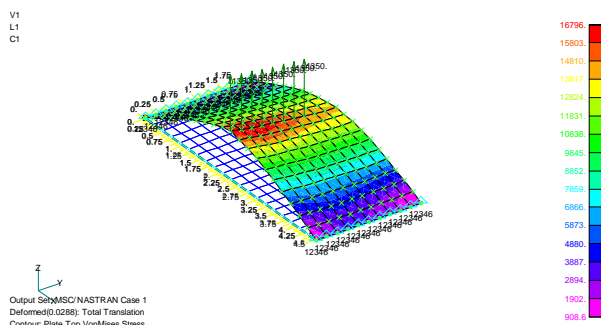


Fig. 6 Deformation and the values of the stresses

### 5. Conclusions

The values of the specific deformations, respectively the stress determined experimentally to the forces applied are closed to the values of the specific deformations respectively the stress that appear during the expansion process.

Further to the comparison of the experimental results with the theoretical one offered by NASTRAN program, it is found a difference of under 10% , that makes possible to be safely approached the process of expansion.

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## A FLEXIBLE TOOL MANAGEMENT STRATEGY FOR THE ADAPTIVE TOOL DEMAND RATE SIMULATION ANALYSIS

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**Abstract:** Management of the tools warehouse is a difficult operation, so, a flexible tool management strategy is required. Inside an unautomation enterprise, a planned tools demand rate for a certain period of time is calculated by the responsible staff, without taking in consideration an eventual deviation from the production plan. In this case, between the planned demand rate and effective demand rate, can be very huge differences. To avoid these problems, this paper work proposes an adaptive tool demand rate simulation through the application of a flexible tool management strategy.

**Key words:** flexible tool management strategy, adaptive demand rate.

### 1. INTRODUCTION

Management of the tools warehouse is quite difficult because, it isn't involve only the arrangement of the tools inside the warehouse, but also the tools supply from the external supplier and their delivery to the production line. A supply network consists in suppliers, factories, warehouses, etc., working together to fabricate products and deliver them to customers. Parties involved in the supply network have their own resources, capabilities, tasks, and objectives. They cooperate with each other autonomously to serve common goals but also have their own interests. A supply network is dynamic and involves the constant flows of information and materials across multiple functional areas both within and between network members.

Generally, inside the enterprises, tools warehouse is managed by the staff, based on their abilities and experience. It is very obvious that an advanced and automatic procedure is required.

In recent times, there was developed different software architecture, based on multi-agents technology, to manage supply networks at the tactical and operational

levels. Multi-agent technology therefore appears to be particularly suitable to support collaboration in supply network management, because the supply network is viewed as a system made of a set of intelligent (software) agents, each responsible for one or more activities in the supply network and each interacting with other agents in planning and executing their responsibilities [1].

### 2. FTMS PROCEDURE

To facilitate the tool warehouse management, it was proposed the FTMS (Flexible Tool Management Strategy) [4, 5] procedure integrated in a Multi-Agent Tool Management System [2, 3], which requires that the values of the tools availability can vary between two limits  $I_{min}$  and  $I_{max}$ . In other words, the inventory level,  $I$ , is left free to fluctuate within the limits  $[I_{min}, I_{max}]$ , provided neither of them is crossed. Whenever  $I$  (inventory level) decreases due to a tool wear-out event, the CBN grinding wheels are sent out for dressing. Otherwise, the enterprise logistics must either provide an additional number of grinding wheel when the lower control limit is crossed ( $I < I_{min}$ ) or reduce the part-number on-hand inventory by suspending the dressing job order allocation

when the upper control limit is crossed ( $I > I_{max}$ ) to bring back the stock level within the control range. Fig. 1 illustrates on a schematic way, the on-hand inventory control of a certain CBN grinding wheel part-number to describe the FTMS procedure functioning. At time  $t = 0$ , on-hand inventory size for a certain part-number is  $I_0$ . Each time CBN grinding wheels wear-out ( $w$ -events in figure 1), the part-number on-hand inventory level,  $I$ , decreases, the adaptive demand rate values are updated, and supplier-independent dressing cycle time predictions,  $T(j+I)$ , are issued.

Each time new or dressed CBN grinding wheels are delivered by the suppliers, the part-number on-hand inventory size,  $I$ , grows but the control limits  $I_{min}$  and  $I_{max}$  are not affected. However, if  $I$  crosses the upper control limit ( $I > I_{max}$  at  $d_1$  in Fig. 1), at the next  $w$ -event ( $w_2$  in Fig. 1) a number of  $I - I_{max}$  worn-out grinding wheels are kept on-hold in the enterprise warehouse ( $h_1$  upper control limit crossing, Fig. 1).

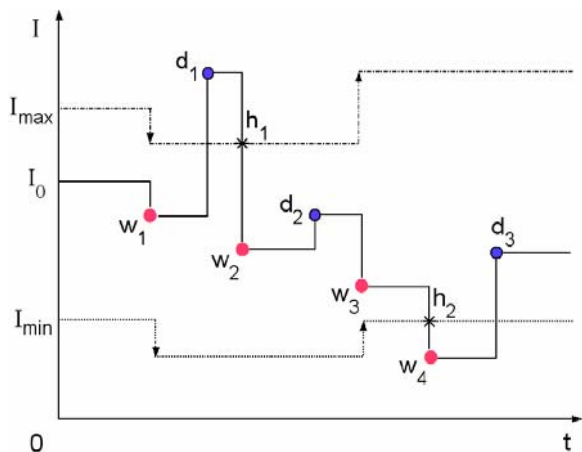


Fig. 1. Time ( $t$ ) evolution of the stock volume (inventory -  $I$ ) for a certain part number of CBN grinding wheel [2, 4]

After control limits updating, if  $I$  is within the control range the worn-out tools must be sent out for dressing but no tool purchase is required ( $w_1, w_3$  in Fig. 1).

If  $I$  crosses the lower control limit ( $I < I_{min}$  at  $w_4$  in Fig. 1), the worn-out tools must be sent out for dressing and further a number of  $I_{min} - I$  grinding wheel must be provided.

If worn-out grinding wheels are on-hold, they are sent out for dressing in partial or total substitution for new tool purchases ( $h_2$  lower control limit crossing, Fig. 1).

### 3. TOOL ADAPTIVE DEMAND RATE (TADR)

Inside an enterprise, the staff responsible for the warehouse tools management calculates the tools planned demand rate  $P/G$ , which is the report between two constant parameters, and represents the average tools necessary for a certain period. Thus, this report can not take in consideration any production plan deviation. In other words, this method considers that, during a year, an enterprise has the same production plan. The effective tool demand rate can result bigger than the planned one, because the increase of the production volume, or the decrease of the tools life cycle time. Also the effective tool demand rate can result smaller than the planned one, because the decrease of the production volume. In consequence, the effective tools demand rate can be very different from the planned one, and thus can result many difficulties for the tool management. The adaptive tool demand rate (ATDR) can be calculated with the I-FUTURE program, using the following mathematical formulae:

$$d_R(j) = \begin{cases} P/G, & \text{if } t(j) \leq 1 \\ j/t(j), & \text{if } t(j) > 1 \end{cases} \quad (01)$$

Where:

$P$  - the number of products that must be processed in a months;

$G$  - the number of products processed by a grinding wheel;

$t(j)$  - the time (in months), computed from the start of the FTMS procedure, at which the dressing operation for worn-out tool is proposed;

$j$  - the number of worn-out tools (grinding wheels).

### 4. SIMULATION USING TADR

Using I-FUTURE program the simulation can be made for one year. To begin the simulation it needs to be created one file Excel,



leaving from the data base of a certain grinding wheel part number. This file contains five columns (Date, Type, Number, Serial number, Dressing time) as can be seen in figure 2.

1	Event list				
2	Date	Type	Number	Serial number	Dressing time
3	06-gen-00	d	1	U2094	6
4	19-gen-00	s	2	U2093	
5		s		U2005	
6	02-feb-00	s	2	U1948	
7		s		U1941	
8	10-feb-00	s	1	U1949	
9	10-feb-00	d	1	U2093	8
10	11-feb-00	s	1	U2095	
11	12-feb-00	d	1	U1948	19
12	13-feb-00	d	1	U1949	8
13	17-feb-00	s	1	U2098	
14	19-feb-00	d	1	U1941	13
15	20-feb-00	d	1	U2240	8
16	24-feb-00	s	1	U1951	
17	25-feb-00	d	1	U2098	9
18	01-mar-00	s	1	U2094	
19	12-mar-00	d	1	U2095	9
20	15-mar-00	s	1	U2260	

Fig.2. File Excel for simulation for a certain grinding wheel part number

- Date – this column contains all the dates for one year in chronologic order.
- Type – this column contains one of two letters: “d” (delivery) or “s” (shipment), according to the type of event that take place. For example for a disassembling event, must be wrote “s”, and for an assembling event, must be wrote “d”;
- Number – this column contains the number of the events of same type that take place in certain day;
- Serial-number – this column contain the serial number of used grinding wheel;
- Dressing time – this column contains the number of weeks necessary for dressing the grinding wheels for the events “d”.

To begin the simulation, in the main screen of Invadapt, click on the box "new simulation". The initialization window appears in which all the information related to the part-number to be simulated must be inputted. The first information item to be inputted is the start date of the simulation. Then, a combo box can be opened where the

part-number to simulate is selected.

Subsequently, pressing the tab key, the text box appears in which the purchase cost of the CBN grinding wheel is inputted. In the same way, the following information must be inputted: dressing cost, planned demand rate (given by the ratio between the planned number of pieces to produce “P” and the average life of the grinding wheel “G”), initial on-hand inventory (number of grinding wheels that are available at the start of the simulation), and number of grinding wheels that have been sent to dressing before the start of the simulation (the starting date inputted in the Command Window), and that have not been yet delivered. After having inputted these information items press "OK". The window "event information" appears in which the information related to the first event is inputted: the date of the event (must be inserted in the international format, for example 1-Jan-2009), the type of event (“shipment” or “delivery”), the number of grinding wheels related to such event.



Fig.3. Initialization window for a certain grinding wheel part-number

By pressing the tab key, a number of rows equal to the number of grinding wheels for the event appear. In these rows the serial numbers must be inputted and, in case of delivery, an equal number of rows also appear where the corresponding dressing cycle times must be inputted. The system, on the basis of this information, makes the decision related to the management of the worn out CBN grinding wheels. An example is reported in figure 3.

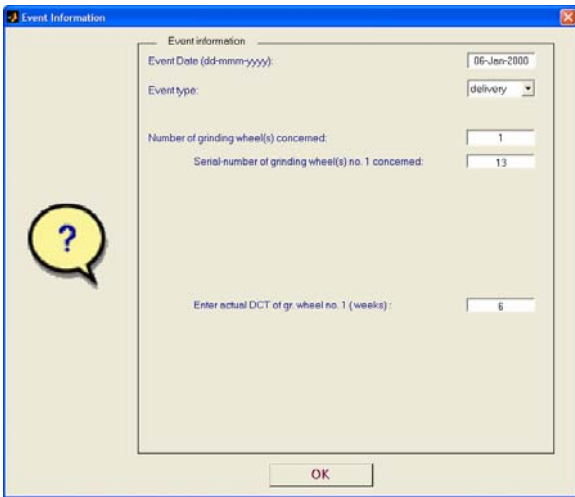


Fig.4. Event Information window for the 6<sup>th</sup> Jan 2000 event related to grinding wheel S/N 13.

The simulation starts by inserting the initial data in the initialization window (Fig. 4).

After inserting the first event, we proceed to the next one, and so one, until we finish all the events for the event list. In the Decision window we have all the decision the program took. For every shipment event insert, we can have one of the following decisions (reported in Fig. 5):

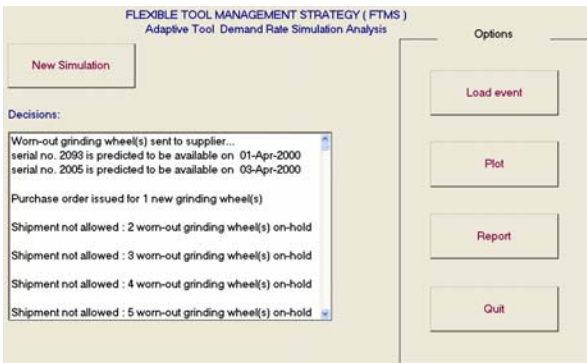


Fig.5. Decision windows

- Shipment not allowed: 1 worn-out grinding wheel(s) on hold;
- Worn-out grinding wheel(s) sent to supplier serial no. "x" is predicted to be available on dd-mmm-yyyy;
- On-hold worn-out grinding wheel(s) sent to supplier serial no. "x" is predicted to be available on dd-mmm-yyyy;
- Purchase order issued for "x" new grinding wheel(s).

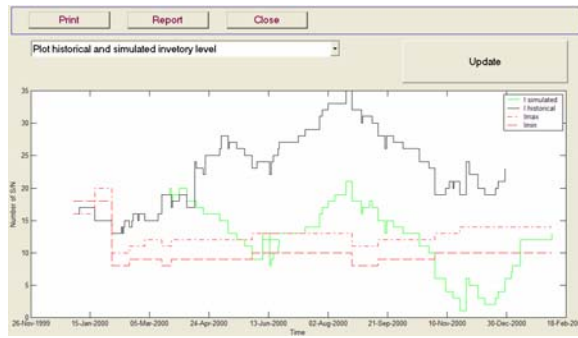


Fig.6. Historical and simulated inventory level trend

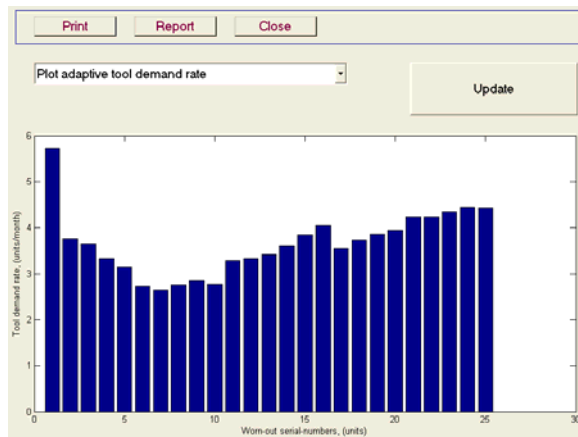


Fig.7. Adaptive demand rate plot

At the end of the simulation, the simulated and historical inventory level can be graphically visualized in figure 6, by clicking the “plot” key of figure 5. This plot allows for the comparison of the simulated inventory level trend  $I$  of the FTMS management with the historical trend and also reports the two control range limits for the inventory level ( $I_{min}$  and  $I_{max}$ ). Moreover, the software allows for the visualization of the “adaptive tool demand rate” plot (Fig. 7).

At the end of simulation we can also see the final report presented in figure 8, by pressing “Report” button from the main window of the I-FUTURE program. Final report shows us some information regarding: the number of worn-out grinding wheel on-hold, the number of dressed grinding wheel, the number of purchased grinding wheels, the number of the undelivered new grinding wheels, the total supply cost, the historical tool cost, and the tool supply percentage.

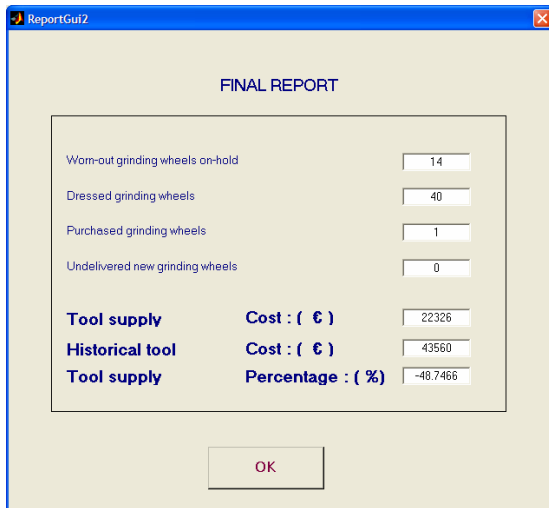


Fig.8. Final report

## CONCLUSIONS

The development and implementation of a Flexible Tool Management Strategy (FTMS) integrated in a Multi-Agent Tool Management System for automatic tool procurement was presented.

The Multi-Agent Tool Management System operates in the framework of a negotiation based multiple-supplier network where the enterprise (customer) requires dressing jobs on worn-out CBN grinding wheels from different tool manufacturers (suppliers).

The task of FTMS is to control the evolution of CBN grinding wheels and to optimize the tool inventory size.

An adaptive tool demand rate approach (ATDR) were presented, to illustrate and assess the FTMS performance, using the I-FUTURE program.

By comparing the historical and the

FTMS simulated inventory level trends for the illustrated example, we can see that using the ATDR approach provide far better results and represent an effective balance solution between the diverging requirements of significant cost reduction and reliable stock-out prevention. Moreover, Fig. 8 shows for the simulated inventory 48% global saving over the historical cost for.

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## THE KONDRATIEFF WAVES AND THE ECONOMIC CYCLE

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**Abstract:** *Recent evolution of the world economy due to the disruptions of financial markets made us ask what happens, if it is something new or the world had got through already. In this paper I try to show that the theory of Kondratieff is still valid for today's.*

**Key words:** *economic cycle, capitalist economies, long wave model, growth, war, global leadership, innovation*

### 1. INTRODUCTION

The recent crisis started in 2007 through the financial disturbances and then translated into the real economy made many people ask about some logical explanations of the events. Although there are many analysts who just try to explain the crisis comparing the situation with the Great Depression from the 1930s, I think this kind of analysis is not enough to explain these events and the right approach is to understand the Kondratieff's long wave theory. Even if, it was written more than seven decades ago it remains actual. It proved to be right for the Great Depression and the subsequent evolution of the economy until our days.

### 2. THE CONCEPT

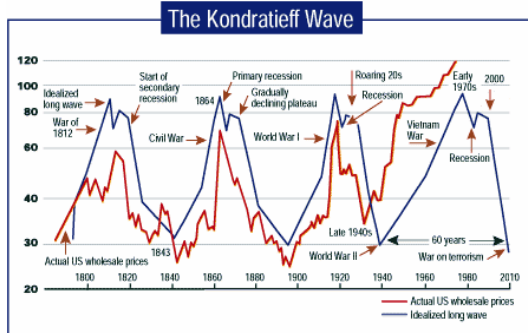
The Kondratieff theory first made its appearance in the mid-1920s, and it was translated into German, at that time, but it didn't make particular stir until the mid-1930s, when the abridged form was translated into English. The long wave had a brief vogue in the late of 1930s but disappeared until 1970, due to the advent of Keynesian theory which claims to be able to fine-tune the economy and eliminate inflation and recession.

Kondratieff's major premise was that capitalist economies displayed long wave cycles of boom and bust ranging between 50-

60 years in duration. Kondratieff's study covered the period 1789 to 1926 and it is based on a study of the price behavior in France, England and United States which included wages, state bonds, interest rates, raw material prices, foreign trade, bank deposits, and other data. He observed certain characteristics about the growth and contractionary phase of the long wave. Among them, he detailed the number of years that the economy expanded and contracted during each part of the half-century long cycle, which industries suffer the most during the downwave, and how technology plays a role in leading the way out of the contraction into the next upwave.

In the idealized long wave model, the cycle (which averages 54 years in length) begins with the "upwave" during which prices start to rise slowly along with a new economic expansion. By the end of a 25-30 year upwave period, inflation is running very high. Its peak sets the stage for a deep recession that jolts the economy. The recession, which begins about the time commodity prices break from their highs, is longer and deeper than any that took place during the upwave. Eventually, though, prices stabilize and the economy recovers, beginning a period of selective expansion that normally lasts nearly a decade. Referred to as the secondary plateau, the expansion persists, giving the impression that "things are like they used to be," but its anemic nature eventually takes its toll as conditions within the economy

never reach the dynamic state that occurred during the upwave. The secondary plateau ends with a sudden shock (financial panic/stock market crash) and the economy rolls over into the next contractionary phase, which is characterized by deflation and the start of an economic depression.



For a better understanding I will detailate the four phases of one cycle:

### 1.1. Inflationary Growth Phase

A common premise among business cycle economists supposes inflation as an inevitable part of growth. Government becomes a passive participant in the inflation cycle. Growth begins from a depressed economic base and expands in an ever-increasing spiral. The interaction of the participants within the economy causes wealth, as represented by savings, and the production of capital equipment to be accumulated for the future. The expansion of production and affluence causes prices to rise, and the increased volume of goods requires a higher velocity of money, thus creating a higher price structure.

Historically, the growth phase requires 25 years to complete. During this time, unemployment falls, wages and productivity rise and prices remain relatively stable. The mood of the growth phase is one of accumulation and the desire for new product manufacture.

Accompanying growth is a shift in social demands. As wealth is accumulated and new innovation introduced great upheavals and displacements take place. The process of social unrest builds with growth culminating in massive shifts in the way work is defined and the role of the participants in society.

### 1.2. Stagflation (Recession)

Eventually, the continuation of exponential growth reaches its limits. Excess capital produces a shortage of key resources and the economy enters a period where growth creates a shortage of resources. An economy will only support expansion to the limits of its resources, both human and material.

The mood of affluence also brings a change in attitude towards work. As an economy gets closer to its limits, inefficiencies build up.

The imbalances of this period have been historically exaggerated by what can be labeled a "peak war". Examples such as War of 1812, the Civil War, World War I and Vietnam, came at the end of a very affluent period. These Wars produce strains on the economy increasing the impact of inflation. A dramatic drop in output, rapid rise in unemployment and unusually severe recession characterize this period. Although this primary recession is short lived lasting only three to five years, it is a key in altering perceptions and the structure of the economy. The "Limits to Growth" now define a maximum level of economic activity that traps the economy into consolidation and tight bounds for the next 20-25 years. With the change comes a conservative shift in the popular mood reinforcing the limits.

### 1.3. Deflationary Growth (Plateau Period)

The primary recession occurs out of an imbalance forced upon the economy by real limitations. The rapid rise in prices and changes in production correct this imbalance – at least temporarily. The change in price structure, along with the mood of a population used to consumption accompanied by the vast accumulation of wealth from the past 30 years, causes the economy to enter a period of relatively flat growth and mild prosperity. Due to structural changes and the limits of the existing paradigm the economy becomes consumption oriented.

Excesses of an unpopular war, along with fiscal liberalism, cause popular reaction toward stability or normalcy. The plateau period generally lasts seven to ten years and is

characterized by selective industry growth, development of new ideas (both technological and social) and a strong feeling of affluence, terminating in a feeling of euphoria. The inflated price structure from the primary recession, along with the desire for consumption, produces a rapid increase in debt. Eventually, wealth consumption expands beyond all practical limits, and economy slips into a severe and protracted depression.

#### **1.4. Depression**

Excesses of the plateau period affect a collapse of the price structure. This exhaustion of accumulated wealth forces the economy into a period of sharp retrenchment. Generally, the secondary depression entails a three year collapse, followed by a 15 year deflationary work out period. The deflation can best be seen in interest rates and wages that have shown a historic alignment with the timing of the Long Wave - peaking with and bottoming at the extremes.

Kondratieff viewed depressions as cleansing periods that allowed the economy to readjust from the previous excesses and begin a base for future growth. The characteristic of fulfilling the the expectations of the previous period of growth is realized within the Secondary Depression or Down Grade. This is a period of incremental innovation where technologies of the past period of growth are refined, made cheaper and more widely distributed, and consolidates industries.

The emerging view now broadly characteristic of a significant body of scholarship might be summarized as follows:

1. K-waves are attributes of the world economy and are more visible in international production data than in those of individual national economies. They are processes characteristic first of all of a lead national economy (such as that of the United States, or Britain in the 18-19<sup>th</sup> centuries) and of world trade in products and services of leading sectors, hence of the global economy.
2. K-waves concern output, rather than prices, and sectoral output surges and infrastructural investment in the world economy rather than the general macroeconomic performance

(GNP growth) of national economies. They should not be sought for in the ups and downs of such indicators as gross domestic product and must be distinguished from shorter-term business cycles and fluctuations in the economic conditions of individual countries. However, high-growth periods for leading sectors tend to translate into general economic expansion and prosperity.

3. K-waves unfold as phased processes that imply S-shaped growth (or learning) curves, including for each particular sector, and over a period of some 50-60 years, a period of slow start-up, followed by fast growth, and ultimate leveling-off. That is why they are waves of economic activity, each wave different in kind from the last one, rather than cycles, seen as mechanical fluctuations in attainment of some uniform quantity. The start-up period of the next leading sector is also the period of flattening growth rates, declining profits, and severe competition for the previous lead industry; this transition between two leading sectors peak may be known as downswing, and takes the form of generalized slow-down and in the 1930s, of the Great Depression.

4. K-waves arise from the bunching of basic innovations that launch technological revolutions that in turn create leading industrial or commercial sectors. In Schumpeter's classic formulation, such innovations concern new products, services, and methods of production, the opening of new markets and sources of raw materials, and the pioneering of new forms of business organization. In that sense, K-waves are caused by the demand for solutions to new problems, and the supply of such solutions by innovative firms.

5. K-waves have their own characteristic location in space and time. Britain's cotton wave was centered on Manchester. The information K-wave is preferentially seen in such locations as Silicon Valley and Orange County in California. K-waves also have a clear location in time, and can be dated. There is no standard listing, but there is some agreement on the four or five most recent ones. Historians and world system theorists now extend such dating further into the past.

6. K-waves each have their own special character and specialization but each in its own way also changes the structure of the world economy; that is why a sequence of K-waves gives rise to structural transformations. Hall and Preston (1988) have shown that the three most recent K-waves (those that launched i.a. the telegraph and electric power, radio and electronics, and computers and the information industries) might jointly be seen as the carriers of the information revolution. Only in such an extended time-frame can truly long-term processes be properly observed.

## **2. KONDRATIEFF AND WAR**

War has influenced economic history profoundly across time and space, generating technological developments, shaping economic institutions, trade patterns, disruption markets and depressing economic growth. Kondratieff himself might be regarded as the originator of the hypothesized link between these two phenomena, observing that wars and revolutions were more likely to occur during what might be called the long start-up, or the transition period. So the first peak of the wave follow the napoleonic wars (1805-1815), the second peak follow the american civil war (1861-1865), the third peak is after the first war (1914-1918), the fourth is after the vietnam war (1968-1975). It is possible that the attacks on September 2000 from New York to be the event of the last wave. At question why the second war was not a peak, I can answer that for Unites State, the second war boosted its economy that was dominat since.

It is important to mention that Kondratieff hadn't considered the wars and revolutions were the cause of the waves but a symptom of them, the effects of the acceleration of the pace and the increased tension of economic life, of heightened economic struggle for markets and raw material.

## **3. KONDRATIEFF AND GLOBAL LEADERSHIP**

Analysing the K-wave it can be observed that it is a close tie in the structural

relationship between the waves and global leadership. The K-waves can be seen as the rise and decline of successive globally-significant lead industries, of world powers, hence. That process can be referred to as the hegemonic cycle, or more precisely, as the long cycle of global politics.

While the precise conditions of that process remain a matter of debate, the existence of a succession of world powers in modern world politics is now taken for granted, and the similarities in the several approaches are now greater than the differences.

The rise of each such power is seen to be coordinate with K-waves in two ways: in space, in as much as each K-wave is largely located in the world power of that period, and in time, in as much as the timing of these two processes of change is synchronized. What is more, a lead economy, which succeeds in launching lead industrial sectors, is a necessary condition in attaining global leadership; in turn, attainment of global leadership creates the political framework of a global economic order.

In that way, each long cycle of global politics has been matched, in the experience of the modern world, by two Kondratieffs. The first of these serves to establish the necessary conditions for global leadership (as when the late 19<sup>th</sup> century industrial expansion in steel, chemistry, and electric power laid the foundation for the United States role in the 20<sup>th</sup> century) and the second is put in place as the result of that attainment of that leadership (as when the settlement of 1945 paved the way for the economic expansion of the post-war years, led by autos, oil, and electronics). The location of the K-wave therefore serves as leading indicator of next global leadership,

These considerations throw light on the question of endogenous and/or exogenous nature of these processes. At one level, the K-wave might be seen as an endogenously generated response to problems facing the world economy: basic innovations as responses to system problems, such as railroads as meeting the demands of a rising industrial economy. At the next level, though, as just shown, K-waves in turn determine, and are determined by, structural changes in world

politics: they help determine the selection to global leadership, and they are determined by the political framework that leadership has established. In that sense, K-waves are exposed not to random shocks, as some economists have called wars, but to predictable influences that make them coordinate with global political change.

#### **4. KONDRATIEFF AND INOVATIONS**

A prominent explanation of K-waves relies on the role of basic innovations leading a succession of socio-technical paradigms. The drivers of that evolution are large and small firms, often fresh start-ups launching innovative products that are, or are not, selected by consumers/ buyers in the marketplace, and when selected, are diffused until they reach saturation in their respective markets. The selective pressure is that of markets, but these markets might include large buyers, such as governments whose demands, and research, can stimulate innovation. This economic process coevolves with the political one of rise and decline of world powers. This is a Kondratieff-Schumpeter type of explanation of the change in the global economy, and it might best be described as evolutionary.

Kondratieff stated that the the scientific-technical inventions are used on a large scale when the economic conditions are favorable to their application, and the changes in techniques springs from the economic necessities.

#### **5. THE PRESENT WAVE**

The current revolution of the Kondratieff Wave began after the global economy pulled out of a deflationary depression in the 1930s. Prices began to accelerate upward after World War II, and reached the commodity price blowoff stage in 1980. Since that time, and then after the recession of 1990-1991 (much longer in some locations such as California and Japan, the latter of which has never really recovered from economic contraction), the global economy has been treading the secondary plateau. During this period,

consumers and investors become aware that inflation is not accelerating, and disinflation becomes the buzz word. The assets such as stocks and bonds do well since neither inflation nor deflation-both of which are damaging to stock investment returns-hurts the marketplace.

But during the secondary plateau, the first signs of problems-the seeds of the deflationary contraction soon to follow become known. Isolated economies fall into deflationary contraction, and telltale signs such as declining gold prices begin to take hold. During the 1990s, it has been the Japanese economy that slid first into deflationary contraction. Gold has already reached new 11-year lows and as yet shows no sign of a bottom.

The stock market crash of 1997 was the signal that the period of economic growth along the secondary plateau is ending. Additional economies collapse and plunge into deflationary contraction, as characterized during this revolution of the Kondratieff cycle by the domino effect coming from Thailand, Indonesia, Asia, and South America. Stronger economies such as those of Europe and North America are likely to hang on until the last moment, then fall off into deflationary contraction.

The message of this revolution of the Kondratieff cycle, which is a cycle of debt repudiation and not just of commodity price deflation (the deflation is caused in part by defaulting debt and a contracting global monetary base), is that humanity is much more aware of the effects of the cycle than, say, in the 1930s, and that the contraction can be handled. When the y2k bug is factored in, we can see that this collapse matches the Kodratieff trough.

The great credit bubble of the last 60 years will be washed away at the very trough predicted by the Kondratieff wave.

However, two factors complicate the picture until this revolution of the Kondratieff Cycle bottoms in 2003 when it can be expected that the collapsing mound of debt will finally be cleaned out (enter y2k).

First, European Union, which takes its next step in 1999, represents a similar situation to that of China's assimilation of Hong Kong in



that it represents a union of different governments. Both the Western and Eastern worlds participated in the excess speculation in Hong Kong leading up to the Crash of 1997. Falling government constructs cause the masses to put too much faith in the free market, and excess speculation results in a collapse. With European Union upcoming, changing government structure to allow for a coordinated European economy has resulted in too much investor confidence in the financial markets there, too. Thus, with the Union coming right at the end of the Kondratieff Cycle, another financial market collapse is likely to lead to a situation that gets worse before it gets better there. In fact, precious resources required for y2k conversion are being diverted to the 'Euro'.

Second, Canada's commodity-dependent economy presents an additional variable to North America's ability to withstand the forces of the deflationary contraction now spreading across the globe. Although there will be periods of rising commodity prices-perhaps the saving grace for economies such as Canada's this does complicate the picture with respect to anticipating Canada and North America's ability to "ride it out" with relatively little damage. In fact, because they are so technologically dependant, we may suffer even more.

## 6. CONCLUSIONS

The study of K-waves has predictive value because it helps to define the long-term development tendencies characteristic of the time and place. It is now quite widely agreed

that the leading sectors of the late 1990s are the information industries, and that the K-wave has now moved into higher gear, for a period likely to extend for some two-three decades, into the 2020s. The United States seems to be on the leading edge in most segments of this large sector. If leadership in this, the 19<sup>th</sup>, K-wave is a leading indicator of future global leadership, then the United States is well positioned for it. Others countries recently prominent in the information industries, including China, Europe, India and Japan, are also well placed in these processes.

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## MATERIALS MANAGEMENT UTILIZING AUTOMATHICAL IDENTIFICATION TECHNOLOGIES

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***Absrtact:** The appearance and development of newest conceptions and methods to carry on the wars, base on newest technologies, optimal and sharp informational inset, assess the development an efficient account system, capable to offer a modern management of resources. The automathical identification tecnique is wishing to be the base for rational and effectivnes support of the materials flux management in logistical process. Will be present radio frequency identification technology (RFID-Radio Frequency Identification) and the results obtain by utilizing this rechnology.*

**Key words:** radio frequency identification, tag, STANAG 2233.

### 1. RADIO FREQUENCY IDENTIFICATION (PROXIMITY)

Radio Frequency IDentification (RFID - *Radio Frequency IDentification*) or **proximity**, is the last and the advanced technological method to automat collect data, acquiring a large acknowledgment in proportion as man understand and practice this technology.

RFID is an identification system like bar cod technology. Bar code systems require a reader and adhesive labels solder on objects, while RFID require a reader and special labels or bound/integrate card in objects. By comparison, bar code utilizes the reflection of a luminous beam over the label that contains the print code, as to RFID utilize a low power radio frequency field. This radio frequency field do not need a strict positioning of the object to read, it penetrate any nonmetallic material and do not need necessary a direct contact with the reading equipment. From these reasons, RFID is an alternative solution to change bar code and can be use in conjunction with these.

The most simple proximity applications can be compare with bar code system, but the most sophisticate RFID products can interface with external sensors for measure some specifically parameters, or even GPS systems (*Global Positioning Satellite System*) for tracking the position of some objects with satellites.

The reader contain electronic components witch emit and receive a signal to and from proximity label, a microprocessor verify and encode receiving data and a memory which record data for a next transmission if is necessary. The reader has connected an antenna to allow receive and transmit data. Antenna can be integrate in reader housing or can be separate, sited on a distance from the electronics.

A proximity label contain a principal component an electronic cip, this controlling the communication with the reader. This contain a memory section to storage the identification codes or another data, activated at once with communication (figure 1).

In majority cases, the reader emits electromagnetic field into area, which depends on system frequency and antenna dimension. When the reader transits this zone, it detect generated signal from it and start to send forward the information stored in memory. The signal generated from the reader offer in the same time temporal information and adequate energy to proximity label to allow good function. Time information is synchronizing the communication between label and reader, simplifying constructive design of them.

When the reader receives data, it encodes and submits to a validity test (*CRC - cyclic redundancy check*). If the data are valid, will transmit to a computer through a

communication protocol (ex: RS232, RS485).



Fig 1. Proximity label

It is not necessary the direct contact or some arrangement at reading, because the generated field pass through non-metallic materials, this thing allow that labels to be attached or integrated in the objects that will be identify.

Irrespectively of modality, the garne datas in the proximity label are read by the reader through electromagnetic field, this situation is possible only if proximity label which is a coincidence circuit more or less complex, has an amount of energy.

This energy may be provide by:

- from a proper battery- active proximity labels;
- from the generated field provide by reader-passive proximity labels.

An active label need an external battery connection or a internal battery by its integration. Those systems have the advantage of necessary energy reduction generate by reader, having a big distance of reading. As disadvantage those systems have a short life by reason of battery, being used just in specific applications, the bigger cost than a passive label. Because the battery cost beyond far the cost of a proximity label, the active method is very seldom used, only when is necessary the reading from distance too far (the range of meaters) for necessary energy to be delivered through the field. Therefore, in the next discussion, it will refer only the passive systems. A passive label operate by energy generated from reader. Those are less and

lighter than the active proximity labels, cheaper and the life time is theoretic unlimited. The disadvantage consist in the short distance of reading. The labels are divided in three main groups, reading – writing, registered once, readed round and round, only reading.

The labels reading- writing have a memory which garnes datas which can be modify through normal operation. The examples of such tags are the telephone cards or the credit bank cards. Those tags are costly than the other ones. The labels which can be only read contain an unique cod programmed which can not be modify. This component confers those labels a high security level. A system which uses such labels needs a cancellation of information processing and storage though computers and adequacy programs.

As to of RFID technology work frequency, exist the standard „NATO consignment and asset tracking by radio frequency identification”, cod STANAG 2233 AST (EDITION 2), which regulize technical requirements (bandwidth, maximum power level, maximum band-pass width, recommended transfer rate, recommended modulation etc.) so that RFID equipments in range of NATO armyes endowment will be compatible.

The systems of high frequency are utilize in applications with very high distance and speed. Applications as cars position by satellite, are about using such labels. Disadvantage consist in costliness owing to very high degree of execution and exploitation.

The labels of intermediary frequency are not very common, they action at a frequency of 13,56 MHz. The applications characteristic for this segment being the control of access and intelligent card, credit cards, where are needed big amount of transfer data.

In applications which short distance of reading and low costs, the most used are tags of low frequency. In general are utilised for the control of access, identify of animals and pursue of products in fabrication lines. The distance of reading depends on the dimension of antenna from the interior of the label and of dimensions of antenna connected at reader.

The last development in this area vided systems anti collision or multiple reading,

capacity which permit the reading of more labels lied in the radiofrequency field.

## 2. PRACTICAL APPLICATION

The accomplished system is compose by three principal components: a fixed RFID reader, RFID labels and a work station witch roll on a computer data soft (fig. 2).

By system execution, we follow up the knowing RFID technology performances by testing administration witch to evaluate the implementation opportunity of this system in materials management.

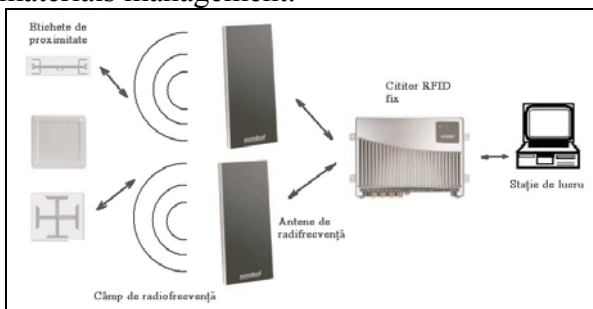


Fig. 2. RFID system composition

### 2.1. FIXED RFID READER

The fixed RFID reader is a Motorola type, model XR480, which allow assumption or record the code on proximity labels by two RF antennas (fig. 3). RFID reader are implement a http server which allow transmit by an acces point – wireless to work station, all the events.

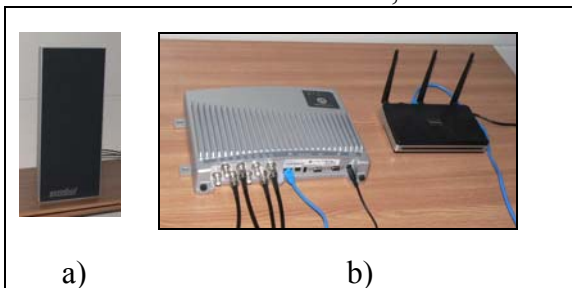


Fig. 3. a) RF Antenna and fixed Motorola XR480 model reader;  
b) „acces point - wireless” D-Link, model DAP-1353

### 2.2. PROXIMITY LABELS

For testing it is used different dimensions of pasive proximity labels which are mounted on different types of packs and produts (fig. 4 and 5). This labels allow frequent reading and writing the identification code and assign a

parole in the case when we wish to secretize the stored identification code. Seeing the realized system has the possibility to write the proximity label and recorded the testing labels with a arbitrary chois identification code.



Fig. 4. Proximity labels

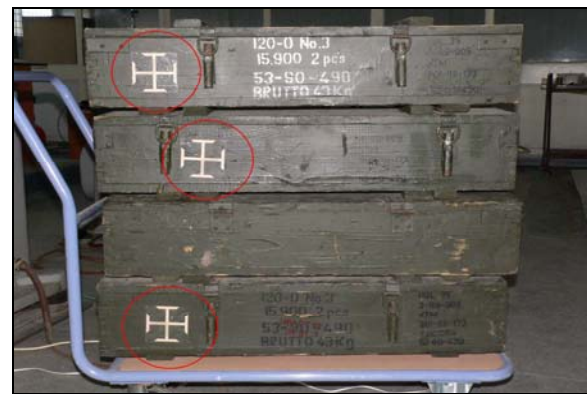


Fig. 5. Proximity labels mounted on 120 mm bomb packing case

### 2.3. WORK STATION

The work station is take up the data running come from fixed reader, store up data base and roll on a computer data soft to data base administration (fig. 6). The tehnological demonstrator utilize a portabil calculator with acces point - wireless D-Link fitted, which allow to comunicate with RFID reader.

The soft realize the following principal operations:

- article automatized identification;
- input basic data in system once;
- input or decrease an article from basic data only in base of a authorization which approve this operation;
- alarm in case that is wishing to an article neauthorization decrease from deposit;
- the identification of persons which input basic data.

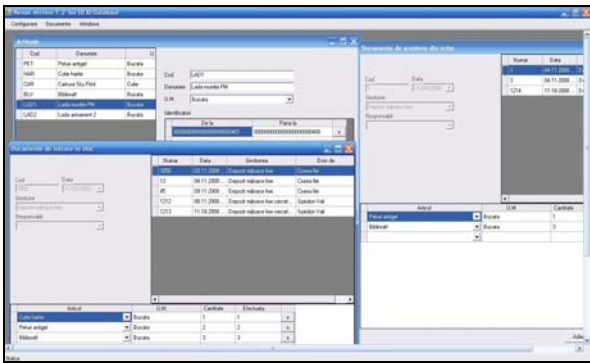


Fig. 6. Soft for data base administration

The informations about of management articles are stored up in a SQL Server base data.

### 3. CONCLUSIONS

Reading accuracy is the best when the number of identification code characteres is smaller. The request labels allow memorize a 24 code characteres, on the unique NATO code – NSN (*Nato Stock Number*), used for the logistic military articles, it is necessary 13 characters.

On the label reading, is determined that the RFID technology isn't enough fast that is describe in textbooks (score of miliseconds order). The displacement forehand between RFID antenna readers of the tested labels, it must be with slow motion. If the article lot is with fast motion forehand between RFID antenna readers them can't be read. The reading distance of labels is direct proportional with the size of proximity label. For a good readind of labeled articles is recomanded to use 2 antennas, face to face locate, which realize circular coverage around scanned article. Is important that the locate mode of RF antennas, for the labeled articles to be in antenna directive diagram in the time of reading operation.

The maximum reading distance whithout obstacles, for the aquired labels was:

- for pasiv label 30/20 mm: 0,5 m
- for pasiv label 100/30 mm: 1,5 m
- for pasiv label 100/100 mm: 2,5 m
- for clamped by screwing label 5/5 cm: 4,5 m.

The aquire labels (the second generation,

which use 860-960 MHz frequency range) don't be read by human tissue. So the human body is shielding the radiofrequency signals necessary reading labels. The second generation labels can be read through carton and wood packing case. It can't be read through metallic walls. The reading distance of labels through wood walls is half.

It is advisable that the system must be extended by "step by step" technique, where will be tested and will be eliminate the eventual difficulties and/or will be choose the best implementation variantes, generate by the practical experience.

In the wake of the RFID system testing and evaluating resultt that the system can be implement in intendance deposits, map deposits, tehcnical materials deposits where the articles are stored don't cover the radio semnal from RFID reader antennas necessary to identificate the labels. The implementation of an RFID system in a dump it isn't possible because the content of stored packing case cover the radio semnal from RFID reader antennas.

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## SOME ASPECTS ABOUT THE TOTAL QUALITY MANAGEMENT CONCEPT

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**Abstract:** *The paper presents some fundamentals aspects about the Total Quality Management (TQM) concept. In is pointed out the representative models: Oakland, SOHAL, three dimensional and also some representative areas of TQM interest.*

**Key words:** *quality, management, TQM, models, areas of interest.*

### 1. DEFINING TQM CONCEPT

Total Quality Management is an organizational strategy founded on the idea that performance in achieving a quality education is achieved only through involvement with the perseverance of the entire organization in improving processes permanently. The objective is to increase the efficiency and effectiveness in satisfying the customers.

The concept of Total Quality Management (Total Quality Management - TQM) has been proposed by Dr. Edwards Deming in 1940 but its use started in 1985 with the takeover by American principles of working in Japanese industry:

- focus on process improvement permanent, so that processes are visible, repeatable and measurable;
- focus on analyzing and eliminating undesirable effects of production processes;
- consideration of how the users use products in order to improve product;
- expanding beyond concerns of product management.

TQM is a description of culture, attitude and organization of a company that strives to provide clients with products and services that meet their needs and expectations. This culture involves all the processes as the company did so well in the first, zero defects, zero waste.

The concept of quality has undergone several stages, adapting to every level of technology and market requirements. Thus, gradually, the selection of finished class performance has been replaced by statistical control of quality parts on-stream, then to extend the process, becoming, through the concept of quality an important factor in delivering products and services. Charge on a gate of which are increasingly a concern for quality led to the appearance TQM as a full definition concept which has a dimension in time correlate thus competing with the concept and simultaneous engineering.

To successfully implemented TQM organization should focus on 6 key elements:

1. Confidence;
2. Training;
3. Teamwork;
4. Leadership;
5. Recognition;
6. Communication

1. Confidence - It is a result of integrity and ethics of the organization without trust can not be built within the work of TQM. The trust helps the full participation of all employees.

Allows every employee empowerment which leads to involvement and engagement. Allow decisions to be made at levels closest to the problem, encourages risk taking individual and continuous improvement to help ensure that everyone on measurement indicators is

made to accuse employees. Trust is essential to ensure customer satisfaction and is one that builds a climate of cooperation essential for TQM.

Ethics - It is discipline which transposes each situation in terms of good or bad. Has two components represented the organization's ethics and individual ethics. Organizational Ethics establishes a code of ethics guidelines emphasize that you should join all the employees when operating. Ethics include the individual opinion of what is right and what is bad.

Integrity - honesty involved, morals, values, honesty, sincerity and support with facts. It is important that expects and deserves to get the client (internal or external). As opposed to the integrity of character have duplicity. In a duplicity atmosphere, TQM can not work.

2. Training - Training is very important for employees to be very productive. Supervisors are responsible for implementing TQM in their departments and to spread the philosophy of TQM among employees operate. Training of employees who need to refer to interpersonal skills, the ability to work as a team, techniques for solving, the ability to make decisions, performance analysis in order to improve the work, understanding the business is located. You have to be trained to become more efficient and more effective.

3. Teamwork - To be successful in business teamwork is an essential element of TQM, with the team can find solutions faster and better to the problems that occur in the organization. Teams can provide improvement of processes and activities. The teams people feel more comfortable to highlight problems that may occur and may receive help from colleagues to find and implement solutions. There are mainly three types of teams that TQM organizations have:

A. Quality improvement teams. Temporary teams created in order to analyze the problems that appear or reappear, often are established for periods of 3-12 months.

B. Teams to solve problems. Intended to solve certain problems and to identify the true root causes. Usually they have a duration of life between one week and three months.

C. Work Teams. These are small working groups comprised of skilled workers who share the same tasks and responsibilities. These teams use concepts such as: employee involvement, self leadership, quality circles. These teams meet one or two hours per week.

4. Leadership - Probably the most important element of TQM. Appears everywhere in organization.

Leadership in TQM means that the manager must have the vision to inspire, to trace the strategic directions that would be understood and implemented by all employees that will lead subordinates. For TQM to be successful in business supervisor must be dedicated leadership subordinates. A leader must understand the TQM, believe in his principles and to demonstrate this fact by faith every day. Supervisor to ensure that strategies, philosophies, values and goals are transmitted down the organization in order to provide focus, clarity and direction. A key factor is that TQM must be introduced and led by management at the highest level. Personal involvement and commitment is absolutely necessary from the top management in determining values and goals for all levels in line with company objectives and define the systems, methods and measurable indicators to achieve these goals.

5. Communication - is one that unites all these concepts. This acts as a vital link between all elements of TQM. Communication is there a common understanding of the ideas so that it emits and the one who receives them. TQM success is conditioned by the communication between all members of the organization, suppliers and customers. Superiors should create and maintain channels of communication through which to receive and transmit information about TQM processes. Sharing of accurate information is vital. For a credible communication is absolutely necessary that the message be clear that the interpretation of receptor to be in the sense in which the broadcaster has intentionally.

6. Recognition - This is the last element of the system, it should be given both for and suggestions for performance, both for teams and individuals. Employees shall endeavor to

obtain recognition for themselves and for their teams. Detection and recognition of individual contribution is the most important duty that each supervisor has. Then when people recognized the merits of producing major changes in terms of self respect, productivity, quality and quantity of effort for each task. Recognition is the greatest impact when it is close can be a reward or just a message from top management.

## 2. REPRESENTATION MODELS FOR TQM

It was proposed several models for the representation of TQM, in accordance with definitions given by different researchers.

*Model Oakland* (1989) proposes that TQM representation of a pyramid in the supply chain to customer-supplier of quality systems, tools of statistical quality control method of teamwork. These are integrated to support communication by stimulating the cultivation of a new industrial crops and immediate employment of all managerial structures. The model focuses on meeting customer requirements in the external and the internal (which is translated by satisfying the requirements of any recipient of services or track the flow of production), the firm commitment to quality that has to start from the high level of management and should be reflected until the last level. This commitment is found both in quality investments for the specific field of activity, and by increasing the risk taken in an effort to get success. A good quality management system covers all major aspects of business such as management, conception, design, materials, manufacturing processes, qualifications, distribution of products and services.

TQM requires a continuing review of compliance with agreed standards of clients and performance tracking tools with statistical control of processes. The "team work" model involves promoting the idea of continuous and sustained improvement, and implementation in the organization.

*Model SOHAL* (1989) suggests that quality improvement continues to come from an integrated approach to quality control action

plans at various operations during the business cycle. The principal elements of the model are:

- focusing the customer: the objective of all of the organization should improve the quality of processes and services delivered.

- engage management to build a culture and an environment of quality, expressed by changing attitudes and expectations and supported by the measurement and quality control.

- total staff participation from the base to the peak, the problems associated with understanding the processes in the sense of moral responsibility and membership.

- use of statistical techniques for analysis of correlated data and to solve various problems.

- a systematic process of solving problems using the cycle execution-check-action-and concentration items on clients business process.

*Three dimensional model* proposed by Price and Gaskill. This model is to:

- the size of products and services, and the degree to which a customer is satisfied with our products and services;

- personal dimension and the degree to which a customer is satisfied relationship with the organization providing personnel;

- size processes and the degree to which the supplier is satisfied with the internal working processes, which are used to develop products and services provided to the client.

The three dimensions are considered together and reflect the organization and request that it can evaluate, analyze and can only improve business.

## 3. FIELDS OF TQM IMPLEMENTATION

In terms of scope of TQM, there are implementations in the different areas are:

- protection of health education and research;

- government agencies;

- the environment;

- banks;

- manufacturing.

The difficulties encountered in implementing TQM come most often from:

- lack of sufficient involvement of top management;



- resistance to change;
- insufficient training and education;
- the poor communication;
- lack of resources, high costs.

#### 4. EUROPEAN QUALITY AWARD - EQA

For the enterprise stimulation and implementation of the TQM, the European Foundation for Quality Management (EFQM) has developed starting with 1991, European Quality Award – EQA.

Developing this reward system, was achieved with the help of European Organization for Quality and European Commission.

#### 5. CONCLUSIONS

The pressure of new conditions in the world economy, globalization of market demand orientation and relaxation dynamics of technology and resources, orientation and expectations of customers, forcing the application of appropriate managerial concepts, this being a condition of competitiveness

By entering the European Quality Award, is meant by the European Foundation for Quality Management (EFQM) the stimulation and implementation of the TQM.

TQM refers to an integrated approach by management to focus all functions and levels of an organization on quality and continuous improvement.

Over the years TQM has become very important for improving a firm's process capabilities in order to achieve fit and sustain competitive advantages. TQM focuses on encouraging a continuous flow of incremental improvements from the bottom of the organization's hierarchy.

TQM is not a complete solution formula as viewed by many – formulas can not solve managerial problems, but a lasting commitment to the process of continuous improvement.

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## MANAGER AND THE BURNOUT SYNDROME

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**Abstract:** *The permanent sense of stress, irritability and exhaustion, the lack of motivation and diminished interest – by these words is defined the term of the burnout syndrome in psychological literature. It is caused by very fast rate of changes, which are followed by unsound stress. Heavy work demands may end in hard problems. There are many professions threatened by this syndrome including the managers. It is necessary to be able to face this threat.*

**Keywords:** *burnout syndrome, emotional exhaustion, depersonalisation, stress.*

### INTRODUCTION

There is no need to underline that the work of manager is evaluated mostly by his addition to achieving the goals of organisation, its prosperity and profit in competitive environment.

For performing of typical managerial functions are required specific attributes, competences and skills, which differentiate the managers and other employees. The main scope of employment of manager is especially leading of people. Manager applies here more functions of control, decision making, motivation, creativity, communication and other spheres. Very important assumptions of managerial work are also personable qualities of manager necessary for his effective activity. We can name some of them, e.g. resolution, responsibility, self-confidence, sanity, optimism and steadiness. For future effective and successful career are needed creativity, intuition, inspiration, innovation etc. We can see from this brief characteristic of functions, activities and required personable qualities that it is not simple to handle this profession. The manager can be successful only if he is able to deal with people, organise them, communicate with them, if they trust him and if he can humanize his work. [3]

The work of managers is accompanied with more risk factors as are conflicts, work under continual pressure followed by stress situations which often cause the rising of the burnout syndrome.

We suppose that knowledges and information from psychology, psychology of work but also organisational psychology, which are in preparation of managers unprized in high rate, may help to eliminate these negative factors and to enhance quality of personal and professional life. The manager should first place handle himself, understand himself and attend self-examination. Only this way he can be able to manage other people in working process.

### 1 CHARACTERISTIC ATTRIBUTES OF THE BURNOUT

The burnout syndrome became in last 30 years watched variable of the research over the world. It is serious psychological medical problem with impact to the quality of individual life and to his production. To its basic signs belongs the loss of energy and ideals which induces the stagnation, frustration and apathy. It affects almost all professions. The professions with higher risk of burnout occurrence are characterised by high work severity, gustiness, intensive contact with people and frequently incommensurate evaluation. [5]

The profession of manager is very difficult and hard and lately is considered as a profession with more frequent existence of burnout syndrome. Beyond managers belong to the professions with higher rate of burnouts also doctors, medics and nurses, social

workers, soldiers, teachers, artists, politicians, sportsmen etc.

The burnout syndrome as a new phenomenon appears in connection with transformation changes, with financial and economical crisis and with chronic stress which is related to these changes. The growth of occurrence of burnout was probably influenced also by raising living tempo and ascending demands to economical, social and emotional sources of people. To the risk of burnout are exposed equally men and women. It is not connected only to work situations but we can encounter it also in families. [4]

The term of burnout was applied in literature for the first time by Herbert J. Freudenburger in 1974. His definition from 1980 introduces the burnout as a „state of exhaustion and frustration caused by absolute absorption in activity, lifestyle or relation which did not come up to expectations“. Another definition of burnout was formulated by Christina Maslach in 1981: „burnout is a psychological syndrome of emotional exhaustion, emotional contraction (depersonalisation) and loss of personable production which can appear by persons with profession connected to work with people“. It is important to notice that the depersonalisation in this understanding entails the untender or negative behaviour towards other people, especially to those of which the inflicted person shall take care from the aspect of its profession. Therefore the burnout does not represent the actual stage but it is a process which has its own flow. It appears as a implication of chronic emotional charge connected with long-time intensive activity for other people. [5]

## **2 PSYCHICAL AND PHYSICAL SYMPTOMS OF BURNOUT SYNDROME**

Essentially, the burnout is a state of physical, psychical and emotional exhaustion. According to World Health Organization (WHO) the burnout syndrome has three attributes: emotional exhaustion, depersonalisation and the feel of personal failure.

Emotional exhaustion express the feeling that we already have and can do nothing for other people. Here belong also feelings of helpless, depression, anger or hostility. The depersonalisation represents the sense of estrangement and the feel of personal failure initiate to us the feeling that we have reach no objectives or results and what we have achieved is unworthy. [8]

The concrete individual symptoms of burnout syndrome have this characteristic:

- chronic state of exhaustion,
- decay of precedent activities, initiative and creativity,
- depressed and sometimes nervous mood, the feeling of glumness, boredom, absurdity, resignation,
- changes in approach to the applied activity – from enthusiasm to the lethargy till to loathing,
- changes of behaviour to other people, communication becomes unpleasant and the effort to help others trails away,
- significant degradation of self-valuation,
- the loss of ideals, extremely transition to cynicism and nihilism,
- various somatic problems,
- increased risk of dependency creation (smoking, alcohol etc.),

The burnout syndrome generally rises after foregoing chronic charge when a lot of everyday troubles repeat always and it grows with other charges, e.g.:

- ungovernableness of personal life problems,
- charge from macrosocial sphere,
- failure in activity – real or thought,
- intensification of the conflict with people of the nearest surroundings,
- uncertainty and dubitation about advisability of own work, whole effort eventually of the whole life,
- the shock to self-valuation, faith in own competencies, to the setting of targets and objectives. [1]

Following this characteristic of burnout syndrome we can describe the process of burnout in more detail.

The increased mobilisation of internal powers is caused by each change for which encompassment man has to invest more energy as it is sustainable. The long-term effect of the charge evokes the exhaustion of internal sources of energy. This process runs sometimes several years and has more phases.

In the first period of this process we can observe for example by the manager in working load great ideals, enthusiasm for concrete objective. He invests a lot of energy to achieve the goals.

In the second period many barriers can be accumulated and it is possible that the ideals are not reached, the work and the responsibilities turn to the burden. The idealistic objectives are not longer the most important. The implication of this situation is estrangement and setting of new alternative objectives, psychical and partly also physical exhaustion appears.

The third period is sometimes called as „life in ash“ when we can observe more from praefatus symptoms.

In the analysis of the reasons we can come out with the categorisation of C. Henning and G. Keller who specified 4 groups of burnout sources:

**1. Individual mental causality** – the stressors – the source of them is the subject by himself – his style of thinking, approach to himself, to work, his objectives, his value system, life advisability etc. To this group authors insert also:

- *Re-active life posture* – exposed to the events in life, „victims of the fate“. The subject transfers his responsibility for life to other people, loses self-confidence, self-assured and identity.
- *Negative – pesimistic way of thinking* – the fixation especially to the negative aspects of the experience (memories but also thoughts about the future) what has strong effect to the subject's general emotional tendencies.
- *Irrational mental and sensational patterns* – many people have stress and internal conflicts because of believing the thoughts which are wrong.

To other factors which are the impulses for individual mental charges belong for

example *deficit of the strategy of stress encompassment, inefficient time management, work without life advisability.*

**2. Individual physical reasons** – especially unhealthy living style and physical age.

**3. Institutional reasons** – we could state that this group can have the strongest impact to the work of managers and can significantly influence their production. It results from the characteristic of the environment, control and the structure of the institution where subject works. The genesis of burnout syndrome in working environment can be supported by these factors:

- *The rate of freedom and control* – as a charge factor can be abnormal rate of freedom without any feedback but also abnormal rate of control without scope for creative solutions.
- *Absurdity of the requests* – when subject does not understand the nuance of the requests the pleasure from work is substituted by secondary financial stimulation. One of these factors is the charge caused by abnormal bureaucratic requests.
- *Problem with authority* – negative impact has excessive force centralisation but also excessively fragmented authority, eventually conflicts of formal and personal authority.
- *Abnormal critique* – sanctions, imputation of mistakes of other people or reward for work to somebody else.
- *Oversized rate of responsibility* – with necessity of instruments to task realisation, but also minimal responsibility which is demotivating.
- *Unrealistic expectations, excessive requests* – inadequate duty in term of capacity, possibilities and capabilities of the employee.
- *Insufficient information* for doing job precisely, opacity of requests and work priorities.
- *Routine tasks* – boredom, work requires lower education.

- *Estrangement* – man feels isolated from the others as a small wheel in the machine.
- *Bad team cooperation* – people compete instead of cooperation, management is protectionistic.
- *Underestimation of the activity* – few professional growth possibilities, absence of positive evaluation of work of inferiors, acknowledgement, approval. Management is insensitive to the needs of its inferiors.
- *The conflict of the values* – subject is doing different job than he would like to do, he has to make compromises.
- *The tasks without the end* – neverending series of tasks end with feeling of the uselessness of the effort no matter of invested energy – e.g. work by assembly line.
- *Problems from time organisation of work* – long time for work alternate with short time for break which do not enable regeneration of the energy, nor the quiet preparation for incoming working charge.
- *Corrupted communication and cooperation in working team* – missing support and bilateral help from colleagues, missing open discussion in solving of working problems.
- *The lack of support* from management.
- *Few professional growth possibilities and inadequate financial work valuation.*

**4. Social reasons** – Social factors have special effect to fulfilment of objectives of organisation and to work of managers. [2]

Very important factors which affect it are economical and political stability, legislation but also social atmosphere. Management has to calculate with other important subjects as rivals, suppliers, clients and public. Continually changing external environment is the factor which sets increased requirements to internal running of the organisation and charging of the managers. Permanent defence of competitiveness of organisation and the threat of failure can activate increasing of stress by managers which can end in burnout syndrome.

The burnout syndrome looks like some neurosis or other malfunctions but there are some differences. If the situation in which the syndrome uprised changes and also if occurs the change of subject's approach to this situation, to the activities, relation to conditions, the syndrome becomes weaker and disappears. By restoring of the charge, especially with loss of advisability feeling, the troubles retrieve. The senses of loss of life meaningfulness occur by burnout syndrome, especially in its last state. [1]

### 3 THE TYPOLOGY OF PERSONALITIES WITH FREQUENT OCCURRENCE OF BURNOUT SYNDROME

People who are affected by burnout syndrome did not need to have any emotional or mental malfunctions in the past. Even though these people suffer from certain type of mental but also spiritual pain.

The burnout is typical for productive people with strong need of success where belong the majority of managers. This effort is followed, as it was mentioned, by the combination of working charge, responsibility, wrong lifestyle, the lack of relaxation etc.

Generally we can divide the types of people with tendency to the burnout in aspect of two following attributes:

In the first group are:

- people with strong need to help others,
- extremely sensitive people,
- people with too serious and hard objectives,
- people living in permanent time stress,
- people with low level of assertivity (they can not say „no“ when they would),
- people with accumulated difficult living conditions, etc.

The second group of people with tendency to the burnout can we regard in aspect of their approach to work and to fulfilment of their work tasks. To this group belong also managers. It is concerned for example about these people, which:

- are often specified as workaholics and perfectionists,

- are maximally hardworking and they try to overcome the crisis with still more activity, they often work above the level of their possibilities,
- are very creative,
- idealize their job and expect maximal reliability, performance and responsibility from themselves,
- involve themselves in various work activities in order to demonstrate how they are reputable, popular and important,
- perceive their failure as a personal defeat, etc. [2]

As we can see, by the burnout syndrome is important the approach of individual, especially if he attaches the burnout to external effects or to himself, if he has possibility to act, e.g. to talk with the chief or to change the job, or he has „only” to change himself and his approach.

#### **4 THE RISK OF THE PROFESSION AND THE BURNOUT SYNDROME**

Following the literature sources, we have outlined in the first part of the article the professions which are intensively connected with the burnout syndrome. The profession of manager belong surely to this group and the burnout relates to all levels of management. We concentrate on specific managerial profession of professional soldier.

According to Klimeková (2007), this phenomenon is not adequately mapped in the conditions of armed forces, but we can find some parallels with other spheres of civil life. The burnout can be seen on all positions as it was found out for example in managerial positions of other professions.

Here can be observed also the permanent request for high and stable productivity which is the considered as a standard with low dispensation possibility, with serious consequences for mistakes and errors, with sporadic or no positive feedback. The reasons are often conflicts, problematic relationships in the workplace, high intensity of work, complicated communication and the pressure from superiors and inferiors. It can exist also by positions where is required intensive personal contact or preferred

orientation for satisfaction of needs of others, but the excessive routine does not offer adequate internal satisfaction from the activity.

The work in armed forces has its own particularity, but the development and attributes of burnout are similar as in other professions. Evocatory reasons can moderately differ from other spheres of work activity. Threatened can be groups as military policemen, training instructors, commanders but also ordinal soldiers of armed forces. Also by these professions is the risk factor especially frequent contact with people and dependency of their valuation, high heftiness, responsibility and longterm negative balance when professional soldiers spend more energy, time and effort as they accept as a counter value. [4]

#### **5 THE PREVENTION OF THE BURNOUT SYNDROME**

We can state that there is no universal receipt for burnout syndrome prevention. There are many techniques, instructions and hints how to eliminate the burnout syndrome by people. It is not possible to name them all, but if we assume that it is not problem of handling the quantity of tasks but the problem of our personality, we have to start by ourselves.

The Alpha and Omega of achievement of the equilibrium, of feeling of satisfaction are personal abilities to master the time and handle the responsibilities. We can ask: How to work that the time would serve us ? It is good to find time for realizing of our life mission: Who exactly am I ? To know myself, to discover my strength and weakness. Our chances grow when we have maximal productivity because of doing what we are doing the best. The very important element is the setting of objectives. More existentially important are our objectives, more useful would be spent our energy for their fulfilment and more would we settle our own priorities. [6]

Many people were able, by certain level of the charge which started to reduce their space for personal life, to say „enough” and they have changed their lifestyle. They achieved it because of setting of their internal limits,

respect of themselves and then also their surroundings could accept their rules. If we would in the long term ignore our needs, we could need the long-time treatment. For some people is enough the longer vacation, but some

end by change of the job eventually they change the whole lifestyle. [8]

These facts should not forget also the managers.

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## MANAGING STRATEGIC RISK

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***Abstract:** A major purpose of this article is to inspire our thinking about integrative risk management approaches and further considerations of effective strategic risk management. This article presents a comparative collection of contemporary thinking that discusses different aspects of the strategic risk management concept with the aim of inspiring new thoughts and creating a better understanding of this complex subject. The article collects different studies that combine the perspectives of practitioners and academics with different involvements in the risk management issue.*

***Keywords:** strategic risk, calculated risk, risk management*

### 1. DEFINING RISK

Strategists and strategic theorists throughout history have grappled with the concept of risk and methodologies for its assessment. The motivation to eliminate uncertainty in policy and strategy development, as well as execution, is natural, if at times chimerical. There will always be uncertainty. It often will be unmeasurable. The very nature of war and conflict and the increasingly complex strategic environment ensures that this is so. Where then does this leave the aspiring student of strategy? Is risk assessment simply the “comfort level that senior planners experience as they assess key variables”?<sup>1</sup> It is this and more. The concept of risk assessment is worth examining in more detail to put some substance to the form.

Defining risk is a relatively simple task. John Collins, in his primer on grand strategy, reduces it to its essentials: “Discrepancies between ends, which we have identified as interests and objectives, and means-available resources-create risks, which can rarely be quantified.”<sup>2</sup> At its core, risk arises when ends and means are not in consonance. This is known as an “ends-means mismatch.” Collins is on solid ground with this definition, the

legacy of which springs from Clausewitz and his discussion of “the political object of war and the effort to be made.”<sup>3</sup> B. H. Liddell-Hart also focused on this basic truth: “Strategy depends for success, first and most, on a sound calculation and coordination of the end and the means . . . An excess may be as harmful as a deficiency.”<sup>4</sup> Strategic risk then is the probability of failure in achieving a strategic objective at an acceptable cost. The concept is simple to articulate and easy to understand. But, as in war, the simplest things in strategy are the most difficult.

The first difficulty is in understanding what Clausewitz and others meant by “means” in the ends-means equation. Current use of the term generally accepts that means constitute resources, that is, personnel, treasure, equipment, political will, time, and so on. Clausewitz also intended a larger meaning that includes concepts or courses of action to achieve particular objectives; these coupled with resources constitute the means or “effort to be made.”<sup>5</sup> It has become increasingly useful to separate these two components of Clausewitz’ “means” for consideration in strategy formulation without confusing Clausewitz’ original intent. Consequently, risk



can be represented by a mismatch in ends and ways or means.

Art Lykke makes the case for this approach, developing a model comprising three variables: ends (objectives), ways (concepts, options or courses of action for achieving them), and means (resources). Using a simple metaphor of a three-legged stool, he points out that if the ends, ways, and means (the legs of the stool) are not of equal length, then we are left with a stool (and a strategy) that is out of balance. Continuing the analogy, he defines this angle of imbalance as risk. The greater the mismatch between ends, ways, and/or means, the greater the risk of achieving ones objectives.<sup>6</sup> This is a subtle but important addition to the simple ends-means equation. One can identify the objective to be achieved correctly and accurately and provide adequate resources to achieve it. However, if the “way” of achieving it is not in balance, then there is an inherent risk of failure to achieve the strategic objective. For example, during the Cuban Missile Crisis, the objective of the Kennedy administration was fairly straightforward: Get the missiles out of Cuba. The means available were adequate and deliverable. However, there were several different ways to achieve the objective. Graham Allison identifies six major categories of possible response: Do nothing, apply diplomatic pressure, secretly approach Castro, conduct an invasion, conduct air strikes, or blockade.<sup>7</sup> One also can see this in the continuing debate over the strategy for Kosovo and the use solely of airpower to achieve particular political objectives. In the Lykke model of the stool, the balance varies depending on which option is chosen. The degree of lopsidedness or imbalance defines risk. Choosing the right policy option (or way) to achieve the strategic objective is therefore a critical consideration, even assuming a clear objective and adequate means. That is, an adequately resourced “way” that is inappropriate to the “end” would still create risk of failure to achieve the strategic objective. Thus, the definition of risk is the degree to which strategic objectives, concepts and resources are in or out of balance. Since strategy is a dynamic process, one must

understand that all three elements are variable and subject to change over time. The formulation of effective strategy for any endeavor is a constant quest to ensure balance among the variables. The definition applies to all aspects of strategy development whether dealing with national security (grand) strategy, defense, military or theater strategies, business strategy or even personal strategies.

## 2. WHY IS STRATEGIC RISK ASSESSMENT DIFFICULT?

The subtitle is borrowed from David Jablonsky’s piece, “Why is Strategy Difficult?”<sup>8</sup> The very nature of war and conflict presupposes a relationship between thinking adversaries. This, in turn, ensures that a degree of ambiguity, uncertainty, and yes, risk will exist in any developed strategy. Indeed, Clausewitz devotes the central theme of *On War* to this very premise; that is what distinguishes his work from his predecessors and ensures its continued relevance to the present day. Clausewitz was not the only one to recognize the subjective nature of war, but he was the first to mark that characteristic as preeminent. Throughout his work, there are allusions to “chance,” “luck,” “guesswork,” “uncertainty,” “probabilities,” and so on. The search for hard truths is a frustrating one. This in itself is a lesson. The analogies and metaphors the Prussian philosopher provides to help understand the nature of war are not based on chess, but reflect “a duel on a larger scale,” “a pair of wrestlers,” “commerce,” a “collision of living forces” or a “game of chance.” Formulating strategy presupposes “an animate object that *reacts*,” and moreover, reacts unpredictably. This equates to Andre Beufre’s definition of strategy as the “art of the dialectic of two opposing wills using force to solve their dispute.”<sup>9</sup> Just as one actor identifies objectives, develops concepts and allocates resources, so does the potential or actual adversary. The variables in the strategic equation have now doubled, further complicating the task. Moreover, ambiguity and uncertainty *increase* as one climbs up the strategic ladder as moral factors gain primacy over material ones.<sup>10</sup> The problem is that these

moral factors can only be guessed at. Clausewitz explicitly refers to this transition from certainty to uncertainty in strategic analysis: *At this point, then, intellectual activity leaves the field of the exact sciences of logic and mathematics. It then becomes an art in the broadest meaning of the term—the faculty of using judgement to detect the most important and decisive elements in the vast array of facts and situations.*<sup>11</sup>

The strategist now faces a prospect “that Newton himself would quail before the algebraic problems it could pose.”<sup>12</sup> Risk assessment is difficult because strategy is difficult; strategy is difficult because war is the most complex of human undertakings and filled with unknowns. Liddell-Hart concludes in this regard: “This complicates calculation, because no man can exactly calculate the capacity of human genius and stupidity, nor the incapacity of will.”<sup>13</sup> It is the inherent nature of war itself that sets the student adrift in a strategic sea of uncertainty.

### 3. GENIUS AND UNCERTAINTY

Despite this uncertainty, there is comfort in the knowledge that others have navigated these waters before. The challenge is to somehow structure or frame the strategic problem to minimize the unknown or more importantly, to account for it. The effective strategist strives for the “closest approximation of the truth” knowing that full knowledge is an impossibility.<sup>14</sup>

Clausewitz identifies two preeminent qualities in a successful strategist that bear consideration: *If the mind is to emerge unscathed from this relentless struggle with the unforeseen, two qualities are indispensable: first, an intellect that, even in the darkest hour, retains some glimmerings of the inner light which leads to truth; and second, the courage to follow this faint light wherever it may lead (emphasis in the original)*<sup>15</sup>.

These are the elements that define what Clausewitz terms “genius.” The aspiring strategist should not be misled or discouraged by the use of the term however. Clausewitz does not refer to the result of good genetics,

but to the development of a mind through study and experience. He is clear on this point as he continues his discussion: “It is the average result that indicates the presence of military genius.”<sup>16</sup> In other words, “genius” as Clausewitz describes it is not solely the unique gift of a Napoleon or Gustavus or Hannibal. It is an achievable skill and the “inner light” can be taught and learned.

Von Moltke the Elder took up the same theme several generations later: *What is necessary is to discover the situation, such as it is, in spite of its being surrounded by the fog of the unknown; then to appreciate soundly what is seen, to guess what is not seen, to take a decision quickly, finally to act with vigour, without hesitation.*<sup>17</sup>

The message is that an education in strategic subjects, followed by continuous historical study to maintain mental suppleness combined with vicarious experience through exercise, and actual experience, all contribute to acquiring the skills necessary for finding the “closest approximation of the truth.” Strategic ability is rarely born, more often learned, but eminently achievable.

Acknowledging the theoretical uncertainties inherent in war, conflict and policy and strategy development is an important, if unsatisfying, step in understanding risk assessment. It allows a better framing of the strategic puzzle. It is simply a matter of knowing what is not known in order to make better use of what is known and, as von Moltke suggests, to guess what is not seen. Guessing well is an inherent part of the art of Grand Strategy.

### 4. THE ENDS, WAYS, MEANS CONUNDRUM IN RISK ASSESSMENT

The essence of the challenge of strategy in general and risk assessment in particular is the core problem of relating ends to ways and means. Compounding this basic conundrum is that most often the ends will be abstract, while the ways and means will be relatively well-defined.<sup>18</sup> In addition, the real test of the master of strategic art is to translate obtuse, politically couched objectives into

specific actions. This is likely to become more of a challenge as the nature, scope, and direction of potential threats multiply. Articulating the political objective in the event of a Major Theater War is relatively easy; however, achieving significant clarity in political objectives in multiplying crises around the world, especially where vital U.S. interests are not at stake, will become increasingly problematic. One analyst notes in a critique of the U.S. foreign policy process: *Any ambiguity in the ends-means relationship, any loss in the value roots of policy, or any failure to maintain a firm commitment to the achievement of the national purpose cannot help but deprive a foreign policy of essential meaning and effectiveness*<sup>19</sup>.

A second related potential pitfall facing the grand strategist is the “tail wagging the dog” phenomenon. In the absence of clear political objectives or policy guidance, the means can in fact “deflect the direction of ends.”<sup>20</sup> What gets done becomes what one has the capability of doing. The ways and means can develop a momentum of their own and the result is strategy by default, usually at the risk of desired political outcomes. The von Schlieffen Plan and America’s experience in Vietnam are two stark historic examples of this effect. This problem has been ascribed to the “triumph of technique” in American foreign policy. One critic specifically targets the militarization of foreign affairs during the Cold War and an emphasis on quantitative assessments based solely on capabilities.<sup>21</sup> In such cases, Clausewitz’ “ephemeral factors” are discounted, and “consideration of political subtleties tends to be shunted aside.”<sup>22</sup> Ferdinand Foch, writing in 1903, complained of the same phenomenon but went further: “while the moral factors were depressed as *causes* [of war], they were also suppressed as *effects*.” The unintended result is that strategy can become a function solely of material factors.<sup>23</sup> The dramatic changes of the last decade and the growing complexities and dimensions of current and future world problems make simplistic, capabilities-based approaches dangerous at their worst, or potentially ineffective at best. Getting ends,

ways, and means right has always been hard; it is becoming harder.

## 5. CALCULATED RISK

The noted naval theorist, Admiral J. C. Wylie, took a more rigorous approach to the problem in a tongue-in-cheek article published in 1953 entitled “The Calculation of Risk.”<sup>24</sup> The impetus for the short article apparently arose from the 1953 budget hearings in which the Army representative answered difficult questions with the rejoinder “Mr. Congressman, that is a calculated risk.” Of course, no one knew what a calculated risk was or how to calculate it, so Wylie decided to try.<sup>25</sup> Although intended facetiously, Wylie’s little paper does merit consideration in its own right. Using a series of variables and equations, he describes various strategic characteristics.

P = Profit if successful  
 Cn = Cost if not attempted  
 Cf = Cost of attempt that fails  
 Cs = Cost of attempt that succeeds  
 S = Probability of success

Wylie defines risk as  $P/C_f$ , or the potential profit divided by the cost of a failed attempt. As long as this is greater than 1, the enterprise (or strategy) is “encouraged”; likewise, if less than 1, “discouraged.” These machinations result in general determining equations:

If  $P \times S < C_f(1-S)$  then “no go”  
 If  $P \times S > C_f(1-S)$  then “go”

These equations describe what is already known instinctively: If the payoff times the probability of success is greater than the cost of failure times the probability of failure, the result is a winning strategy.

Risk is further defined by an equation:

$$C_f/C_s < S/(1-S)$$

That is, the cost of a failed attempt over the cost of a successful attempt must be

less than the probability of success divided by the probability of failure.

Having had his fun with the reader, Wylie further stipulates that “To ensure success in its use, there is only one condition that must be met: the factors involved must never be expressed in arithmetic quantities. That would blunt the fine edge of judgment and obscure the true balance of intangibles.” Wylie clearly subscribes to the Clausewitzian notions of uncertainty and unpredictability in war, and he makes this clear in his important and short book, *Military Strategy: A General Theory of Power Control*. In it, he further admonishes the reader to plan for a complete spectrum of strategies in order to have a “reserve” of strategies for the inevitable changes that will occur. He also warns that “the player who plans for only one strategy runs a great risk simply because his opponent soon detects the single strategy—and counters it . . . planning for certitude is the greatest of all military mistakes . . .”<sup>26</sup> Wylie’s reserve of strategies is essentially conceptual hedging for uncertainty with its inherent risk. This, to borrow from operational art, is planning for strategic branches and sequels or for potential developments requiring adjustments in ends, ways, or means as a particular strategy is implemented.

Although Wylie’s formulations were intended to ridicule early whiz kids, he actually produced a relatively sophisticated approach to a difficult concept. For example, an examination of a recent study prepared by the Central Intelligence Agency to address risk assessment and management of threats to security, uses an identical formulation.<sup>27</sup> Defining risk as the potential of damage or loss to an asset, the study assesses the level of risk as the impact of loss or damage to the asset and the likelihood (probability) that a specific vulnerability could be exploited by a particular threat.<sup>28</sup> The formulation is defensive in nature since it is addressing security protection issues. Nevertheless, it equates exactly to Wylie’s **Cf (1-S)**, that is, the **Cost of Failure times the Probability of Failure**. Strategy and risk assessment are indeed eternal.<sup>29</sup>

## 6. RISK MANAGEMENT

The process of risk assessment is dynamic in nature over time and circumstance. That is, the variables are in constant flux. Risk assessment is simply the constant effort to identify and correct imbalances among the key variables. The first ability of the strategist is to recognize when variables change. The second is to adjust the remaining variables to account for the “delta” or, as it has been defined, the risk. This is known as risk management. In simplest terms, the strategist has several clear options:<sup>30</sup>

*Modify Ends.* When the price to achieve a particular objective is too high or the ability to affect a “center of gravity” is limited, it may become necessary to reduce the overall objective to more realistic terms. Examples include the decision to forego a cross-channel attack in 1942 in favor of North Africa, or accepting a lesser objective than the unification of the Korean peninsula after the Chinese intervention.

*Modify Means.* An increase or reallocation of resources may affect the ability to implement a strategy and achieve the objective. This is, however, not simply a quantitative solution. A definition of resources includes unpredictable and changeable elements as well. For example, public support of a particular policy/strategy is a key consideration in a democracy and must be accounted for, even if difficult to measure. Vietnam is a classic example of not adequately modifying means by calling up the reserves and generating sufficient public support for the effort.

*Modify Ways.* Assuming that the objective is sound and resources are adequate, there will likely be multiple ways to achieve the desired end-state. Use of the various elements of power (political, military, economic, informational) in differing combinations with varying emphasis may enhance the ability to achieve the same overall objective. The recent Kosovo experience serves as a good case of modifying ways: The deployment of Task Force Hawk and increasing information about planning for possible ground options coupled with

retargeting the air operation are thought to have contributed to Milosevic's decision to withdraw forces.

*Reassess the Risk.* Over time some of the going-in assumptions may be proven invalid. Additional information may become available or gaps in knowledge filled. The strategist needs to recognize the potential strategic effect of more or less information, recognizing that the 100 percent solution will always be elusive due to the "ephemeral factors." It is important to reemphasize that this process is dynamic and "at once abstract and rational, [and] must be capable of synthesizing both psychological and material data."<sup>31</sup> Indeed, one man's risk is another man's certitude and therefore grist for the continuously grinding strategic mill.

## 7. FIVE PATTERNS OF STRATEGY FOR RISK ASSESSMENT AND MANAGEMENT

Andre Beaufre addresses the "ends-means" conundrum in his classic book *Introduction to Strategy*. His intent is to provide a series of models, what he calls patterns of strategy, to assist in the process of strategic thinking.<sup>32</sup> The models are intended to show how various and fundamentally differing strategies can spring from the dynamic relationship between ends, ways, and means. These five patterns are macro-descriptors and it is clear to see that countless variations are possible.

*Ends Moderate, Means Large.* This is described as a strategy of "direct threat"; nuclear deterrence strategy is given as example of this pattern.

*Ends Moderate, Means Limited.* Consisting of a pattern of "indirect pressure," this pattern is useful when freedom of action is limited. It emphasizes political, diplomatic, and economic elements of power at the expense of direct military action. It models the basis of Soviet strategy, that is, avoiding direct military confrontation with the United States.

*Ends Important, Ways Limited (Low Freedom of Action), Means Limited.* This pattern constitutes a combination of "direct

threat" and "indirect pressure" applied in successive actions and reflects the strategy of indirect approach as described by Liddell-Hart. It is most appropriate to nations strong defensively but with limited resources.

*Ends Important, Ways Unlimited (High Freedom of Action), Means Inadequate.* This reflects a strategy of protracted war but at a low level of military intensity. It is the theoretical basis for Mao Tse-Tung's theory of protracted struggle.

*Ends Important, Means Unlimited.* This traditional pattern is characterized by "violent conflict aiming at military victory." Beaufre describes it as the classic strategy of the Napoleonic era with Clausewitz as its principle theorist. With these five patterns of strategy as a basis, Collins addresses risk specifically with seven examples of how to balance the strategic equation:<sup>33</sup>

- Eliminate waste [modifying ways and/or means]
- Compress objectives [modifying ends]
- Adjust strategy [modifying ways]
- Augment assets [modifying means]
- Reduce ends and increase means [modifying ends and means]
- Bluff [adversary misinterprets your ends, ways, means]
- Give up on the objective [the ultimate modification of ends].

Intended as examples, achieving strategic balance, and hence strategic effectiveness, may require application of one, more, or other creative elements to induce change in the strategic equation.

## 8. CONCLUSION

Assessing and managing strategic risk is an inherently inexact process. It encompasses a combination of inputs, both material and moral, that defy empirical resolution. Weighing these inputs, identifying possible outcomes, and planning for uncertainty should be done with the clear understanding that a complete solution is impossible to achieve but always striven for. Once a strategy is developed, the most important strategic skill and the true mark of strategic "genius" is accounting for potential

change and recognizing actual change in a timely enough manner to adjust the strategic variables and thereby ensure a valid strategic equation oriented firmly on achieving the political objectives at hand. This is increasingly difficult to do in a dynamically changing strategic environment with myriad threats, challenges, actors, and unclear potential effects. This is why the development and execution of strategy is primarily an art and why the requirement for developing masters of that art is so essential. In the end, though, the essential elements of strategic risk are unchanged through the ages and consist in the proper balancing of ends, ways, and means to achieve the desired strategic outcome. Understanding that fundamental relationship and “guessing well” through study, exercise, and experience will ensure that assessing and managing strategic risk rises above simply “the comfort level of strategic planners.” A gastro-intestinal assessment is not good enough. It never was.

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<sup>2</sup> John M. Collins, *Grand Strategy: Principles and Practices*, Annapolis MD: Naval Institute Press, 1973, p. 5.

<sup>3</sup> Clausewitz, *On War*, pp. 81, 92, 585

<sup>4</sup> B. H. Liddell Hart, *Strategy*, 2nd ed., New York: Meridian, 1991, pp. 322-323. Liddell Hart sounds here very much like Clausewitz. See Clausewitz, *On War*, p. 177: “A prince or general can best demonstrate his genius by managing a campaign exactly to suit his objectives and resources, doing neither too much nor too little.”

<sup>5</sup> See Clausewitz, *On War*, pp. 92-95, for a discussion of “ways.”

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<sup>10</sup> Clausewitz, *On War*, pp. 178, 586.

<sup>11</sup> *Ibid.*, p. 585.

<sup>12</sup> *Ibid.*, p. 112, 586. Attributed to Napoleon, it is interesting that Clausewitz uses it in support of two different discussions; one on Military Genius and the other on the Scale of the Objective and the Effort To Be Made.

<sup>13</sup> Liddell Hart, *Strategy*, p. 323.

<sup>14</sup> *Ibid.*

<sup>15</sup> Clausewitz, *On War*, p. 102.

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## ASPECTS REGARDING ACTIONS OF THE COMUNITY POLICE IN CRISIS SITUATIONS. METHODS, TECHNIQUES AND MEANS OF ACTION

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**Abstract:** *The high amplitude and diversity changes from the modern world have affected Romania too, bringing profound changes of political, diplomatical, social, financial, economical, technical and technological, religious, informatical, juridical, ecological, military nature and so on.*

*These structural changes have detrmined an increase of the frequency and the intensity of some certain distinct situations, wich some authors consider as social, diplomatical, financial, economical, cultural, military, juridical crises or plain crises, conflicts at personal, institutional, regional and strategical level. The crises differ depending on their own characteristics and the domains of manifestation. This act presents a clasification of these crises, wich we consider to be updated and necessary in the methodical-theoretical process of learning this actual phenomenons. It is well known that when the phenomenons are learnt and efficient and realistic prevention methods are taken the costs will be much reduced than when the crises are acute and developed because of unpropper management of the causes wich led to their genesis and development.*

**Key words:**

### 1. ASPECTS REGARDING ACTIONS OF THE COMMUNITY POLICE IN CRISIS SITUATIONS

**1.1. Forces and means destined to take prevention and deterring actions against crises.** In this chapter we want to present the forces and means wich whould be propper in a political-military and/or economical-social crisis situation, to deploy actions to counterfight anti-social acts and solve an internal crisis. The National Public Order Assurance System is formed from laws, authorities and institutions of the public administrations, the institutions, forces and resources created and specially prepared, wich acts to protect the rights and liberties of the citizens, protects public and private properties and the normal function of the state.

The **Public Order Forces** are the state authorities wich are invested through the law with atributions and competences regarding the public order, wich are offered to use the right of police by the state. The **Public Order Forces** are formed from main forces, complimentary forces and exeptional public order forces. To establish a range for this forces the management of the activities regarding the public order has to be conceived on two majior dimmesions: maintaining public order and reestablishing it.

**1.2. Maintaining public order.** Maintaining public order in normal situations is a duty of:

a) **Main Public Order Forces** are formed by units from the structure of **Ministry of Interior** wich are specilized on activities and on stand-alone missions. These forces act to: maintain public order, protect the rights and liberties of the citizens, the private and public properties and to counter criminal acts, offer



military protection of the objectives important for romanian state, prevent and extinguish fires, guard, supervise and control the crossing of the Romanian borders, take into account the movement of the foreign citizens on Romania.s teritory, counteract the effects made by disasters.

The Main Public Order Forces are the base compound of the forces destined with the maintenance of public order. These assure the unity character of the activity of the rights state to guarantee that the rights and liberties of the citizens are kept, and that the other components of the national security system are functioning in normal terms.

They are organized on the principle of the territories and the specific operational situation and are formed by romanian citizens, specially prepared and fitted, enforced by the states laws and act according to discipline rules, established through laws. The Main Public Order Forces are prepared and fitted to assure even in times of war the order conditions needed for the optimal manuevres and deployments of the army units, without damaging their capability to fight. To fullfill this task, the Main Public Order Forces may deploy actions to defend their own headquarters and units, the objectives and areas in their jurisdiction, and to adopt exceptional measures, with the main characteristic the use of force, wich apply in times of urgency, siege or war.

The Main Public Order Forces are formed by intervention forces specially build, prepared and fitted.

The usage of the **Main Public Order Forces** during crises implies problems regarding the fitting, the instructions and specifical preparations to this kind of missions. Thus, the usage of this kind of forces to control an internal crisis starts with the best knowledge of the area of jurisdiction, causes of conflict, crisis and the existence of legal actions, and these forces are complex, taking into account the nature of the missions that have to be fullfilled during crises.

**b) The Exceptional Public Order Forces** are formed by some units from the Army, Romanian Intelligence Service, Guard and Protection Service, timely formed and

prepared, wich will act only wich the approval of the President of Romania according the the laws in the situation that the capabilities of the Main Public Order Forces are overwhelmed. The reorganization and updating process, used to reform the Public Order Forces has the goal to create the frame where they can respons adequately to the evolution of the operational situations. The main elements of this process are: the structure and optimal dimmensions of the components, perfecting the laws, increasing their prestige and authority in the relation with the citizens, perfecting the funding system, fitting accordingly with techniques and specifical materials and incresing the control of the public authorities over these forces.

**The Special Civil Forces** are those forces formed by technocrats, scientists, culture personalities, economists, bankers, specialists in many domains. For a social crisis are used specialists from the affected social domains wich are members of those commisions in every Ministry involved in solving that crisis.

**The Military Special Forces** are those groups, teams, units, small units or big units prepared, fitted and trained timely on possible crisis scenarios (including those economical and social ones) wich act only at the order of the legal authorities constituted on local or main level with the goal to reestablish public order and tranquility.

In this Military Special Forces can work civilians (negociators, mediators, socialogists, psychologists, priests, and so on), soldiers specialized on social and economical problems. The dynamics of the military actions led to counterfight the internal crises are working after next algorithm: prevention(here act all the responsible factors), prevention and counterfight. In the first two phases can be excluded the military presence but, usually, the third phase rarely can be done without military aid.

From the **Ministry of Interior** for the prevention and the management of the crises can participate, depending of the type of crisis, the Special Forces with the means given by their equipments. The management of the internal crises is executed gradually by the forces from the Ministry of Interior. When

these forces are overwhelmed by the situation forces from the Defense Ministry come into action.

From the **Defense Ministry** the management of internal crises can participate: compartments or officers from General Staff Office, staff offices from the armed forces, officers and compartments from arms commands, Army Corps and brigades, with the means from each one, big units, units and small units from the Swift Reaction Force. Regarding the military forces used to counterfight internal violent manifestations these can be constituted from: conventional military units, according to the Rules of land forces- TU 1; special units used for protection, guard, defense and intervention related to **Public Order Forces** which, mainly, can be unmovable, mobile or a mix of these two. Related to their goal the military actions could be: intimidation and destruction, guard, surveillance, defense and intervention.

If these units of the Defense Ministry are specifically for the military actions deployed during internal political and military crises, it should be taken into account that, regarding the type of crisis, the adversary, time the **management of the crisis** is lasting, it has to be constituted from: 1-2 assault groups; one assault group and a backup one; 1-2 groups for blocking and isolation; 1-2 groups for evacuation and filter; helicopter support units; artillery, demolitions and backup units; anti-air artillery units; detachments to ensure the movement; medical and intervention formations; specialized guard units; special detachments with the role of evacuation and protection of the civil population.

The structure, equipment and positioning is done according to the type of the internal crisis, type of military actions and so on.

Regarding the prevention of the military and political crises or of those economical and social ones we agree with the analysts in the field that these have to be stopped timely, from birth phases. **The management of the crises** has to be done, even in these conditions, according to the laws of the state, respecting the human dignity, considering the assumption of innocence, under the control of the civil society.

We have defined the prevention of the actions which lead to internal crises as being an assembly of measures and activities which refer to firm counterfight, swift through forms and procedures of civil actions, military or nonmilitary, which transform them selves from civil and military non-violent actions, gradually, in phases and steps, until the objective has been reached.

During the **management of the crises**, sometimes, it has been seen that the prevention didn't give the requested result, the crisis had evolved, escalating the steps of violence until it became an acute conflict.

In the phase of acute conflict, in the majority of the cases, there have to be used the specialized means and **forces in the counterfight of the internal crises**, which, through the military counterfighting actions against the violent internal manifestations will act this way: the illegal groups will be identified, their positioning; the systems which lead them and the bases of logistical support will be destroyed; short times assault; swift attack by surprise; the interdiction to deploy activities which disturb severely the public order; the actual intervention to establish normal social conditions.

**1.3. The intervention of the police forces detined to take actions to counterfight internal violent manifestations.** Depending of the type of internal crisis, usually, the intervention is done in four steps:

a) in the first phase the intelligence is verified. This is done through the specialized police units which propose to the leading factors involved in the management of the crisis an document which include intelligence regarding legal or illegal actions deployed during the internal crisis;

b) in the second phase are taken the measures at the level of ministries and local units involved in the internal crisis. Mainly, it is named the special representative on central level, when the amplitude of the crisis escalades over the local jurisdiction. On local level we consider that these objectives should be fulfilled by local authorities, respectively **the Community Police**;

c) in the third phase are deployed the actual actions to solve, manage the internal crisis.

Then it follows the building of negotiation committees which analyze and suggest solving scenarios of the internal crisis;

d) in the fourth phase are applied the plans established in the third phase like:

- if it has been reached a common accepted point it will be followed the solution, gradually, until the terms of the parts are fulfilled;

- if there are met the legal conditions and there is written approval to intervene in force there will be established the forces, means and it will be named the sole commander which will take over the crisis management activity. We consider that this is the moment when the **military force** will be involved in the management of the internal crisis.

## 2. METHODS, TECHNIQUES AND ACTION PROCEDURES

### 2.1. The duties of the Community Police regarding the public order, guarding objectives, goods and values in times of crisis

One of the main tasks of **the Community Police** is maintenance of the public order and tranquillity. This has to be very well understood because of this depends the activity of the community policemen. This situation is felt and appreciated by every citizen of the community, where the community policeman acts every day, having as a result the order, not only for the local people but visitors too.

Taking this into account and determining that the main task is very complex and that this is the task of other institutions too, leading these activities through a guard plan is imposed. The guard plan of the place has to ensure the organization and leading of the activities of the guard forces from the locality, to ensure maximum efficiency in the activities deployed by these forces, having as goal the normal functioning of the life in the community, the protection of life, of physical integrity and human health, the protection of goods and values, prevention of events that disturb life, work and tranquillity of the people, re-establishing the normal order.

To the conceiving of these plans have to be taken into account next things:

- geographical positioning of the locality, big or small city, near to a big city, if it is a touristic area, industrial or agricultural, and so on;

- the status of the security in the area, where it will be taken into account the status of the criminal activity, the number of convicted persons in the area, ethnic and cultural composition of the people, their occupation, the number of policemen in the locality, the quality of their work, of other forces too, like, community policemen, guards, and so on;

- the dimensions of the locality, number of inhabitants, area, and so on;

- movement of the citizens, of the residents, road and railroad circulation;

- the mechanical and technical means or human forces at available.

When the guard plan is written it has to be taken into account the terms related to **Acts 196/2005, 333/2003** regarding the guard of goods which establishes the strategy of Ministry of Interior to maintain public order to increase the safety of the citizen and to prevent road criminality.

The strategy has been established taking into account the difficulties of the transition period, the economical instability, the economical and institutional reform, the difficulties related to judicial protection, the existence of some institutional functions related to counterfight criminal actions and maintaining **public order**, the weak cooperation between the institutions with duties in this line of activity, the existence of corruption and, sometimes, the weak reaction of the authorities in several occasions.

The goal of the Ministry of Interior's strategy in the line of maintaining public order and preventing criminal action represents activities like:

- prevention and counterfighting the criminal phenomenon;

- ensure a climate of order and safety;

- ensure and protect the constitutional rights and liberties;

- safety of the citizens and of properties.

### 2.2. The organization and the deployment of guard activities in Romania (according to **Act nr. 333/2003** regarding the guard activities in Romania).

The guard activity appeared on a certain level of social development, as a necessity

imposed by the existence of property (public and private) over goods and values.

In our country this activity is governed juridically by Act 333/2003 regarding the guarding of objectives, goods, values and the protection of persons. This Act has led, through article 69, to the apparition of Government Decision nr. 1010/2004 to approve the Metodological Rules and the documents regarding the guarding of objectives, goods, values and the protection of persons.

According to the laws here presented the guarding and protection are made through specific forces and methods, with the goal to ensure the security of objectives, goods and values, against any kind of illegal actions, which attack the right of property, their physical existence, and also to protect the persons against any kind of hostile activities which could endanger their life, physical integrity or health.

The guarding and protection are made through forces and means, military or civil, by the specialized institutions of the authorities of public administration or in private regime, by the owners or administrators of the objectives, goods or values, and by the specialized guard and protection societies.

The organization and deployment of this activities are done by the ministries, institutions from the central and local public administrations, autonomous management, national companies and societies, national research institutes, commercial societies, no matter what social capital they have, and by other organizations which have goods and values of any title named by Act 333/2003 as units, which must ensure the guarding of objectives, goods and values they have.

Depending on the importance, type and value of the goods they have the managers of these units, named in art. 2, 1<sup>st</sup> alinment, Act 333/2003, with the aid of Police for civilian objectives, and from Gendarmerie for the military objectives, will take the necessary measures to ensure the protection needed. In this way there are established actual models of organization and executing the guard service, depending on the case, through community policemen, employees, guards from specialized societies, respectively guard in the rural areas.

Where it is not possible an organized guard system the managers have to build fences, grids, shutters, safe locks, security lights, anti-breach systems or other such systems to ensure the protection of the objective.

The guard service is organized and it's done according to the guard plan made by the unit which has goods and values to protect when the guard service is done with employees or with the managers of the specialized security societies, if the guard service is done with members of those societies or with community policemen, with the agreement of the Romanian Police.

#### **Types of guard services:**

**a) Protection through members of the Gendarmerie.** The members of the Gendarmerie ensure the safety of the objectives of major importance for national defense, state activity, places of the diplomatical missions, and the transport of very important values.

The installation of the guards is made only after the owner has met the conditions of the contract and of the guard plan.

**b) Protection through Community Policemen.** According to Act 371/2004, at art. 7, letted b. It is mentioned that the Community Police ensures the protection of objectives and goods of public and private interests, established by the Local Council, according to the protection and public order plans.

Also, as specialized local public service, the Community Police may ensure, on the basis of an contract, the protection of objectives.

**c) Internal protection.** Is made with qualified personell, employed at that society, according to the law. The personell from the internal guard service is fitted with uniforms, protection equipment and distinguishable signs. With the notice of the Police the internal guard service personell may be fitted with firearms, protection bats, sprays and other means allowed by the law.

**d) Protection in the rural areas.** The guard service in rural areas is organized through means according to Act 333/2003, art. 15-19.

In rural localities the rural guard represents the protection method, through rotation, by the inhabitants of the locality or through any form of protection allowed by the law. In smaller

towns, even in villages, the Comunity Police has among its tasks the rural guard too.

e) **Protection and guard through specialized guard societies.** This guard form is

done according to art 20-24 from Act 333/2003. The object of the activities of these societies is the protection of objectives goods and values, the protection of transports of goods and values of great importance and the protection of persons (body-guards).

The citizens can hire bodyguards only through contracts made with the specialized guard societies which have a licence in this line of work and only if there is available trained personell (art. 23, 1st allingment, Act 333/2003).

### **2.3. The system of public order and security forces. Principles of action.**

**2.3.1. General concepts.** The democracy and social order have constituted, contitute and will certainly constitute essential phenomenons of study, analisys and forecast of many types of specialists and scientists from defferent doamins: filosophy, politics, sociology, psichology, juridical sciences, military and so on.

A short analisys of history reveals that these two options, under modern or similar concepts, have contitutes goals of all types of societies dating with the antique greek fotified towns untill nowadays. Also, those two terms have their origins in the two universal languages of the world: greek and latin. **Democracy**, from the greek words „demos”- people and „kratos”- power, is defined as „form of organization and leading os a society where the people exerts (directly or indirectly) its power”, and **order** from the latin words „ordo + inis”, wich means „normal way of placement, succesion, action of things, facts, phenomenons in an certain space or domain”. In the same time the two concepts have constituted the aspirations and promoters of the social development of human kind, beeing closely linked to the concepts of righteousness, equality, equitty, freedom, justice and others.

The strategy to ensure public order and safety to increase the safety of the citizen and to prevent criminal acts has been established by the Ministry of Interior on the basis of the

National Security Strategy of Romania, from the Defense Ministry, with the according limitations in the field, wich defines public safety and order and national interests in this field, asseses the nowadays status of public order and risc factors, builds the principles and priority lines of action.

To execute the measures and actions to ensure public safety and order the Ministry of Interior has available some types of specialized institutions, among them are established relations of subordination, cooperation and collaboration.

Trying to define them generically, it can be said that the Public Order Forces are formed by all components and effectives to wich the institutions and authorities wich have competences regarding public order give tasks to exert the right of police of the state wich allows them to summon anyone to obey to the laws of the romanian state and to some conduct rules and to discipline those who brake them.

**2.3.2. The structure of the public order and safety forces.** Starting from the deffinition stated before, professionally speaking, with a restricted meaning, the Public Order Forces include only those forces wich offer services of ensuring, maintaining or establishing public order, no matter the actions or persons wich provoked the disturbances.

The Public Order and Safety Forces are formed from:

a) main forces;

b) support forces;

c) complimentary forces;

d) exceptional forces.

a) Main forces- are those forces of Ministry of Interior enforced by the law to exert the right of police of the state respecting the base component of the structures destined to manage the entire problematic regarding public order in times of peace or emergency, and are constituted of policemen and police soldiers.

b) Support forces – acoording to the competencies and duties are formed from special protection and intervention structures, border police, civil protection, firemen and airforces from Ministry of Interior.

c) Complimentary forces – are organized at the levels of each division of the central public

administrations and ensure public order through :

- prevention and deterring tax dodging;
- supervise the abidance to sanitary rules;
- military order and discipline in garrisons;
- supervising and guarding the detainees;
- protection of objectives, other than those protected by the main forces;
- the protection of environment.

**These forces** are formed by structures of : Defense Ministry, Romanian Intelligence Service, Guard and Protection Service, and also from the Justice Ministry, Financial Guard, **Community Police**, services of civil firemen, groups of civil protection from the authorities of the public administration, National Sanitary-Veterinary Agency, National Environment Guard, specialized guard societies, institutions and economical agents and from other forces established by the law, which participate at the efforts with main and support forces, according to their duties.

**d) Exceptional forces**- are those forces constituted from specialized structures of Romanian Intelligence Service, External Intelligence Service, Guard and Protection Service and from Defense Ministry which act in crisis situations, siege and emergency status, during mobility and times of war, when the democratic institutions are in danger and all the other measures to establish public order have failed, and also when the main, support and complimentary public order forces are overwhelmed.

**2.3.3. The principles of ensuring public safety and order.** The activity of ensuring public order to be done in a organized fashion, orderly, according to the law and to the internal rules established in each force that participates. Entire activity of the **Public Order Forces** has to be governed at theoretical level, but most at actual level, by the abidance to main principles generated from Romania's Fundamental Law and the other specific organic laws, and from the international conventions regarding the respecting of human principles.

Thus, fulfilling the objectives of the public order strategy, will be done starting from this principles:

**a) All actions will be lawful** – the actions of the Public Order and Safety Forces will be

done respecting the spirit and the letter of the laws, and the citizens – while exerting their fundamental rights and liberties – are to be limited to the confinements established by the law and normal moral constraints.

**b) The territorial and mobility principle** - the public order and safety community forces are to be organized at central and local level with structures and competencies according to the positions and the organizing of the administrative-territorial units and related to the criminal phenomenon.

**c) Prevent the disturbing actions against public order** – the capability of leaders and of order forces to take timely the necessary measures to avoid production of any kind of deeds or actions that are pointed against public order, to avoid escalation and transformation into violent action which severely affect public order.

**d) Operational principle** – according to this principle the order forces have to be available to deploy action in homeland, to cooperate with similar forces from other areas and to execute specific missions to ensure public order and safety.

**e) Non-discrimination principle** – an correct, objective and non-discriminatory behavior, regardless of race, religion, gender, nationality, political affiliation, wealth or social origin, with all the citizens.

**f) Avoiding surprise** – is the principle that forces the leading factors from public order domains to warn and to summon for the usage of force means, mostly of firearms, and, depending the case, to give necessary time to stop the action and leave the area.

**g) The principle of sufficiency, graduality and of proportions** – the usage of force, according to this principle, is done according to the type and level of disturbance created, only as much as necessary and only on limited period, enough though to execute the mission. The usage of the procedures and action means which involve constrain measures will be done progressively and only if it is really necessary.

**h) Continuous cooperation with the community** – the order forces depend in their activities on the support of the citizens and have to act respecting the public.

**i) The irrefrangibility of the person** –the order forces must respect the life, physical and moral integrity of the person and the inseparable attributes of his personality. This principle forbids the usage of torture and of bad treatments and the right of the person to a equitable trial, public and fair in front of an juridical instance, independent and objective, according to the law.

**j) The principle of specialized intervention and of cooperation** - the usage of public order forces is done according to legal terms, to preparations and endowment of each category of forces.

**k) Unitary leadership** - the cooperation and the deployment of actions, regardless of the number, *diversity of the forces* used, forms and procedures, has to be done only on the decision of one sole commander wich has to have full authority, the responsibility of the actions resting on his shoulders.

#### 2.4. Civil Protection

The Civil Protection is a component of National Security System and is formed from the measures, both humanitarian and public information, ment to prevent and reduce the risks related to disasters, to protect the civil population, goods, enviroment, against the effects of emergency situations. The law behind the activities of *Civil Protection is Act 481/2004*.

The coordination of this line of work is done by Ministry of Interior through the Emergency Situations General Inspectorate, and on local level, by the teritorial Inspectorates. At local level, the Local Counsils, at the proposal of the mayor, approve the organizational civil protection structure and the mayor fullfills the decisions made.

The Comunity Police, wich is under direct leadership of the mayor, has multiple duties in this domain too, mainly when it is about

ensuring public order in disstressed areas, but activities of information too, prevention preparation of the population regarding self-protection measures, its duties and means of action during emergency situations.

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## OPINIONS AND GROUNDS REGARDING THE ROLE OF COMUNITY POLICE IN DETERRING TERRORIST ACTIONS FROM PRECURSORY STAGE AND DURING TIMES OF SOCIAL CRISIS

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**Abstract:** *Political analisys at global level reveal that, in the world of this start of century and millenia, the events are on the verge of redefining international relations. The main results are the the incresed reducing of the probabilities that a major military confrontation whould take place and the developing of an cooperation and partnership climate, having as objective the moddeling of a new security architecture for the manking of the 21<sup>st</sup> century, united through the values of democracy, freedom, human rights, state of right and the development of functional market economy.*

*The expansion of international terrorism and of organized crime, the increase of manifestation deversity and their violence, their trannational character, and the danger imposed by the proliferation of mass destruction weapon need new ways of approach of security risks. It is harder and harder to make a difference between internal and external threats for states, wich involves the reconsideration of the role of national and international security institutions in the joint activity to prevent and deterr these phenomenons, where the fight against terrorism is at priority level. In the same time there are oppenened new opporunities of cooperation, collaboration and partnership.*

**Key words:**

### 1. OPINIONS AND GROUNDS REGARDING THE ROLE OF COMUNITY POLICE IN DETERRING TERRORIST ACTIONS

**1.1.General concepts.** In the context of ensuring national and transnational security Romania's effort is pointed at finding the methods and forms of cooperation to ensure its security and to implement defense and promotion procedures of its interests and of the common ones, based on democratic values and principles.

In the first place, the internal security of Romania is closely linked to regional security, meaning european and global security, beeing perceived as an dynamic process with a variable placing wich needs to be continously related to different types of threats from external source – terrorism, organized crime, illegal immigration, unsecure borders or democratic shortfall, the complexity and the

fluency of the nowadays international security enviroment.

In the second place, we channel our efforts, in close relashionship with neighbouring states, allies and partners, to identify new means to counterfight the threats from this region.

The clear and real dangers come specially from the area of organized crime, of terrorism and of low intensity armed conflicts, wich have the capability to extend in geometrical progression, with the most severe consequences on local and general level-european and even international.

Romania faces more and more the manifestations specific to organized crime, wich are deployed in its close vicinity, in the balcanic area, in the ex-sovietic space and in Middle East. We need to create new means of action wich should ensure the control and surveillance of the asymmetrical risk factors, to intensify the cooperation between special



services and security agencies with duties in deterring **terrorism**, we have to find correct answers to the challenges and risks of asymmetrical nature. There have been made important steps to realize these objectives, we have a unitary vision about the actions which must be taken and of the legal instruments needed for the actual actions, lawful and coherent, of the institutions which work in the line of counterfighting terrorism.

Romania is placed at the crossroad of the main geopolitical and geostrategic interest areas – the Balkans, Black Sea, Caucasus and Caspian Area - and of three major areas on instability and conflict – ex-Yugoslavian and ex-Sovietic spaces and Middle East. It can be stated that our geostrategic position is a trump in the efforts of promoting equity politics between these areas and in the development of our capabilities and those of our allies to counterfight the risks against the order and the tranquillity of the citizens.

There are immigration politics and there has been created a package of laws related to justice, acts which actively contribute to gain positive results from the transnational cooperation from South – East Europe, region with a source of risks against European security, arguments which led the security institutions to a prevention conduct.

The prevention conduct is based on two things: first, on the development of the structural capacity of Romanian democracy to respond to the terrorist challenges and defiances, to cope with the threats at every level, and secondly, on the quantification of the virtual effects of **the terrorism on state** and society, because the cycle “terrorist attack-reaction” could lead to dramatical changes in the physiognomy of the states.

On operational level Romania's structures with duties in the line of deterring terrorism act to prevent and to counterfight criminal actions from border lines: smuggling, illegal immigration, arms and munitions traffic, drug traffic, and so on.

The projects have the goal to multiply Romania's efforts to support international actions to counterfight terrorism and organized crime, to obtain more stability and to

strengthen the position of the state as security supplier.

**1.2. Strategic involvements of terrorism.** Terrorism, as special violence form, is not a philosophy nor political movement. Terrorism is a weapon or a mean used across the history by states and by organizations with a variety of causes and political objectives.

This special political violence has some characteristics:

- is premeditated and has the goal to create a climate of fear and extreme terror;
- is directed to an audience and with an objective greater than the immediate victims involved in the violence;
- involves attacks against random and symbolic targets, including civilians;
- the civil violence acts are considered irrational by the society where they are produced.

Mainly, **terrorism** is used to influence the political behavior in a certain way, for example, to force the opponents to accept some requests, to provoke a shock reaction, to serve as a catalyst in a more ample conflict or to make publicity to a political or religious cause, to attract new members and to free the hate and the will to revenge, or to contribute to the undermining of governments and institutions called by the terrorists as enemies.

An ample research in the literature related to **terrorism** reveals a multitude of informations about the groups involved at this moment in terrorist actions which have the bases in nationalism, segregationism, racism, faith in paramilitary groupings, left wing radical ideology and religious fundamentalism.

A significant trend of internal and of international terrorism is the strengthening of **the terrorist groups** motivated partly or totally on religious fundamentalism.

In the case of terrorist groups with internal activity there are obvious next important tendencies:

- organizing bombings against big urban places;
- organizing attacks with lethal substances;
- organizing attacks which could endanger national economy through bombings

in maximum importance commercial and financial centres or through attacks against vulnerable sectors;

- in many countries takes place the escalation of attacks with hostage situations to extort funds from families, governments or companies;

- it takes place a much more intense cooperation between political terrorist groups and organized crime.

There are no universally applicable anti-terrorist politics in democracy. Each conflict which involves terrorist actions has its own characteristics.

To counterfight the challenges from terrorist movements with a certain degree of public support and with significant resources, the local polices have to gain public support, demonstrating that they can respond to the needs and the requests of the general population.

Learning timely about the planning of terrorist activities, about arms, involved persons, financial means and fund raising tactics, communication systems, the prevention of terrorist attacks can be a feasible thing, as well as the destruction of terrorist cells and bringing their members to justice.

## 2. DETERRING TERRORIST ACTIONS FROM PRECURSORY STAGE AND DURING SOCIAL CRISIS

**2.1. The dynamics of the actions to counterfight social crisis.** The complex process of political, economical, social and moral reforming is followed by a multitude of phenomena, sometimes hard to control and which can weaken the capability of the states affected by crises to protect and promote its fundamental interests.

The costs generated by the transition to market economy, unemployment, social insecurity, insufficient basic products, dramatic depreciation of national currency, decrease in the level of subsistence and others, induce in the citizens anti-social feelings, which are mutually stimulated and, combined with the increase in the number of criminal acts, organized crime, corruption and others, lead to a well known nowadays crisis scenario.

The management of crisis may be understood as a process which involves ordering, plans and measures to control the crisis, to stop its evolution and to project an acceptable situation.

The basic components of the crisis management are: the intelligence gathering and assessment procedures, status assessment, finishing options of response according to economical, social and political objectives.

The objectives of crisis management could be: reducing the tensions, so that the escalation to the level at which it may affect the system could be avoided; the actual management of crisis, to prevent their transformation into social conflicts; organizing civil and military preparations according to each type of crises and their stages; exerting the reaction control and, in the case of stratified conflicts, escalation prevention and the deployment of activities to convince the assailant unit to retreat.

The main activities deployed by the community polices to manage the crisis are:

- identify the crisis creation elements, and their tendencies;

- establishing a programme to apply specific measures to solve the problems, risk assessments and establishing backup action plans, if the situation goes out of control;

- reestablishing previous status-organizing the discussions and actions destined to ensure the maintenance of post-crisis stability;

- supervising the status by gathering intelligence and analyzing it.

The practice has demonstrated that, in principle, the crisis management measures have to be built from: a list of measures which can be selectively undertaken by the units of community policemen or in cooperation with institutions from intelligence, prosecutors, justice and other levels.

The general objective is: ensuring the preparation of reaction mechanisms in crisis situations and realizing an real daunting capability.

### 2.2. Action forms to counterfight crises.

To prevent and manage internal crises there are some universally needed actions and duties:

- creating, modernizing and harmonizing internal juridical frame;
- promotion and initiation of specific law projects and harmonizing them with international acts in this domain;
- establishing the competencies for the structures which Romania leads and of the instruments in the prevention, control, limitation and deterring activities of crisis situations;
- identifying possible crisis situations at sectoral and local levels as a result of the internal and external genesis factors;
- assessment of possible crisis situations and forecasting their evolution;
- ensuring economical and financial conditions for the functioning of the institutions which deploy activities of prevention and management of crisis situations;
- establishing timely action plans and action procedures to prevent and manage crisis situations;
- the correct and efficient intervention to control, stop and to remove the evolution of the situations of internal social and economical crises;
- continuous perfecting and adaption of the crisis prevention and management system;
- intensifying education and informing activity of those involved in crisis management and of the civil society regarding the way of solving internal social crises.

**a) Ways of action which involve or not the usage of force(violence):** supervise through surveillance, which is a form of fight actions where public order forces ensure public order and are formed from continuous and systematical observation of places and areas supposed to generate criminal acts and anti-social deeds.

This involves the exerting of police control and the usage of public order tactical police measures; raids are the actions of police untis, executed independently or in cooperation with other forces with same duties, to suddenly control and verify crowded places; counterfight criminal acts and to discover and retain criminals, escapees and deserters; the protection and safety of meetings and manifestations is formed by the actions led by

the community police; the protection and guard of objectives, goods and values is meant to ensure the temporary or continuous security of objectives important to community, country, economy, science, culture and art.

**b) Ways of action which are non-violent:** humanitary actions organized and deployed by police untis to limit or remove effects of event which affect severely life, health and physical integrity of persons or of goods; controlling traffic where barriers are done.

**c) Tactical actions of Public Order Forces:** interventions to strengthen the protection of objectives; ensuring safety and protection during manifestations and meetings; counterfighting violent manifestations and reestablishing public order; intervention in certain areas where criminal elements act, isolated or in group.

The deployment of Public Order Forces to solve crisis situations on national territory is done when the emergency or siege status is instituted; to fulfill specific tasks; when civil forces try or have gained control over civil institutions which function according to the Constitution.

To do this task the Public Order Forces use own arms, shields, protection caskets, rubber batons, electrostatic charged batons, irritating gases, white weapons, water jets, handcuffs, dogs, lights and acoustic devices and other protection and immobilizing means.

The usage is done only after the warnings and summons have been done. To let the dispersal take place it will be given the right amount of time, depending of the number and of ways and roads to retreat. The usage of the means will be done gradually and will not exceed the actual needs to immobilize the turbulent or aggressive persons or to neutralize illegal actions and will stop immediately after the goal of the mission has been fulfilled.

The action possibilities of the Public Order Forces depend on: tactical conditions at place; quantity of forces and means available in that structure; actual conditions where there can be done those actions; number and force of adversary; the character of the actions of the adversary; status of weather, season and other factors.

**2.3. Tactics and intervention procedures in crisis situations.** The disturbance of the public order is a severe act incriminated by the law and can be produced on local or regional level, in one or more localities, urban or rural, or which are pointed against headquarters of local or central administration authorities, of parties or other legally formed associations, of economical, public or private, objectives, of culture and art institutions, on stadiums or other public places destined for sport activities, committed with intent, which affects the well being of the rights state, which may endanger national security, the life and integrity of the citizens, the public or private property.

The intervention to establish the severely affected public order is deployed when the **Public Order Forces** have exhausted all the other means.

**The Public Order Forces** have to have in future the capability to use tactics and intervention procedures to establish public order.

The tactics and action and intervention procedures are according to the activity of community police. They can be: **non-violent actions**- usually to prevent and to convince aggressors to renounce to their actions; **violent actions** – which are deployed only when the peaceful means have failed and when the aggressors affect through their activities severely the public order.

The violent actions of the police are the activities deployed swiftly and in force, independently or cooperatively with other institutions, with the goal to solve a situation which represents a severe danger to public order, safety of citizens, of objectives and institutions and these are the actual interventions.

The tactics and non-violent procedures used are formed from measures of prevention, through investigations, and the measures to realize a peaceful dialogue with the leaders of terrorist groups to make them renounce to the activities they had in mind.

The tactics and violent intervention procedures are formed from the deployments and knockings which take place during the missions to establish the public order, in the situation when it is severely affected, with the

goal to re-establish the normal course of events in the objective or place when this disturbance had occurred. To re-establish the public order when it has been severely affected **the Public Order Forces** have the right to intervene in force, to use protection and intervention gear and the firearms they have available according to the law.

The forces are bound not to hesitate when they act to interdict or neutralize disturbing acts. The police leaders have to have available detailed plans to deploy in best terms the intervention, to make sure that these actions are legal and to discipline the forces regarding ways of action for the situations that may occur.

While deploying the intervention the traffic in the area will be blocked and in the same time will be taken action to prevent others to adhere to the turbulent groups.

**2.4. General tactical rules which must be respected during police intervention as a result of a crisis situation.** The principle of respecting and protecting human dignity which states that the life, the physical and moral integrity, his honour have to be respected, no matter the deeds committed.

The usage of force has to be done only if the violent or terrorist actions could not be otherwise removed through the usage of other legal means like warnings and summons to leave the area.

The proportional usage of force states that its level of strength has to be according to the actual level of opposition and has to stop as soon as it reached its goal. The graduality bounds to a progressive usage of forms, procedures and means of action which involve force, from the simplest ones to the very violent. The use of firearms is considered an extreme measure.

The principle of minimal risk, for the aggressors or terrorists and for members of the police, states that there has to be chosen adequate intervention methods to avoid as possible the harming of body integrity; even if the intervention has been done in force the human life should be protected, according to the principle of protecting the human being. Thus community policemen have to: give first aid in case of any harm, deny the use of

violence and bad treatments against retained or arrested persons.

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## THE NECESSITY OF CHANGES IN THE STRUCTURE OF FIRM CAPITALIZATION TO OVERCOME THE FINANCIAL CRISIS

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**Abstract:** *In order to progress and successfully overcome the crisis period, Romanian enterprises should give up the old, outdated products and methods. Innovation is not exclusively technical or technological. It can occur in relation to the distribution channels, the management, the organization, the adopted strategies; practically, it can occur in any field where one can ensure a better allocation and use of resources, an increase in productivity and efficiency, as well as a higher level of efficiency. Enterprises should resort to new technologies that are more easily to access by small and medium enterprises by means of license purchases or collaboration with national or European research institutions.*

**Key words:** *innovation, information, knowledge, economy, education, join-ventures.*

### 1. INTRODUCTION

In our age, characterized by economic globalization, which implies trade liberalization and cost reduction in the field of telecommunications, thus generating the competition between the developed countries and those with an underpaid work force, yet well trained, it is obvious that innovation should play an essential part. In this context, the progress of science and technology is also worth mentioning, as it allows innovative enterprises to benefit from more opportunities and competitive advantages. Despite our society's awareness of the necessity to continuously innovate, innovative enterprises are facing a series of difficulties: the lack of financial resources necessary to purchase advanced technologies, the contractors' failure to take innovation-associated risks, the poor cooperation between research and production, which also results in the lack of technological transfer between these sectors (the slow transfer from knowledge to innovation and market), the clients' failure to pay for new services and, their reticence towards some innovations, etc.

This is why management plays a decisive role in stimulating the innovating processes.

### 2. THE SOCIETY OF KNOWLEDGE

The society of knowledge involves a new type of production and functioning of the social relations, determined by the radical reorganization of knowledge. This process is no longer restricted to knowledge that is specific to scientific rationalism, but it becomes interdisciplinary knowledge, oriented towards the solving of some global problems that are related to the evolution processes in nature, society and the relations between them. "Knowledge itself becomes an economic resource (the most efficient one) in the production of goods and services, and also a merchandise that can be sold as the results of research-development, information on the market, consultancy, professional training". It involves pre-planned investments in education during lifetime, but also generating and disseminating of knowledge. The society of knowledge has several defining characteristics that, set it apart from the previous models of societies (table 1).

Table 1[5]

No.	Characteristics	Industrial Society	Knowledge society	Comments
1.	Main resource	Capital	Knowledge	The progress of knowledge is at the basis of the progress of society in general
2.	Specific goods	Machines, energy plants, self-propelled vehicles, transport networks and communications	Electronic computers in networks, program-products, IT and communication services	Information and communication technologies allow market globalization
3.	Specific industrial technologies	Intensely consuming manual labor, energy and materials, and negatively affecting the environment	Slightly consuming energy Ecological	Presently, traditional technologies migrate from more developed countries to those that are currently developing, endangering the planetary balance.
4.	Value of costs	a) production-type activities b) in raw materials, energy and materials	a) in concept activities b) in investments	
5.	Exchange of values	Equivalent values: the value of the exchanged goods is slightly equal	Multiplying the value: exchange of information is made with no losses, the information obtained can therefore lead to a significant increase of the initial information's value	By using the information and communication technologies, it is easier to obtain the necessary number of collaborating specialists, resulting in a higher probability to generate new ideas
6.	Work	Increase of productivity accompanied by unemployment (faster than the necessary increase of the personnel)	Generating new activities that incorporate workforce	- new economic sectors: industry of programs, multimedia etc. -new services: information centers -new fields for catering the population
7.	Education	Rigid, in accordance with some principles Education – training discontinuity	Flexible, in accordance with the prospective requirements Education – training continuity	
8.	Access to information	Via specialized units	Directly, via computer networks	
9.	Democracy	Representative	Participative	In the sense of exercising the right to take part in the decision making process regarding major issues

The intelligent digital monitoring, coupled with real data acquisition, based on a subsidiary virtual reality, leads to the constant increase of the efficiency in classical technologies, the rational and intensive approach of “green energies” and a civic and generally scientific saving based on an advanced knowledge management.

By approaching the newest creative accomplishments, in state-of-the-art technologies and, especially, in information and communication technologies, day by day a

myriad of new vectors are discovered that increasingly determines the minimizing of energy consumption and losses from the generator to the transporter and to the end-user.

### 3. TYPES OF ENTERPRISES FROM THE POINT OF VIEW OF THE COMPLEXITY OF CHANGES

Enterprises will have to adapt themselves to the complexity of changes. There is no single solution to the problem, but whole series of

approaches, based on the way in which enterprises and the management approach complexity based on a specific context.

Innovative enterprises can also be called „entrepreneurial enterprises”, i.e. enterprises that promote innovation systematically, permanently, intentionally, successfully, as a “new application of management”. [2]

Innovation can be practiced also by those enterprises based on adaptive management, but entrepreneurship does not wait for changes to occur within the contextual complex in order to search for answers, but it rather causes changes, innovates systematically, permanently, intentionally, and not due to circumstances.

For the same medium, different enterprises, using different types of management, will elaborate different strategies.

Based on the types of strategies that enterprises apply and their results, a typology of the enterprise can be created. At the moment, enterprises are: innovative (by own foundation or transfer), adaptive, relatively static (viable) and non-viable enterprises.

For the innovative enterprise, an analysis of accessibility and desirability can be carried out. The following will be taken into consideration: accessibilities (resources necessary, available or in condition to be obtained; the necessary actors capable of meeting the scenario requirements; the probability of meeting the scenario requirements; the difficulties involved in ensuring accessibilities; imposed costs; impeding or opposing factors to the scenario), desirability (the predicted results to each scenario; the basic values taken into consideration when evaluating desirability; the possible advantages in comparison to the necessary efforts; the possible advantages in comparison to the probability of accomplishment; risks and constraints associated with moving to a scenario), necessities of action in order to make some of the scenarios with a high degree of desirability, more accessible (research-innovation requirements; new relations with research-innovation units, setting up clusters, networks, alliances; identifying risk capital investors,

personnel training, etc.) and designing the prospective “critical path” (decision and action tree).

Each alternative can generate other new ones that can be blocked - in case the requirements are unattainable or require efforts surpassing desirability - or can be developed until several accessible scenarios are identified, with different degrees of desirability in comparison to the advantage-disadvantage assessment, cost-benefits, and certainty-risk.

#### **4. CHANGES TO THE STRUCTURE OF FIRM CAPITALIZATION**

The capital structure and value is correlated when the so-called “new economy” emerges. The market spirit determines the physical and structural evolution of a modern firm’s capital.

Capitalization comes at a price. The quantifying of structure and intellectual capital’s value becomes increasingly important, as a contribution to the operational fundamental location of the enterprise. The management, the licenses, the company culture, the adaptation ability, the exterior contact, and ecology are participative elements to redefining the structure and value of the capitals in firms.

If the physical capital decreases (in absolute, unitary values), the intellectual capital share should increase. Innovation in concrete forms can noticeably change the physiognomy of a firm. Economy thus acquires new content features. The new content refers to the presence of information in the economic phenomena and processes, recognized as resource, respectively as raw material.

Information plays the role of capital resource. It is historically and organically present within the operational structure and content of the firm, but in conventional economy it is used as an ingredient, a measuring instrument in order to get to corrections.

Intellectual property is now placed within the competitive economic field.

The prices to guarantee the quality and the compliance with the ecological criteria frequently originate from the costs of



intellectual property. The capitalization of firms in a knowledge-based economy is based on the following requirement: how much money can the products/services of ideational type, the knowledge, and the quasi-technological flows from offices generate?

Attracting foreign investors with the purpose of implementing modern technological systems is essential for promoting compatibility between national economy and European/world productive technology organizations (of the developed countries).

Crisis management, insurance and re-insurance, stock crisis, consulting services for businesses, training and even success and failure quantifying – once solved, they all lead to an increase in productivity, which means knowledge contribution to changes.

New relations are formed between capitalization and entrepreneurship.

Business Coaching becomes the task of both individual and group economic actors, be it private or state-owned. For instance, the development of fundamental sciences is predominantly the task 1) of the state, 2) of NGOs. The results of the fundamental research foster innovation. The same task, i.e. to foster innovation in the economical field, is to be carried out administratively and strategically by the state. Therefore, the extension of entrepreneurship to innovation is mandatory.

Among scientists (read: science trainers) and entrepreneurs (read: production investors) a recomposition of actions takes place.

#### **4.1. Types of technology acquisitions from abroad**

Enterprises have a large array of external sources that can be divided into several groups: to “commission” the new technology to an external research forum, a method that is integrally used by small and medium enterprises, and partially by big and very large companies; to cooperate with different external partners with the purpose of elaborating it; to exchange technologies with a partner that has supplementary needs; to simply purchase technology from the exterior.

The choice for one of the above mentioned alternatives depends on a multitude of factors, among which the most important are: the enterprise size and products/services diversity on offer; enterprise organization, the level at which the development plan is carried out (the existence and influence of the research service, the activity type, the relation between the new technology and the one already owned by the enterprise, the urgency of the need for the new technology, the current available financial resources).

One recent practice is the right to exploit a technology, “license agreement”. A license refers to patentable and non-patentable aspects, sometimes to the right of using a brand, etc. A license agreement can be profitable for both parties provided it is well drafted from the very beginning. The cash flows to which each party is entitled are significant, and extend over a long period of time. Thus, the buyer initially pays a fixed sum of money (lump sum) that will cover the transfer expenses and personnel training, and a quota from the expenses related to elaborating the purchased technology, and then a “royalty” that represents a quota from the profits obtained as a result of exploiting the transferred technology. The one that offers the license usually preserves their right to sell it to other parties as well, but on condition to protect it (by maintaining the validity of the stock licenses against those who try “to steal” them, etc.). On the other hand, the buyer is not allowed to resell the license to a third party. Exclusive sales of license are also possible, but at a higher cost and rather very rarely.

One delicate problem refers to whether the license is conferred to a technological field or strictly to a license. The contract shall state the duration as well as the contract cancellation reasons. Also, many a times licenses are bought from a foreign country which usually has a different legislation.

License purchase is a very beneficial solution for the following reasons: the expenses and risks associated with research activities are avoided; the success of the product on the market is tested

and confirmed by the seller; the technology transfer is rapid.

Of the disadvantages related to license purchase, the most important one is that the buyer is never a leader in the field and thus they will always depend on the technology seller.

Technology exchanges between enterprises with supplementary needs are common practice in some industrial fields, especially the high tech field. There are two forms of technology exchanges: joint-ventures and strategic alliances. The difference between them resides in the commercial aspects of the contract.

In a Joint-venture more investors can take part, some of them contributing with money, others with technical knowledge. Strategic alliances can be established even in the absence of a legal contract. The partners seal a collaboration agreement with general objectives that later on are drafted more specifically (technology exchanges or sales, jointly built objectives, etc.).

Reverse engineering. It represents the technique of copying from competition a successful product, changing it very slightly only to justify the innovative component and to adapt it to the company's array of products and market segment.

Research collaboration or simply research financing can lead to very interesting results. When carried out in a university or external institute, its objectives are: access to experience and knowledge that the company does not have (including equipment); use of highly qualified personnel; solving of immediate problems without hiring research staff.

The research contract should be drafted in a manner as to outline the advantages that the method can offer to both parties, the potential pitfalls thus being prevented.

**4.2. Generating innovations by putting the research capabilities within the company to good use; attracting funds by project presentations as part of the national and European programs to foster research;**

Acquiring new, competitive products can also be achieved by using the potential of the employees of the company's research department. This option is usually valid for big companies, with financial support for research. However, medium enterprises could also develop the research department by being given access to non-refundable funds.

The national strategy of the research, development and innovation field, voted by Government Decision no.217 from 28 February 2007, for the period 2007-2013, is based on the Romanian society vision regarding the role of science, technology and innovation for the development of knowledge in Romania. The strategy implementation is carried out by means of the National research, development and innovation plan II and a set of EU initiatives that aim at fostering entrepreneurial skills and knowledge transfer to products and services.

The component programs of the National plan II are: Human resources (in order to increase the number of researchers and improve their performances), Capabilities (in order to allow researchers to work using advanced technologies, to benefit from an appropriate management and maintain a permanent contact with the social and economical needs), Ideas (in order to foster knowledge, given the importance of fundamental research), Partnerships in fields of interest, Innovation, in order to support the competitive research projects initiated by the economical operators.

For 2007-2013, the following programs are envisioned at the level of the European Community: the framework program 7 for research, which supports research and development programs, transnational cooperation in the field, border research and excellence networks and The program for competitiveness and innovation that promotes SMEs innovation and development, providing financial support and sustaining a transnational network of technological transfer.

## **5. CONCLUSIONS**

As a result of the implementation of the Informational Society and Knowledge in our country, apart from the classical ones - energy, material and financial - a new pillar of economical support emerges at a macroeconomic level. This new informational pillar is about to become crucial in the building of a modern economy, based on scientific and ecological knowledge that will result in a viable long term development. In fact, this new economy, which is based on digital electronic technology, processes scientific knowledge and strictly pursues the ecological ideals.

The innovation concept itself has changed. The conclusion is that this is the result of a systematic, organized, and precisely directed effort, rather than the fruit of inspiration, as it has been consolidated based on the systematic study of a great number of successful innovations and their implications. In order to successfully innovate, enterprises should give up old and outdated products and methods.

Innovation is not exclusively technical or technological. It can occur in any field where one can ensure a better allocation and use of resources, an increase in productivity and efficiency, as well as a higher level of efficiency.

Enterprises should resort to new technologies that more easily to access by the small and medium enterprises by means of license purchases or collaboration with research institutions or bigger companies (multinational), which can afford to invest in research. However,

for certain fields, SMEs should draft development plans envisioning the expansion of the research department's activity as well, with the possibility to be granted structural non-refundable funds or with a certain rate of company participation in the development of these departments.

This is the only way in which they could become leaders in the field and be successful in an economy affected by the financial crisis and tough competition with the EU companies.

The Romanian enterprises should foster continuous innovation because, as P. Druckner said: „Knowledge is different from other resources. It ages on its own and, therefore, the advanced knowledge of today is but the ignorance of tomorrow.”[3]

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## CONSIDERATIONS FOR ENERGY MANAGEMENT IN FUTURE

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**Abstract** (summary): *non-renewable energies are closely related to energy policy in Europe. All forms of energy are used to serve to generate electricity, hot water, and other opportunities. Energy is vital for the functioning of Europe, such as developing a common energy policy is welcome. European Energy Charter, the Green Paper Energy are some ways to support the political unity of the EU. Like a modern support green energy is used, which are sources of new and renewable energy (biomass, solar energy, wind energy, hydro, photovoltaic Pila etc.) have already become, for industrialized countries, national structure of energy production. In this context, renewable energy was first seen as a possible alternative to oil. Transparency is essential for the functioning of the market. In the energy policy of the European Union, whose central pillar is market power, as some problems are solved, new ones appear, becoming more complete. Monitoring, reporting and transparency will be essential in the development of a progressive energy policy effective.*

**Key words** (keywords): *Unconventional Energies, Energy Policy, the European Energy Charter, the Green Paper, Green Energy, Transparency, Single Energy Market, Energy Industry.*

### INTRODUCTION

Non-renewable energy refer to forms of energy produced by the transfer of energy from renewable natural processes. Thus, solar energy, the wind, water, biological processes and geothermal heat can be captured by people using different methods. Non-renewable energy sources including nuclear energy and energy generated by burning fossil fuels such as oil, coal and natural gas. These resources are limited to the existence of such deposits and are generally considered non-renewable.

All these forms of energy are used to serve to generate electricity, hot water, etc. To stop the increasing concentration of carbon dioxide present in the atmosphere by 2050, emissions have injumatatite current planetary level and thus reduced by 3 to 5 times in developed countries.

Energy is vital for the functioning of Europe, but it seems that the period in which Europe have secure and cheap energy resources has ended. All EU members are facing the challenges posed by climate change and dependence increasingly higher imports

and higher prices of all energy. Moreover, increasing the interdependence of EU Member States on energy, as in many other areas such as cases leading to - a flat in a country currently has immediate effects on other countries.

### 1. DEVELOPING COMMON ENERGY POLICY

European Energy Charter, of which the final document was signed in The Hague by 51 states in December 1991. The legal framework of cooperation to implement the principles of the Charter was developed by the Energy Charter Treaty. This is a multilateral document signed in December 1994 in Lisbon, with the objective of "establishing a framework to promote long-term cooperation in energy field." Treaty is based on the principles of the internal energy market and represent an extension of it to Europe and further on.

The final report of the **Green Paper on Energy**, resulting from a public debate of a magnitude unprecedented in the past 30 years, was presented by the European Commission on 27 June 2002. A moment which recently

gave a signal acceleration in the development of common energy policy occurred at the Barcelona European Council (March 2002), which was a total liberalization of the electricity market for industrial and commercial customers since 2004.

**Energy Green Paper** is the first truly important energy achieved after 70 years in Europe and is a strategy based on long-term energy of the European Communities. Its aim was not to provide solutions, but to alert the current status of energy sector and the implications and consequences of energy consumption on the economy and environment.

The Green Paper highlights the need for renewables to become an increasingly important part of the structure of energy. By 2010, the proportion of renewables should reach 12%, compared to 6% in 1998. In current conditions, however, the increase would amount to only a percentage, that should be considered complementary measures. Conventional energy sources with lower potential pollutant (oil, natural gas, nuclear energy) are reviewed in the sense of support, through them, develop new energy resources.

Nuclear power. Fears of global warming have changed the perception of nuclear energy. It is recognized that the use of nuclear energy and the renewable energy with high efficiency, leading to limiting the effect of greenhouse gases emitted by fossil fuels. Total abandonment of nuclear energy would mean that 35% of electricity production to be covered from other sources. Therefore, the nuclear option remains open to European states which want. However, processing and transport of radioactive waste remains an issue still unresolved

The internal energy market. Alone can ensure healthy competition and ensure the security of energy supply, increasing competitiveness of the European economy, but requires cross-border capabilities improved. Energy trade in the EU. Trade only 8% for electricity, and still need interconnection capacity. There is a plan for developing the infrastructure for gas and electrical networks,

and was identified several projects of European interest.

Green energy sources and renewable energy in November (biomass, solar energy, wind energy, hydro, photovoltaic Pila etc.) have already become, for industrialized countries, national structure of energy production

In this context, renewable energy was first seen as a possible alternative to oil. When oil prices fell sharply in the 80s, the vision of "solar" and has become attractive again.

The report on the internal market and the sector inquiry shows the risk of discrimination and abuse when controlling both the power networks, and production or sales, protecting national markets and preventing competition. Also, such a situation discourages firms with vertical integration, which do not adequately invest in networks, because they increase the capacity of networks, the increased competition in their domestic market and the market price falls.

Transparency is essential for the functioning of the market. Currently, operators of transportation systems provide information at different levels, so in some markets, new competitors can cope more easily.

The experience of recent years has shown that to enhance the viability of the EU electricity and prevent black-outs are needed at European level of minimum standards and common security binding networks.

## **2. EUROPEAN ENERGY POLICY**

The internal energy market increases the interdependence of Member States in terms of energy supply, both for electricity and gas. Despite the goals of energy efficiency and renewable energy sources, oil and gas will continue to cover more than half of the EU's energy needs.

The EU has strong and fruitful relationships with traditional suppliers of gas in the European Economic Area (EEA), in particular Norway, and beyond - with Russia and Algeria. EU is confident that, in future, these relations will become even stronger.

In 1997, the European Union has begun to act to achieve an objective that the share of

renewable energy in 2020 will amount to 12% of its energy sources, doubling the level of 1997. Since then, renewable energy production has increased by 55% and the EU, however, will fail to reach its target. It is unlikely that the share of renewable energy to exceed 10% by 2010.

Policy on renewable energy must cope with a challenge: to find a balance between the immediate installation of large capacity for producing renewable energy and providing a space that will allow research to help reduce those costs capacities.

Europe has two key objectives in terms of energy technologies: to reduce the cost of clean energy and make the EU take the lead in energy technologies with low carbon in growing.

By 2020, technologies must target that renewable energy is 20%, allowing an increase in the share figure cheaper sources of renewable energy (including dissemination of large wind power and biofuels from second generation);

By 2030, it is the production of electricity and heating to use all sources more low-carbon, is also required extensive use of the power plants on fossil fuels with near zero emissions and capture and storage CO<sub>2</sub>. Transportation will have to adapt gradually to the use of biofuels and second generation of hydrogen fuel cells;

To the horizon in 2050 and later, European energy system should be based solely on sources with low carbon, which could include renewable energy, sustainable sources of coal and gas, hydrogen in major proportions, and nuclear fission Fourth generation and fusion energy for the Member States concerned.

### **3. FUEL FOSSIL WITH LOW CO<sub>2</sub> EMITTED**

Coal and gas provide 50% of electricity supply and the EU will definitely remain an important part of our total energy resources. Reserves in the long term are considerable, but coal generates CO<sub>2</sub> emissions almost double compared to gas. It will take production methods based coal less polluting and reducing CO<sub>2</sub> emissions. Moreover, the development of

such methods cleaner capture and storage of carbon are of global capital: IEA foresees doubling the production of electricity based on coal by 2030.

### **4. THE FUTURE OF NUCLEAR ENERGY**

Currently, approximately one third of electricity and 15% of the energy consumed in the EU comes from nuclear energy is one of the most important sources of energy without carbon dioxide (CO<sub>2</sub>). Nuclear power is less vulnerable to fuel price changes than that generated by coal or gas, because uranium is a small fraction of the total cost of nuclear power generation and is based on sources which will be exhausted for many decades and are distributed widely throughout the world.

As can be seen in the table attached to this document showing the advantages and disadvantages of different energy sources, nuclear power is one of the least expensive energy sources with low carbon products in the EU, and the costs are relatively stable. The next generation of nuclear reactors should reduce costs even more. The decision to rely on or not nuclear energy is for each Member State.

### **5. ENERGY INDUSTRY**

Promoting renewable sources is an issue than the potential of each country separately. At present, the carbon dioxide emissions in the new party is not considered serious.

In creating the internal energy market, establishing the regulatory framework is not the most difficult task. Much more problematic is proving to be the law dominated in this sector Directive. Adoption of gas and electricity, in fact first concrete step towards the establishment of the internal energy market, proved to be started to initiate reforms in the economic sectors most conservative in Europe, the monopoly rather than competition, were considered as a natural state of things.

The issue of safety in the supply of electricity. Dependency of imported energy resources lead to a safe low energy supply.

However, the increase in food safety, only reduce imports and increase domestic production would be insufficient and would betray a simplistic approach to the problem. The Commission believes that the key problem is a much more complex, including among others the diversification of energy sources, technologies and a new type of management of energy demand.

The reason is that in Romania there are additional storage capacity for minimum stocks mentioned. Rehabilitation of existing capacities will cost around € 3.5 million / year and maintaining stocks, 48 million €. Stocks minimum will be managed by a structure created in the Ministry of Industry and Resources. For Directive 98/93/EEC on safety stocks, Romania requires both a waiver from 90 to 67.5 days, and a transitional period of 5 years.

High energy prices have negative effects particularly in developing countries. While few such countries can benefit as producers, others are where the high prices of energy imports exceed income by dezvoltare<sup>29</sup> aid. Africa and other regions in developing countries are deeply concerned, like Europe, stimulating energy efficiency and diversification, which could represent a major contribution to the Millennium Development Goals. EU takes so committed to assist developing countries in promoting energy supply and use in a sustainable and safe.

To achieve the above commitment, the EU should focus on the distribution of energy services affordable, reliable and sustainable for the poor, especially coming from renewable sources and to develop clean and efficient technologies for the production of oil and gas.

Monitoring, reporting and transparency will be essential in the development of a progressive energy policy effective EU. The Commission proposes to establish an Energy Observatory within the Directorate General for Energy and Transport.

## 6. CONCLUSIONS

Energy, for decades regarded as an exclusive attribute of national governments has proved over time that traditionally

centralizing policies and monopolistic even applied under the sign of the highest considerations of national protection, globalization can not survive and can not escape the pressures of competition. Income already proven by the opening of the market is falling prices, but because it has any value, the complexity of the problems of energy increases as it increases the number of actors, be they suppliers, manufacturers, traders and market regulators as. What is acutizează global environmental problems ignored decades on end.

So is it that the energy policy of the European Union, whose central pillar is market power, as some problems are solved, new ones appear, ever more complex.

Adverse developments relating to the continuous growth of dependency on energy imports, with implications for food safety and long-term influence on consumption and development, with increased emissions, are challenges which the European countries has to face in an effort whose purpose is found in energy policy.

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## NATO CRISIS MANAGEMENT

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### Abstract

*North-Atlantic Treaty Organisation rejected the idea that its role had ended with the fall of the Iron Curtain and affirmed its desire to adapt its missions to the new reality of the European security landscape. The critics of the NATO called this an institutional self-preservation instinct but many others recognised that the end of the Cold War did not imply an end to the all hot spots. Fortunately and unfortunately, events in the summer of 1990 and the followings in the next years supported this approach and showed the need for regional security arrangements of which NATO represented a unique model of success.*

### Introduction

Crisis management, including non-Article 5 crisis response operations, has been a major theme in the continuing adaptation of the Alliance to the post-Cold War security environment. The new Strategic Concept adopted in Rome on November 8, 1991 emphasized the importance of crisis management, stating: "The success of Alliance policy will require a coherent approach determined by the Alliance's political authorities choosing and coordinating appropriate crisis management measures as required from a range of political and other measures, including those in the military field."<sup>1</sup>

The Strategic Concept adopted in Washington on 24 April 1999 went even further, listing crisis management under the rubric "fundamental security tasks" of the Alliance. It stated: "... in order to enhance the security and stability of the Euro-Atlantic area: Crisis Management: To stand ready, case-by-case and by consensus, in conformity with Article 7 of the Washington Treaty, to contribute to effective conflict prevention and

to engage actively in crisis management, including crisis response operations."<sup>2</sup>

The Strategic Concept also recognized the need for "military capabilities effective under the full range of foreseeable circumstances" as "the basis of the Alliance's ability to contribute to conflict prevention and crisis management through non-Article 5 crisis response operations."<sup>3</sup> Allies noted that NATO's preparedness to carry out such operations supports the broader objective of reinforcing and extending stability and often involves the participation of NATO's Partners, which conducts to the full use of partnership, cooperation and dialogue.<sup>4</sup>

### 1. Considerations on Crisis Management within NATO<sup>5</sup>

The Alliance's crisis management policy has been adapted since the end of the Cold War to take account of the radically

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<sup>1</sup> NATO, "The Alliance's New Strategic Concept," adopted by Heads of State and Government in Rome on November 9, 1991, paragraph 32

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<sup>2</sup> NATO, "The Alliance's Strategic Concept," Press Release NAC-S(99)65, 24 Apr. 1999, paragraph 10

<sup>3</sup> NATO, "The Alliance's Strategic Concept," Press Release NAC-S(99)65, 24 Apr. 1999, paragraph 29

<sup>4</sup> Ibid.

<sup>5</sup> Sources: NATO Handbook, NATO Office of Information and Press, 2001;  
<http://www.nato.int/docu/handbook/2001/index.htm>

different nature of the risks which it now faces. It is based on three mutually reinforcing elements: dialogue, cooperation with other countries and the maintenance of NATO's collective defence capability. Each of these is designed to ensure that crises affecting Euro-Atlantic security can be prevented or resolved peacefully.

**Consultation** among NATO member countries **plays an essential role** in crisis management and takes on particular significance in times of tension and crisis. In such circumstances rapid decision-making, **based on consensus** on the measures which need to be taken in the political, military and civil emergency fields, depends on immediate and continuous consultation between member governments. The principal NATO forums for the intensive consultation required in this context are the Council (North Atlantic Council-NAC) and the Defence Planning Committee, supported by the Policy Coordination Group, the Political Committee, the Military Committee and the Senior Civil Emergency Planning Committee. Other NATO committees may also play a role when required.

### **Supporting Elements for NATO Crisis Management**

The NATO Crisis Response System (NCRS), the NATO Intelligence and Warning System (NIWS), NATO's Operational Planning System and NATO Civil Emergency Planning Crisis Management Arrangements are designed to underpin the Alliance's crisis management role and response capability in a complementary and synergistic fashion, as part of an overall NATO Crisis Management Process.

The practices and procedures which are used form the Alliance's crisis management arrangements. Facilities, including communications, in support of the process are provided by the NATO Situation Centre (SITCEN), which operates on a permanent 24-hour basis. Exercises to test and develop crisis management procedures are held at regular intervals in conjunction with national capitals

and NATO Strategic Commanders. Crisis management arrangements, procedures and facilities, as well as the preparation and conduct of crisis management exercises, are coordinated by the Council Operations and Exercise Committee (COEC), which also coordinates crisis management activities with Partner countries.

The Council Operations Section supports NATO crisis management by the development and improvement of procedures, organisation and facilities to support the needs of the Council and Defence Planning Committee, and to facilitate consultation in periods of tension and crisis.

The Peacekeeping Section supports the crisis management process by providing conceptual and technical strategic planning and advice on peace-support operations. The Peacekeeping Staff also support other aspects of NATO's work in the field of crisis response operations, including the development of Alliance peacekeeping policy, the development of CIMIC (Civil-Military Cooperation) policy, and support for the NATO-Russia Council (NRC) and Political Military Steering Committees (PMSC) Ad Hoc Groups on Peacekeeping. This section also maintains close relations with other international organisations including the OSCE and UN.

The Situation Centre, known as the SITCEN, has three specific roles:

- to assist the North Atlantic Council, the Defence Planning Committee and the Military Committee in fulfilling their respective functions in the field of consultation;
- to serve as a focal point within the Alliance for the receipt, exchange, and dissemination of political, military, and economic intelligence and information;
- to act as a link with similar facilities of member nations and of the major NATO Commands.

A Communication Centre or "COMCEN" supports the Situation Centre.

At the earliest opportunity, the Partners and then non-Partner nations are invited and

consulted to offer forces. These contributions are often in important areas of Allied shortfall such as medical, engineering and technical specialists.

The intention behind participation by Non-NATO Troops Contributing Nations (NNTCN) is to create a truly multinational framework and to better demonstrate international support and **legitimacy**. The NNTCN are also given the opportunity to comment on operations plans, and their views are taken into account. This allows partner and non-partner nations to contribute to the provision of political guidance and oversight of operations, and contributes to what is called as “Decision Shaping”.

Non-NATO Nations close to the conflict area can also offer Host Nation Support in the form of basing, transit and over-flight rights. This kind of support is, in many situations, crucial.

In response to a potential or developing crisis, to acting on time it is essential to have a variety of different measures or possible responses in place, so that they do not have to be developed on an ad-hoc basis for each new situation. In deciding what to do about a given situation, the Council/DPC has a wide range of measures, and Allies have agreed from which to choose. These measures have been substantially revised since the end of the Cold War to seek to ensure that they are relevant for the contemporary crisis environment.

Measures include: (1) diplomatic, economic and military preventive measures, (2) a large variety of military response options and (3) a spectrum of precautionary measures. Examples of the preventive measures could include: messages, trade restrictions, expressions of support for threatened states, closure of ports and airports and special programs in favour of threatened states. Examples of military response options could include: cancellation of military cooperation, confidential military consultations, request inspections and evaluation visits, surveillance, increased readiness and activation of forces. There are also a variety of contingency operation plans, which can be drawn on for detailed operational planning if required.

In addition to these lists of measures, NATO also has a system for assuring preparedness and timely response in crisis for civil and military commands, agencies and headquarters, and national military units and agencies.

## **2 NATO decision making and planning considerations for Peace Support Operations<sup>6</sup>**

### **2.1 Key Aspects of Alliance Involvement in Peace Support Operations**

Individual member States as well as the Alliance as a whole will take a variety of considerations into account in any decision to undertake PSO. These may include the objectives of the operation, essentiality of NATO participation, the probability of success given NATO participation and possible risks. Prior to approving Alliance support, the NAC may take into consideration the factors outlined below to provide an acceptable framework for accomplishment of the PSO.

- **Legitimacy.** The wider perception of the legitimacy of the Peace Support Forces (PSF) by both the conflicting parties and the wider international community will be a significant factor in the success of PSO. Legitimacy has legal, social and political components as outlined below:
  - **Legal Component.** All military operations must take into account both the letter and spirit of national and international law. The appropriate legal considerations will provide the framework for the conduct of military operations. The planning and mounting of PSO raises some legal issues that are different from those raised by conventional military operations. These include:
    - a. The legal basis or authority for any given PSO.

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<sup>6</sup> Source: AJP-3.4.1: Peace Support Operations

b. The legal status of personnel and equipment engaged in PSO, which is generally enshrined in a Status of Forces Agreement (SOFA).

c. The Rules of Engagement (ROE), governing the conduct of personnel and the employment of equipment, engaged in a PSO.

d. The requirements of the Law of Armed Conflict (LOAC) which is often referred to as the law of war or International Humanitarian Law (IHL).

e. Legal obligations stemming from Arms Control Treaties.

○ **Social Component.** The social aspect of legitimacy for any operation is based upon the support of the population and political leadership in the participating nations and the wider international community. The PSO needs to be perceived as being justified and the right thing to do. Social legitimacy is therefore a major pre-condition for the successful initiation, continuation and conclusion of any PSO and contributes to the broad support and wider participation with the operation by international and non-governmental organisations.

Support from the population in the conflict area is also critical to the long-term success of a PSO. Compliance and consent for the PSF enhances its freedom of movement and allows military aspects of the overall operation to move more quickly to a successful conclusion.

○ **Political Control.** The overall political control of NATO participation in a PSO will be the responsibility of the NAC. In addition one or more UN Security Council Resolutions (UNSCR) will usually mandate an operation. The conduct of PSO is based on an agreement with, or at the request of, the recognised government where one exists, and all the parties in the conflict. In the absence of consent for the PSF intervention or where there is an expectation that consent may be withdrawn, the conditions for

NATO involvement and the use of force should be specified in the NAC Initiating Directive.

○ **Neighbouring Countries.** It is also important to consider the role that neighbouring countries may play in providing facilities for the PSF to operate from, or transit over or through, their territory. It should not be assumed that these states would automatically consent to the operation, as they may be part of the problem. Separate SOFA or MOU may require negotiation with each involved country.

➤ **North Atlantic Council Initiating Directive.**

Ideally, the NAC Initiating Directive for a PSO should both define the strategic objectives that constitute a clear political end-state and allot organisations, resources and responsibilities for the achievement of those objectives and the end-state. When reaching this decision the NAC will consult contributing states and relevant International Organisations.

Crisis Response Planning, including military and civilian advice on operational feasibility and the required capabilities, should initiate the drafting of decisions. When the political or operational environment changes, the decision should be reviewed and if necessary, new missions defined or, alternatively, missions terminated. NATO nations and, in accordance with the agreed procedure the NNTCN must be consulted in the formulation of the Initiating Directive and subsequently when:

a. The mission duration is extended or its task revised.

b. There is a fundamental change of the situation in the mission area, which could affect implementation of the directive.

c. Consideration is given to partial or complete termination of the mission.

d. Consideration is given to changes to ROE.

The complex multi-functional nature of PSO requires that commanders understand that military objectives will generally be only milestones on the road to achieving the political end-state. It is therefore important

that clear mission guidance is given which allows commanders, at all levels, to understand not just their senior commander's military intent but where that intent fits into the broader political context of the operation. Military directives, orders and ROE should be drafted carefully so as to permit commanders the maximum latitude to respond to the multi-agency, multi-dimensional and dynamic nature of PSO while guarding against the potential for an escalation of violence and the destabilisation of the ongoing political process.

➤ **Voluntary Participation by Member Nations.**

In NATO, member nations may choose not to participate in a non-Article 5 CRO, and therefore may also not wish their personnel to participate in a CJTF HQ. Nonetheless, if the Alliance provides a CJTF HQ for a non-Article 5 CRO, personnel planning should be based on the principle that such nation's personnel serving in a position in a CJTF HQ nucleus should remain in their posts until they are replaced by suitably trained personnel.

➤ **Force Contributions.**

Troop Contributing Nations (TCN) should be involved in the planning, preparation and decision-making procedures in operations to which they contribute. Non-NATO Troop Contributing Nations (NNTCN) will be involved in accordance with the Political-Military Framework for NATO-led PfP Operations (PO(99)28, 20 Apr 99). The type of personnel (professional, conscripts, or reserve) and units (standing or reserve) to be deployed are decisions left exclusively to contributing nations. However, implicit within a nation's offer to support a PSO is the understanding that resources will be made available promptly. This includes the ultimate national responsibility for the necessary logistic support and may be discharged in a number of ways, including agreements with other nations or with NATO as set out in MC 319/1 "NATO Principles and Policies for Logistics". Once contributed, resources should not be withdrawn or reallocated by nations without suitable notice being given to the NAC through the chain of command.

Any political, legal or military limitations on contributions to the PSF should be stated early so planners may account for them. Political restrictions should be minimised to allow commanders maximum flexibility within the terms of the directive.

It is also essential that military contributions contain the required capabilities and meet the necessary standards of training and readiness for the tasks and organisational structure prescribed by the mission directive.

➤ **Conditions for Terminating the Operation.**

The mission's mandate should be reviewed periodically by the responsible international organisation to determine what progress has been made, how the operation may be adjusted, or if the mission should be terminated. The NAC would advise the mandating authority of its collective view on the continuation of a PSO involving Alliance support.

The definition of strategic objectives and the political end-state in the Initiating Directive should facilitate the development of criteria and conditions that allow the progression of the operation to be assessed regularly. The SC is responsible for providing periodic updates through the MC to the NAC. The NAC may then provide additional direction to reduce, increase or terminate the PSO based on the SC assessment.

The imposition of time constraints for the duration of the operation is a high level political-military decision. Time lines imposed upon the former warring parties may ensure that the PSO maintains momentum. However, the declaration of an operational timescale, including a withdrawal date for the PSF may cede the initiative to the parties. They can then wait for the departure of the PSF. On the other hand, establishing a fixed date for the participation of the PSF serves notice that parties must also work diligently to resolve their differences, unless they are willing to forgo the support of the PSF.

In either case, it is important to establish criteria that require quantifiable actions by all parties that demonstrate successful implementation of the mandate to the

international community. Additionally, the SC should ask the NAC to maintain positive momentum in resolving political and other related issues. Failure to move forward on these issues will likely prolong the duration of the mission and the engagement of Alliance assets in it. Critical in this respect is a clear and common understanding among all contingents of the PSF, as well as among the political and military leadership of the PSO, of what constitutes success, what measures or activities could facilitate success and what threats to success can be identified.

## **2.2 The NATO Planning Process for PSO**

### **➤ Preliminary Planning Considerations.**

The Alliance aim at the earliest stage of planning will be to establish:

- a. Legitimacy of the operation.
- b. Nature of the operation.
- c. Freedoms, constraints and restraints.
- d. Strategic objectives and timelines.
- e. End-state.

The NAC, with advice from the Military Committee (MC), may need to give advice to the authorising international body on the formulation of its mandate, which should contain the strategic objectives and political end state. Planning will take place in a crisis management environment. The results of early planning will indicate the broad nature of the mission, possible Alliance objectives, resource requirements, and the likely outcome of a NATO commitment. This analysis is fundamental to the NAC decision. It should also identify strategic options and their associated advantages and disadvantages; this will allow potential force contributors to consider their position.

As part of this iterative process, the NAC and MC will consider the preliminary conclusions in order to agree to the strategic objectives and political end-state and to provide high-level strategic guidance to the SC. This guidance should define Alliance strategic objectives in order to allow the Strategic Commanders (SCs) to conduct all necessary contingency

planning. In addition to an Alliance end-state which is compatible with that identified by the mandating authority, the NAC will also identify those conditions that would lead NATO to consider terminating its part in a PSO. These conditions may be judged against:

- a. A loss of the International Community's resolve to remain committed to the operation caused by:
  - A loss of consent.
  - A lack of compliance.
  - Insufficient commitment to or progress with civil projects.
- b. Unacceptable casualties among members of aid agencies or the PSF.

A critical decision at this time is the selection of a suitable HQ below SCs level to lead the operational planning effort. This may be an existing HQ or require the activation of a CJTF HQ (Combined Joint Task Force Headquarters).

### **➤ Initiating Directive.**

At the earliest opportunity, the NAC will issue an Initiating Directive through the MC to the nominated SC. It is this directive that provides the framework for the development of the military Operational Plan (OPLAN).

### **➤ Public Information Plan.**

Any NATO PSO will generate and attract intensive major international and domestic media and public attention. This attention will inevitably lead to public scrutiny and debate. For this reason, as the plans evolve the political and military authorities must produce a supporting coherent Public Information Plan (PIP). While support by the media does not guarantee an operation's success, continuing media criticism and hostility can help cause its failure.

An agreed PIP must be implemented from the outset and be co-ordinated with the mandating authority, national governments and all HQs. Whenever possible involved civilian organisations and agencies should also be made aware of the PIP and their activities coordinated with it. To be of value a PIP should take account of all military and civilian activities within the mission plan. The military element of the PIP will require a sensitive balance between the distinct but related areas

of Public Information, Peace Support Psychological Activities (PSPA) and Civil-Military Co-operation (CIMIC). Their activities will need to be co-ordinated in the Information Operations Plan.

➤ **Liaison and Reconnaissance.**

To ensure effective planning, the NAC must authorise reconnaissance in the Initiating Directive. This will enable the SC and designated subordinate HQ to conduct reconnaissance and establish liaison to ensure early co-ordination in the mission area with those civilian agencies already engaged. The development of crisis response plans will depend on the ability of the designated Joint Force Commander (JFC) and his principal staff officers to observe and assess conditions in the JOA. All information-gathering activities must take account of the cultural and ethnic environment, the history of the region, the political and civil objectives of the parties and the objectives of civilian agencies already engaged.

Reconnaissance should be given a high priority in the initial stages of the planning process. Once political approval is given for detailed planning, subsequent reconnaissance visits should be planned frequently, and liaison teams from the designated HQ should be deployed to appropriate agencies in the JOA as soon as possible.

The establishment of a comprehensive liaison network is vital to success in any PSO. There will invariably be a requirement for mobile and deployable liaison elements equipped with suitable, secure communications. Military headquarters at each level must plan to have capable liaison personnel at a wide range of locations, including the local offices of the international civil agencies and NGOs as well as the headquarters of the parties to the conflict.

➤ **Planning Force Structure and Composition.**

Following the political direction to develop a plan, the SCs will first develop a Concept of Operations (CONOPS), which can include an initial Statement of Requirement (SOR). After NAC approval of the CONOPS, the SCs will develop the OPLAN which will have a

detailed SOR. This process will be iterative, because a matching between forces provided by nations and the CONOPS/OPLAN requirements will have to take place.

While an initial troops-to-task assessment may result from the reconnaissance and mission analysis, it is during the concept development stage that identification of the required military capabilities, numbers, generic grouping and the command structure, (joint) support forces and facilities is completed. This information becomes the JFC's SOR. The SOR is used as the basis of the NATO force generation process through which PSF contributions will be sought from member nations. High-level political contact should be made to determine the desirability and likely extent of non-NATO nations' participation in the operation as well.

If nations are not likely to make the necessary forces available, the MC in consultation with the responsible SC will determine if the mission may still be accomplished, perhaps by sequentially accomplishing objectives or by an alternate concept of operations. Alternatively if sufficient resources are unlikely to be made available the SC and MC may recommend the cessation of any further planning.

As in other military operations, the final force structure depends on a number of factors, including the size of the operational area, the nature and expected duration of the mission, lines of communications, terrain, weather, threat, and logistical requirements. The PSF must be a task-organised, multinational organisation. The SC will closely monitor the final grouping of national contingents into formations, thereby avoiding unwanted or uneven organisational structures. The SC will also decide as to the final division of the JOA into areas of operation, thereby avoiding unwanted combinations of formations with parties in the conflict, as well as taking into account national preferences for certain areas of operation.

An additional planning consideration is the balance between the security of the force (force protection) and the signal these actions send. A heavily armed and aggressive PSF may be perceived in certain cultures as a

provocation demanding a violent response. Similarly, a PSF that places undue emphasis on overt force protection measures is less likely to command respect, establish sufficient liaison with the local population, or inspire confidence in the security environment.

➤ **Writing and Approving PSO Plans.**

Military OPLANs for PSO follow the NATO Operational Planning system as outlined in MC 133. The political nature of PSO will normally generate a high level of political and military interest and involvement as the subsequent OPLANs are developed. Work on an OPLAN should start as early as possible and must incorporate the timely build up, deployment, employment, sustainment, reinforcement of in-place forces and redeployment of assigned forces to support the JFC's concept of operations. The early engagement in planning will help clarify the objectives of the mission and thus pre-empt problems that may occur as the mission becomes operational. A full understanding of the mission and the JFC's Intent down to the lowest level within the PSF is critical for success. The logistic concept should also be developed as early as possible, in accordance with the doctrine set out in the AJP-4 series documents to ensure that any force committed to a PSO is effectively deployed and sustained for the forecast duration of the mission.

➤ **Multifunctional Planning Approach.**

The development of an overall, comprehensive and multifunctional planning approach for what is a profoundly political situation is crucial to the successful organisation and execution of any PSO. The multifunctional approach should be developed in co-operation with all agencies thus addressing the overall needs of the situation with a view to making the best use of resources. The multifunctional planning approach will address the structure to deal with all civil and military aspects of the PSO. It must be adaptable to changing circumstances. The key to success is a clear enunciation of objectives and those conditions which determine the political end-state. These objectives may be milestones along the way to achieving the political end-state or elements of

it. The approach should contain strategic assumptions, indicate functional activities against time for the different civilian and military elements of the mission, identify the potential main effort and highlight decision points in a phased concept of operations. The identity of the political body responsible for the development of the civilian mandate and mission plan, will determine whether the NAC, SC or JFC or a combination of the aforementioned should be responsible for integrating the NATO contribution within the multifunctional planning approach.

The multifunctional planning approach will provide coherence and unity of effort. In doing so, it should clearly establish the high level Chain of Command (C of C) by unambiguously explaining all C2 relationships, and the responsibilities and mechanisms for co-ordination.

Many aspects of a PSO (e.g. the actions of various NGOs) will be difficult or impossible to predict in detail. Until the division of responsibility between the civil and military objectives is identified and agreed, military planners should anticipate where assistance might have to be given in the early stages to support civilian efforts. This analysis must be flexible and recognise the difference between 'mission creep' and 'mission development'. The former being involvement in activities which are unrelated to the political end-state, the latter being efforts to ensure progress is made to achieve strategic objectives including the political endstate.

➤ **The Context for Multifunctional Planning.**

The PSO can be described in 4 phases:

a. **Phase 1.** From a period of relative stability, unspecified causes create a level of human suffering which prompts international concern. The situation is monitored, perhaps externally or by the deployment of human rights monitors or long term international development agencies already on the ground, and governments and aid agencies mobilise resources to alleviate suffering and promote development. If the situation deteriorates further, emergency relief agencies deploy, hoping to deal with the immediate crisis in



human suffering to allow longer-term aid and development to take effect. These activities attract increasing media attention which inevitably forces international Governments to pay greater attention to the developing crisis. Throughout this phase, all organisations and agencies involved or likely to be involved, must co-ordinate their planning.

**b. Phase 2.** When the international community decides that the crisis is no longer containable without military intervention, a NATO military force will be deployed to conduct a PSO which may have a PK or PE profile. Deploying rapidly, the military will build up sufficient forces to stabilise the security situation. While the military mission may well take precedence at this stage, it will be conducted within the parameters of the overall operation, and the planning and conduct of operations must again be closely co-ordinated with the activities of other agencies. It is critical that both, MSU and Civil Police (CIVPOL) units or representatives deploy at this stage with a rapid build up of CIVPOL as soon as possible. As the security situation stabilises, the military may begin to withdraw, having created the conditions for the other agencies to progress the operation towards the end-state of a self-sustaining peace.

**c. Phase 3.** Once the security situation is sufficiently stable, and CIVPOL can cope with the maintenance of law and order, the main PSF can withdraw but MSU units may need to remain until the end of this phase. Emergency relief agencies may need to continue their activities to reduce human suffering.

**d. Phase 4.** At the stage when human suffering has reached a level where immediate emergency relief is no longer required, longer term aid and development agencies will continue their work to develop the capabilities of the Host Nation to cope on its own. The final end-state of the PSO is a self-sustaining peace that requires no special international effort over and above normal developmental aid and assistance.

## **2.3 Deployment and Mission Execution**

### **➤ Deployment.**

The PSF should move to the operational area as soon as possible after the decision to commit forces and once reconnaissance, site surveys and approval of the OPLAN are complete. OPLANS and deployment plans must be kept up to date to reflect any changes to the political or military situation in the Joint Operation Area (JOA). Prompt and efficient deployment helps to establish the immediate credibility of the force. Engagement by the international community in a crisis area will be multi-directional and take place in many different dimensions. The PSF may be only one element in that wider engagement, with the engagement of the Alliance also multi-directional and in several dimensions. For example sanctions or grants may set the economic and fiscal conditions in the JOA, just as the public information plan and any Information Operations activities will influence perceptions and the psychological conditions in the JOA. The physical deployment of the PSF should therefore be part of a co-ordinated engagement strategy. The appropriate timing of deployment will depend upon a number of factors including:

- a. Consequences and requirements of any on-going political or diplomatic initiatives.
- b. Force readiness and training states of the various force elements.
- c. National deployment plans and competition for Ports of Disembarkation (POD) and other reception facilities.
- d. National and JFC's Transfer of Authority (TOA) criteria.
- e. Funding and legal issues affecting international organizations and national governments.
- f. On-the-ground situation assessment of security conditions and requirements.
- g. Over-arching these military considerations will be the pressing political imperative for action; this must be tempered by the JFC's assessment of the degree of consent and impartiality in the operational environment.

### **➤ Mission Execution.**

Once an OPLAN has been developed and the deployment has occurred, the remainder of the

PSO should be executed in accordance with the phases and objectives of the OPLAN and in the wider context of the civilian mission plan and agreed multifunctional approach. It will be essential to strategic success that the military activities are continually reviewed to ensure that they are synchronised with those of the political and civil elements of the mission. The OPLAN will have defined the JFC's and Component Commanders' (CC) Intent, Main Effort and supporting objectives for each phase of the operation. Monitoring operational progress will require detailed assessments of the level of compliance of the parties and judgements of progress towards decision points. Particular attention should be paid to changes in the operational environment which could lead to changes being required in the mission directive or the structure and capabilities of the PSF. Appropriate contingency planning should be conducted by the development of branches and sequels in the OPLAN.

The dialogue between the JFC, the SC, NAC and any other authorising political body is crucial to ensure that the PSF is properly prepared, balanced and provided with suitable ROE for the operation. Flexibility of approach and adaptability of forces are keys, as will be the dissemination of any changes to the JFC's intent to every member of the PSF. The compression and overlap between the strategic, operational and tactical levels in PSO is such that a tactical military action can destabilise the political process of which the military is but one element.

## **2.4 Withdrawal, Transition and Redeployment Operations**

### **➤ Withdrawal.**

The decision to withdraw NATO support for a PSO will be based upon a political assessment that the benefits of achieving strategic success no longer justify the required expenditure of resources.<sup>6</sup> Any decision to withdraw will include consideration of its consequences on the actions and objectives of civilian implementing partners.

It is possible that one or more of the factions, as well as the local population, could resist, or even attempt to prevent, the withdrawal of NATO forces. The possibility of civilian unrest and opposition to a withdrawal of NATO forces should be addressed in contingency plans. A withdrawal could be conducted in an environment of widespread human rights abuses, ethnic cleansing and large numbers of displaced persons. Such circumstances would have potentially catastrophic moral, ethical and political consequences and would therefore merit very serious consideration before any decision to withdraw.

As with any operation, a withdrawal will require detailed planning. It should be based upon a contingency plan written early and updated throughout the operation. It must address both a permissive and non-permissive environment. The plan must state clearly the conditions for TOA of formations back to national command.

The plan must also take into account the requirement to protect or even evacuate the civilian elements of the mission, in a deteriorating situation. This will require liaison and a high degree of co-ordination and co-operation. The latter may not be easy to achieve as many of these organisations will be highly committed to their work and will generally have made their own evacuation plans.

A withdrawal plan must also state the policy for the disposal of the civil and military infrastructure and equipment owned by NATO or the TCNs in the JOA. It must make clear what is to be handed over to other organisations, what is to be extracted as part of the withdrawal and what is to be destroyed before the operation is complete.

### **➤ Transition Operations.**

Transition operations not only refer to the transfer of command, missions and tasks from one element of the PSF to another but also transfers of responsibilities to non-NATO forces or civilian organisation or agency<sup>7</sup>. Whenever possible, such operations should be identified and planned in advance. They will be executed generally upon the attainment of a

particular objective or decision point in the OPLAN. A transition operation may also be required to reflect a change in the political situation, political guidance or operational environment.

Transition operations may indicate an escalation or de-escalation of activity as well as a change in political emphasis or military main effort. They can include a changeover of HQs, a relief in place of one NATO force element to another or the transfer of responsibilities to a non-NATO, possibly UN or civil police force.

➤ **Redeployment.**

Redeployment of the main military force should signal the achievement of the primary military end-state. The planning and execution of any redeployment operation is just as important as that required for deployment.

The acknowledgement of success expedites the pace of the operation and can create pressure to TOA forces back to national command too early. If not properly controlled and coordinated, this can result in unwarranted competition for routes, infrastructure, and PODs. For these reasons, the JFC requirement for unity of effort at all levels of his PSF is as important as ever. Casualties incurred at this stage of an operation are particularly unjustifiable.

It should not be assumed during planning that all forces would redeploy to their home countries or original deployment bases. There may be a need to base them elsewhere in the region to condition stability or to release them for other missions. Whatever their destination there will be stringent administrative, logistic and environmental criteria to be met before personnel and equipment leave the JOA. This places significant demands on real estate management in the form of staging and marshalling areas. The coordination function of the Multinational Joint Logistic Centre (MJLC) staff together with J3 and J4 staff at CJTF HQ will be especially crucial for the smooth execution of this function.

Depending on the mission, it may be necessary that the PSF leaves established structures that will facilitate the future operations of the humanitarian agencies or the host government.

Planning for this should be just as thorough as for preceding phases. Preliminary redeployment planning should be part of the overall planning for the operation. A smooth, well-planned, well-orchestrated redeployment will ensure that the PSF leaves a lasting favourable impression and more importantly, ensures that the civilian elements of the mission can work successfully towards the achievement of a lasting and self-sustaining peace.

Redeployment requires that the PSF HQ coordinates not only the routes, infrastructure and PODs but also the management of environmental issues, for example for the hand back of bases and training areas to the Host Nation. Environmental issues will require a policy and possibly specific NATO funding.

### **3. Different types of Crisis Management Operations**

The way of dealing with a crisis depends on its nature, scale and seriousness. In some cases, crises can be prevented through diplomacy or other measures while others require more robust measures such as military action. Depending on the nature of the crisis, different types of crisis management operations may be required.

#### **3.1 Collective defence crisis**

Since its creation in 1949, NATO has always been prepared for Article 5 crises. Although mutual guarantees under Article 5 of the Treaty are reciprocal and implicate all member countries, the primary purpose of Article 5 in the post World War II environment was to enable the United States to come to the aid of its Allies in the event of aggression against them.

Up to 1991, the strategic environment in the North Atlantic region was dominated by two superpowers that were each supported by military structures. During this period, NATO's principal concern was the perceived threat from the Soviet Union and the Warsaw Pact. Deterrence worked with the result that the East-West confrontation of the Cold War

ended without NATO's Article 5 having to be invoked.

Referred to as "Article 5 operations", these carry the implication that the decision has been taken collectively by NATO members to consider an attack or act of aggression against one or more members as an attack against all. However, it does not guarantee assistance. It states, in part, that "an armed attack against one or more [allies] shall be considered an attack against them all." Additional language makes clear that the commitment to assist an ally is not unconditional. Each signatory will assist the ally under attack with "such action as it deems necessary, including the use of armed force ....."<sup>7</sup> Article V raises the possibility of a range of responses to counter a threat: An ally may take "such action as it deems necessary, including the use of armed force, to restore and maintain the security of the North Atlantic area." By presumption, such action could be an economic embargo or other steps, short of force, to compel a state threatening an ally to adopt a more benign policy.

NATO invoked Article 5 in September 2001 following the terrorist attacks against the United States.

Despite some opinions which stated that NATO has to become a collective security organization, after the Cold War Era, NATO remains an organization designed for collective defence and leaders of NATO states point out that the Organization for Security and Cooperation in Europe (OSCE) serves the

purpose of collective security through such actions as monitoring human rights, arbitrating conflicts, and overseeing elections in selective member states. NATO, in contrast, insists that candidates for membership resolve ethnic and border conflicts before entering the alliance. An exception to this rule has been NATO's effort to manage tensions between Greece and Turkey, both Alliance members.

### **3.2 Crisis Response Operations**

Crisis response operations cover all military operations conducted by NATO in a non-Article 5 situation. They support the peace process in a conflict area and are also called peace support operations. Peace support operations include peacekeeping and peace enforcement, as well as conflict prevention, peacemaking, peace building and humanitarian operations. NATO's involvement in the Balkans and Afghanistan are an illustration of this.

#### **➤ Peace support operations.**

Peace Support Operations (PSO) are multifunctional operations in which impartial military activities are designed to create a secure environment and to facilitate the efforts of the civilian elements of the mission to create a self sustaining peace. PSO may include Peacekeeping (PK) and Peace Enforcement (PE) as well as conflict prevention, peacemaking, peace building and humanitarian operations. Outside of military circles, the term 'Peacekeeping' is often used erroneously to embrace all PSO, including PE.

All military operations are conducted with a degree of restraint, be that only an adherence to the Law of Armed Conflict or Geneva Conventions. What makes PSO distinct is their impartial nature. PSO are neither in support of, nor against a particular party, but are conducted in an impartial manner. PSO are designed to enforce compliance with the operation's mandate and to create a secure environment in which civilian agencies can rebuild the infrastructure necessary to create a self-sustaining peace. Peace Support Force (PSF) actions are based upon judgements of the degree of compliance and/or non-

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<sup>7</sup> **Article V states, in full:** "The Parties agree that an armed attack against one or more of them in Europe or North America shall be considered an attack against them all and consequently they agree that, if such an armed attack occurs, each of them, in exercise of the right of individual or collective self-defense recognized by Article 51 of the Charter of the United Nations, will assist the Party or Parties so attacked by taking forthwith, individually and in concert with the other Parties, such action as it deems necessary, including the use of armed force, to restore and maintain the security of the North Atlantic area. Any such armed attack and all measures taken as a result thereof shall immediately be reported to the (U.N.) Security Council. Such measures shall be terminated when the Security Council has taken the measures necessary to restore and maintain international peace and security."

compliance of the parties with the operation's mandate.

➤ **Peacekeeping.**

Traditionally, peacekeeping has been defined as a process where a group of lightly armed military personnel stood between two parties in a conflict who had agreed to a ceasefire, to keep the peace. Peacekeeping operations are generally undertaken under Chapter VI of the UN Charter and are conducted with the consent of all Parties to a conflict to monitor and facilitate implementation of a peace agreement.

➤ **Peace enforcement.**

The peace enforcement is mandated to restore and maintain a cease-fire in situations where such a cease-fire has been agreed to but not complied with. Put differently, their task would be to enforce a ceasefire by taking coercive action against either party, or both, if they violate it. As such, these units would have to be more heavily armed than peace-keeping forces. Clearly, peace enforcement, as the name would suggest, involves the use of force beyond self-defence. Peace enforcement operations are undertaken under Chapter VII of the UN Charter. They are coercive in nature and are conducted when the consent of all Parties to a conflict has not been achieved or might be uncertain. They are designed to maintain or re-establish peace or enforce the terms specified in the mandate.

➤ **Conflict prevention.**

Activities aimed at conflict prevention are normally conducted under Chapter VI of the UN Charter. They range from diplomatic initiatives to preventive deployments of forces intended to prevent disputes from escalating to armed conflicts or from spreading. Conflict prevention can also include fact-finding missions, consultations, warnings, inspections and monitoring. NATO makes full use of partnership, co-operation and dialogue and its links to other organisations to contribute to preventing crises and, should they arise, defusing them at an early stage.

Conflict Prevention includes:

- Monitoring and/or intervening to stabilize a potentially violent conflict before its outbreak by initiating activities that address

the root causes as well as the triggers of a dispute.

- Establishing mechanisms that detect early warning signs and record specific indicators that may help to predict impending violence.
- Using planned coordination to prevent the creation of conflict when delivering humanitarian aid and in the process of development.
- Institutionalizing the idea of preventing conflict at the local, regional, and international levels

➤ **Preventive deployment.**

A preventive deployment within the framework of conflict prevention is the deployment of operational forces possessing sufficient deterrent capabilities to prevent an outbreak of hostilities.

Preventive deployment is a deterrent, and a preventive deployment of peace-keepers is normally not designed to take on an attack. This deterrence function is reinforced when a stronger force is kept in reserve to react to any violation of whatever ground rules have been set. Preventive deployment provides conflicting parties with a solution that can be mutually acceptable and in some cases face-saving.

Troops in preventive deployment handle the following tasks.

- Monitor and report on activities that undermine stability and good will such as infiltration, provocative behaviour and arm smuggling.
- Monitor and assist in establishing law and order
- Monitor and in some cases intervene to prevent abuses against civilian populations
- Assist in delivering humanitarian assistance and social services such as water and road maintenance.

➤ **Peacemaking.**

Peacemaking covers diplomatic activities conducted after the commencement of a conflict aimed at establishing a cease-fire or a rapid peaceful settlement. They can include the provision of good offices, mediation, conciliation and such actions as diplomatic pressure, isolation or sanction.

➤ **Peace building.**

Peace building covers actions which support political, economic, social and military measures and structures aiming to strengthen and solidify political settlements in order to redress the causes of a conflict. This includes mechanisms to identify and support structures which can play a role in consolidating peace, advance a sense of confidence and well-being and supporting economic reconstruction.

➤ **Humanitarian operations.**

Humanitarian operations are conducted to alleviate human suffering. Humanitarian operations may precede or accompany humanitarian activities provided by specialised civilian organisations.

➤ **Natural, technological or humanitarian disaster operations.**

Operations to assist member and partner countries that are victims of disasters. For instance, NATO assisted Turkey in 1999 when it was hit by earthquakes and has helped Ukraine, which has been frequently devastated by floods.

NATO decides on a case-by-case basis and by consensus whether to engage in a crisis management operation and takes these decisions in conformity with Article 7 of the Washington Treaty. Increasingly, it contributes to efforts by the wider international community to preserve or restore peace, and prevent conflict. In this context, NATO has offered to support on a case-by-case basis in accordance with its own procedures, peacekeeping and other operations under the authority of the United Nations (UN) Security Council or the responsibility of the Organization for Security and Co-operation in Europe (OSCE). The record of NATO's successful co-operation with the UN, the OSCE and the European Union (EU) in the Balkans stands as a precedent.

NATO's growing strategic partnership with the EU, including through NATO support to EU-led operations using NATO assets and capabilities, is also significant, as is the Alliance's expanding co-operation with non-NATO countries which are members of the Euro-Atlantic Partnership Council (EAPC) and of NATO's Mediterranean Dialogue.

**4. NATO's ability to improve its participation in PSO - points of view<sup>8</sup>**

- Presuming that NATO is willing to play a major role in crisis management operations, the most important function will be to provide physical security and to create a stable environment. Amongst all the institutions and organisations likely to be involved in a particular PSO, NATO will have to be committed from the beginning, taking into consideration that the international contribution to conflict solution will start with the deployment of military forces. Consequently, it is the military forces that are usually obliged to assume the overall responsibility for controlling the operation during the early stages. The transfer of control and responsibilities to the civilian authorities can be a slow process. As long as the military forces are the only available reactive force, they have to undertake a number of traditionally civilian tasks during the conflict resolution phase. If NATO is to gain optimum success in the peacekeeping (or even peace enforcement) role, it cannot avoid establishing the minimum necessary capability to cover the transitional phase.
- To ensure that NATO's military forces are able to meet all the challenges which could occur during its future PSO missions would be worth to bring a new dimension to its current capabilities. In the case of PSO with a peacekeeping or peace enforcement component, the essential task of ensuring internal security and stability by enforcing law and order and, at the same time, helping to implement a reliable administration is enough beyond the military capabilities and requirements of the more traditional missions for which NATO forces are currently trained and equipped. Consequently, the settlement of a special

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<sup>8</sup> The views expressed are personal and do not necessarily reflect those of NATO or any other organization or body

designed or a reserve force to be used in the peacekeeping or peace enforcement role, being able to complement the existing military forces, might be a suitable solution to solving the problem. This kind of solution could be set up in a close manner as NATO Response Force (NRF) has been tailored.

Following my experience at NATO HQ and knowing the process of doing businesses in organisation, I have some doubts that such initiative is to be well received, especially from the political part of the house. There is much sensitivity among some member states which do not envision the NATO increasing role in these kinds of missions, especially because of the costs.

- The interaction between NATO and the civil environment is essential to the success of any PSO. The large spectrum of tasks necessary to be solved during a PSO and the number of the international institutions involved, make CIMIC an essential tool for NATO. In this respect, the efforts should be directed towards the planning process which should include both NATO's planning authorities and international organizations. A working relationship between both the civil and military personnel included in the conflict management should be developed as early as possible.

NATO cooperation in the field of logistics should focus both on providing assistance to those civilian agencies for which humanitarian activities are the principal function, and by helping to coordinate activities in support of economic rehabilitation and reconstruction.

- A very necessary post-conflict step should be the task of gaining the trust and cooperation of the all former conflicting parties. A variety of initiatives, primarily diplomatic in nature, should be taken as soon as possible. Strengthening and rebuilding civil infrastructure in order to avoid a return to conflict, implementing the measures in support of economic reconstruction and other mechanisms that help the confidence building and promote the well-being of the local population are

essential. For NATO forces, such initiatives might include involvement in medical support operations and restoration of civilian infrastructure. However, the aim should not be to replace a civilian capability that is able to offer the same services. As a rule, NATO should avoid additional tasks outside of its mandate because of the additional resources, manpower and money that are required to sustain such operations.

### **Conclusions**

Since the end of the Cold War, NATO has increased its focus on crisis management and has improved its crisis management organization, procedures and tools. It has also demonstrated, in Bosnia-Herzegovina, in Kosovo, in FYROM or in Afghanistan (with force generation, communications, logistics and movements) political will to use these tools and their efficacy.

I wish to stress that the necessary military capabilities are essential for NATO to be a credible and effective actor in the future in these areas. The Prague Summit decisions reflect this emphasis clearly in their multifaceted approach to enhancing NATO's military capabilities. The NATO Response Force, the Prague Capabilities Commitment and the new command arrangements are all intended to address the capability shortfalls that allies have identified, increase the speed of the process of transformation of allied forces and ensure that the command structure is capable of responding to the challenges of rapid deployment for high-intensity operations wherever and whenever required.

A related essential ingredient for successful NATO crisis management is political will. Even the greatly improved instruments and procedures that NATO has developed will be of little help if allies cannot agree in a timely manner, or at all, to use them. As reflected in the much more rapid engagement in Macedonia than had been the case in Kosovo, allies appears to have learned that early engagement is more likely to be effective. These were sensitive and complex issues, but allies were able to agree and to

persevere even in the case of significant pressure.

Concerning NATO-EU relations, despite significant progress in successfully preventing conflict in Southern Serbia and Macedonia and agreeing the complex procedures for consultations in peacetime and crisis and to provide NATO support for EU-led operations, suspicions and political impediments continue to complicate relations. The tensions that arose in the fall of 2003 regarding the establishment of an independent EU operational planning cell and a change in UK views on inclusion of defence in what is known as “structured cooperation”, were reflected in US Ambassador Nicholas Burns calling for a special meeting of the North Atlantic Council to address these matters and his statement that EU plans represented “one of the greatest dangers to the transatlantic relationship.”<sup>9</sup> The degree to which these differences impede cooperation in crisis management and conflict prevention remains to be seen.

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## AN EXAMPLE OF EXPERT SYSTEM USED IN ECONOMICAL FIELD

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**Abstract:** Expert systems are designed to deal with problems in a particular field, which includes experts' knowledge domain. These systems are planned and shaped in order to facilitate tasks in the fields of economy, industry, process control, medicine, human resources, banking system etc. Indeed, the core work of a successful expert system is influenced by a series of technical measures and improvement that may be designed by related experts. In this paper we present an example of expert system with application to economical and human resources field using an expert system shell called VP Expert. A study on a transportation company has been used in order to build the application which will be used to offer bonus payments for employees' activity.

**Key words:** artificial intelligence, expert system, knowledge, task, expert system shell

### 1. EXPERT SYSTEM

Chronologically the expert systems were the first applications developed by artificial intelligence.

In the early 1990s, the expert systems knew an explosion in terms of development, starting to be used in increasingly variety of areas [5].

The most expert system is built with products called expert system shells. Those are software products that include a user interface, a method for declarative knowledge in the knowledge database and an inference mechanism [2]. One of the most complex and easy to use expert shells is VP Expert.

Expert systems are applications that propose a non-algorithmic way of solving different types of problems. They are designed to deal with problems in a particular field, which includes experts' knowledge domain [1].

Expert system is a type of application that takes decisions or solves problems in a given field such as finance, using the knowledge and analytical rules defined by experts in that field.

He manages to treat successfully problems for which algorithmic solutions are not clear or for which the algorithm is inefficient because of its high complexity.

From the functional point of view, an expert system is build for obtaining results for the tasks that are difficult to solve for the human experts [5].

The basic components of an expert system are: the knowledge database, the inference mechanism, the acquisition of knowledge module and the user interface [2].

Knowledge database contains all the knowledge from the application field of expert system and is organized often in IF THEN rules. The knowledge database is composed by the facts database and the rule database as input data, the data obtained during the inference process and the target data [4].

The inference mechanism is the most important section of the expert system. Based on knowledge from the knowledge database, it concatenates an inference mechanism performing a reasoning which leads to solving the proposed problem.

An important aspect that we need to know about the inference engine is the type of reasoning used. From this point of view there are two alternatives when we use the expert system shell represented by VP Expert: goal driven reasoning and data driven reasoning [4].

The acquisition of knowledge module takes knowledge from human experts in the ground of expert system. The set of rules that is provided by the human experts has an increased importance because synthesizes knowledge gathered in years of experience in the studied area.

User interface aims to facilitate dialogue between user and system.

The multiple benefits that using of expert systems offers make them one of the most investigated methods of Artificial Intelligence.

The principal benefits mentioned in the specific Artificial Intelligence literature are: reducing dependency upon one expert, reducing the errors, improving the flexibility, making possible the knowledge sharing [2].

The principal benefit of an expert system is the partition that takes place between collected knowledge and problem solving strategy. Because of this separation maintenance cost of the system can be reduced at minimum [4].

The expert systems are designed and shaped in order to ease tasks in the fields of economy, industry, geology, medicine, human resources, banking system etc [5]

Nevertheless they have known a special development in the financial accounting field: tax planning, calculating wages, credit analysis, risk analysis, etc.

Big accounting companies developed their own expert systems performed in the internal control and auditing: ExpertTAX, Risk Advisor (Coopers & Lybrand), Loan Probe, Peat/1040 (KPMG), VÁTI, Flow Eval (Ernst & Young), Planet, Compass, Comet (Price Waterhouse), Rice (Arthur Andersen), Audit Planning Advisor, World Tax Planner (Deloitte Touche)[5].

## 2. EXPERT SYSTEM DESCRIPTION

Our expert system can be used by any company in economical field to establish the bonus that must be paid to have merchandise moved from one place to another. This bonus is rated as a percentage of the goods' value that had to be transported.

To begin with, depending on how the stuff is shipping (on the sea, on the river or there is a mixed carriage) the bonus value is different.

Then, when is calculated the bonus amount other important elements are the period of time and the region where the merchandise is moved to.

On one hand, the period of time is referring to the spring - summer time (April 1<sup>st</sup>– September 30) or to the autumn - winter time (October 1<sup>st</sup> – March 31<sup>st</sup>) of the year when the stuff is shipped.

On the other hand, the distance between the delivery place and the region where the merchandise is sent is an important factor that influences the value of the bonus.

In table 1 are presented the values for marine shipping depending on the period of time and the world zone where the merchandise is transported.

Table 1 Marine shipping bonus

	April 1 <sup>st</sup> –Sept 30	Oct 1 <sup>st</sup> – March 31 <sup>st</sup>
A Zone	15%	16%
B Zone	19%	20%
C Zone	21%	22%
D Zone	20%	30%

The table can be read, for example:

If shipping = marine and period\_time = April\_1<sup>st</sup>\_Sept\_30 and zone = Zone\_A then transport\_bonus = 0.15 / 100 \* merchandise\_value.

This is an example of the rules needed in VP Expert to implement the first part of the expert system knowledge database.

Table 2 Riverine or mixed shipping bonus

	April 1 <sup>st</sup> –Sept 30	Oct 1 <sup>st</sup> – March 31 <sup>st</sup>
Route A	12%	15%
Route B	15%	18%
Route C	17%	20%

If the goods are transported on a river or there it is mixed shipping, meaning the merchandise is rapt fluvial and marine the bonus is different. Like marine shipping, it depends on the period of time. These values are presented in table 2.

One of the rules extracted from the table is:

If shipping = riverine or shipping = mixed and period\_time = April\_1<sup>st</sup>\_Sept\_30 and route = Route\_A then transport\_bonus = 0.12 / 100 \* merchandise\_value.

Apart from this, there are several factors that are considered when it is calculated the bonus.

One of them is the robbery risk of the merchandise. This risk can be covered totally or just partial, it can be coated only if the goods are not delivered or it is not covered at all. One of the rules for the robbery risk bonus is:

If robbery\_risk = not\_covered then robbery\_risk\_bonus = 0.015 / 100 \* merchandise\_value.

Another element is the type of the merchandise insurance: it covers all the damage risks or it is with or without responsibility for some damages.

For example, the insurance\_bonus = 0.1 / 100 \* merchandise\_value if insurance = all\_risks.

It is important to mention that the variable insurance is declared *plural*, because it is wanted this variable to store more than one value while the interrogation of the knowledge based system.

The insurance bonus will be lower than main bonus.

If there it is signed insurance for the breaking, crunch or leakage of the merchandise there will be ask the user the percentage of the extra bonus.

In the same way, the user will be asked for the rate of the stored bonus if there it is insurance for the stuff storage.

Furthermore, the franchise influences the value of the bonus. The franchise is the amount of the damages values that is covered by the owner. If there it is a withdrawal of the franchise there will be an additional bonus of 2 percent.

There are at least two aspects that need to be mentioned when it is calculated the shipping bonus: the transshipment of the merchandise and the additional transports before or after the main shipping.

The number of reloading is given by the user and the transshipment\_bonus is 1 percent for each one.

If transshipment = yes and number <> 0 then trans\_bonus= number \* (0.1 / 100 \* merchandise\_value).

The additional transport refers to the fact that the merchandise must be shipped before or after the main transport by train, on a river or on the sea.

For each additional shipping there will be a supplementary bonus added:

Table 3. Additional shipping bonus

Additional transport	Percent
Train	1.5%
River	0.5%
Sea	0.3%

The user will be asked if there is any additional shipping by the train. While the answer is affirmative it is registered the number, then the value of the additional train transport bonus is determined and added to the bonus.

In the knowledge database there are three rules that calculate the bonus provided by the each type of extra transport.

One of it is:

```
rule 22
IF val_mer<>? AND tr_sup_by_train <>?
THEN
    n1=0
    val1=0
whileknown tr_sup_by_train
    n1 = (n1+1)
    reset tr_sup_by_train
    find tr_sup_by_train
end
val1 = (n1*0.015/100*val_mer)
prima_tr_sup = (prima_tr_sup+val1)
reset y
find y
x=aici
else x=aici;
```

This entire extra considered bonus will be added to the main value of the bonus.

### 3. RUNNING THE APPLICATION

To set up the bonus value that has to be paid for a certain amount of merchandise we can run the expert system.

For example, if we want to move 20000 Ron merchandise, using marine shipping into zone\_B on the 1<sup>st</sup> of July the main bonus will be 38 Ron.

Furthermore, the expert system will ask us information needed to calculate the rest of the bonus.

Table 4 Input data

Variable	Input value
merchandise_value	20000 Ron
shipping	marine
zone	Zone_B
period_time	April_1 <sup>st</sup> _Sept_30
robbery_risk	not_covered
insurance	all_risks
withdrawal_franchise	yes
transshipment	Yes
number	3
add_transport_train	3
add_transport_river	1
add_transport_sea	1
breaking_rate	0.2%
store_rate	0.1%

If the input values are the one from table 4 for all the variables required the final value of the bonus is:

Main\_bonus = 38 Ron plus:

- insurance\_bonus = 14 Ron,
- withdrawal\_franchise\_bonus = 4 Ron,
- transshipment\_bonus = 60 Ron,
- additional\_transport\_bonus = 25 Ron,
- breaking\_bonus = 40 Ron,
- store\_bonus = 20 Ron.

And it is lower with the value of

- robbery\_risk\_bonus = 3 Ron.

Therefore, the value that is paid to transport 20000 Ron merchandise is 198 Ron.

#### 4. CONCLUSION

Artificial intelligence meets an impressive development due to the specific methods that provide application in various fields. Research in the field expert systems led to the development of powerful software products

used today by large companies in different areas.

The example presented in this paper represents an example of expert system with application to economical and human resources field using a VP Expert. The application accomplishes a study on the way of estimation of bonuses in a transportation company.

The bonuses are calculated taking account on the merchandise value, on the way that this merchandise is transported, on the arrival zone, on the period of time needed for transporting the stuff, on the risk of robbery. According to these factors, it will result an estimated bonus received by the transporting firm.

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# MANAGEMENT CONFLICTS WITHIN THE INSTITUTIONS OF PUBLIC ADMINISTRATION

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**Abstract:** *Within institutions there take place numerous and complex activities mainly aiming at achieving objectives in conditions of feasibility.*

*In this process, there are formed relations between employees and working groups who consist of individuals with different personalities, mentalities, educations, value systems and behaviours. In such circumstances, to maintain a perfect harmony is difficult. There appear many difficulties which can transform into conflicts, with numerous and complicated consequences. In this respect, there appears the need that the public servant to understand in his job the place and role of conflicts in the management of public administration, their nature and form of manifestation, the causes generating conflicts, the consequences and the effective means to combat them.*

**Key words:** *management, conflicts, institutions, public, administration*

## 1. INTRODUCTION

In time, the conflict in general and the conflictual states in particular, and especially their role were treated differently. This is why it is necessary, when approaching such phenomenon of psychological and social nature, very well-spread when working as a public servant, to insist on the effective means of characteristic avoiding conflicts to the respective field.

In the beginning we will refer to the necessity to approach conflict in the public administration institutions in a constructive manner.

## 2. OUR POINT OF VIEW REGARDING THE DEFINITION OF THE MANAGERIAL CONFLICT

The conflict represents an incident provoked by the existing divergences between the attitudes, means and methods of action regarding a situation or a phenomenon which represent the object of the analysis.

The conflict, from a psychological and social point of view, appears as a form of the human interaction through which two or various members partially or totally disagree in one or various economical or social matters of the public administration management, by

attempting its re-evaluation usually through the concession of one of the party towards the other.

The presence and the action of the interpersonal conflictual rapports in the public servant's job proves the necessity of their acknowledgement for the continuous improvement of the institution's management.

The conflictual state is accompanied by an atmosphere of tension and competitions. There are certain *causes* in all the specific conflicts of the public servant. The most significant causes are the followings:

- The distribution of the resources which, irrespective of the institution's dimensions, are limited. We are referring mainly to the fact the public servant is obliged to distribute the material, the human and financial resources among different subunits and departments and to mobilize the factors which can train them for the achievement of the purposes of the institution. With respect to its meaning and difficulty in the managerial reality, this process constantly generates different types of conflicts;
- The interdependence of the tasks, acknowledged as a possibility of a conflictual state appearance, is present in all the situations in which the personnel depends on the

accomplishment of the task by another persons. The consequences of this cause – factor of conflictual states becomes complicated when connected to the systematic characteristic from a horizontal and functional point of view of the institution. As the entire organizational constitutive parts represent the constitutive parts of that specific system, in the case of an inappropriate activity of one of the subunits the independence to which we refer can be constituted as a conflictual state generating factor;

- The different content of the means can represent a cause of the conflicts, during the development of the institution's specialization and divides in subunits which carry different means and objectives. In practice, referring to the quality of the means, the subunits can grant more attention to the accomplishment of their own objectives then to those of the institution;
- The different appreciations regarding certain situations or states of the managerial process or of an action conceived by the public servant, usually subjective, generated by an analysis of the superficial situation discussed, can lead to the over-appreciation of certain alternative points of view and aspects which can be favourable for the micro-group, but unfavourable for the institution;
- The differences in the behaviour and in the treatment of the experience can increase the possibilities of the conflicts' appearance, especially when the manifestations of aggressiveness and malice interfere in the relationship system;
- The communication insufficiency, especially the defective transmission of the information, can be considered both the cause and the consequence of the conflictual states;
- The differences encountered in the professional training, the capacity of

effort, the stress endurance, present in every institution or micro-group lead in reality to the transmission of various and harder tasks to the competent and dedicated persons. As a consequence, there appears a feeling of injustice and revolt which, in the majority of the cases, generates conflicts;

- The differences from the point of view of the character and of the work style influence the compatibility of the employee with his job and his group, due to the fact that the work collectives are formed of shy people, for example melancholic and phlegmatic persons and dynamic, opened and cordial persons, a phenomena which gives birth to states of irritation and conflict during the work period.
- The difficult behaviors of certain public servants generate "problem cases", leading to antisocial manifestations which generate conflictual states;
- The ambiguous definition of the individual and derived objectives, the ambiguity in the decisions' transmissions, the existence of certain parallelisms between departments and jobs, the imprecision in the establishment of the tasks, authorities or responsibilities of certain jobs or of the activities and attributions can generate conflictual states which accompany the battle for power which appear in the abnormalities of which we are referring;
- The discontent regarding the social status which grants greater and more honourable chances to certain groups;
- The environment differences which impose certain clothing, work hours, special work conditions, attract privations or privileges capable of leading in the end to conflicts;
- The incomplete description of the job or of the position;
- The unbalanced load of tasks;

- The lack of concordance between the official authority and requested responsibility;
- The discordance between the material and moral rewards and the level of the work results;
- The lack of cohesion inside the informal group;
- The motivation differences between the members of the informal collective.

In general and especially inside the institutions, the conflicts do not appear suddenly. They develop in time, in accordance with the accumulation of tension states. After the finalization of the study regarding the dynamics of the group conflicts, **R.R. Blake, H.A. Shepard** and **J.S. Mouton** (1964) underline the following stages of the cumulative tension process that lead to the activation of the conflict:

- The tensional state, characterized by the existence of all the conditions that lead to the activation of the conflict, but they are not yet observed;
- The recognition of the conflictual state, in which the tensional state of the conflictual participants is recognized;
- The accentuation of the conflictual state, a situation in which the tensional state is accumulated without activating the conflict, which is inevitable;
- The activation of the conflict, when the battle was activated and the participants at the conflict promote their attitude to the persons who are not involved in the conflict;
- The end of the conflict, a stage characterized through the modification of the conflicts which have activated the conflict, in order to create new conditions of cooperation or for the preparing of a new conflict.

**Maria Goian** (1995), who was preoccupied by the dynamics of the conflicts, starts from the realization of the dynamic phenomena feature of the conflict and observes its evolution from the potential state as a starting point, its manifestations and reaches the point of its solution through

treaties and negotiations. From a methodical point of view she underlines and defines the following phases (states) of the conflicts:

- The previous phase, in which the latent or potential conflict represents the period and the conditions which precede the conflict and which can lead to the appearance or prevention of the conflict. The conflict appears in this phase only as a possibility, it is in the subconscious and it manifests itself through a loaded atmosphere, having different consequences:

- If the partners realize that there are submitted to certain threats, the conflict can occur;

- If one of the partners does not observe or take into consideration the tensions, special consequences can be avoided;

- The observance phase of the conflict in which, according to the feelings of the partners, we can assist at a potential misunderstanding or manifestation which attracts a feeling of frustration, states of rage or fear;

- The feeling phase, with different reactions and possibilities of solving of the conflict through a deal, aggression in the solving of the conflictual problem by the superiors;

- The commencement, meaning the actual activation of the conflict and which is manifested when the partners actively defend their interests through fight or negotiation;

- The solving of the conflict through the agreement of the partners, the rough reactions' detour.

As regard the *consequences of the conflicts*, we will refer to the dysfunctional conflicts as the functional conflicts are motivating and generating favourable ideas regarding the actualization and the change. This way, the consequences of the individual dysfunctional conflicts consists of animosity, resentments, fear, aggressiveness, discontent, frustration, absenteeism, stress, low yield and often the abandonment of the working place. At the group level the consequences are even more numerous and significant. Their group has been conceived by **J. Gipson, J.**

**Ivancevici and J. H. Donnely** (1988) in the following manner:

- Modifications inside the group, which are installed as a consequence of the continuity or escalate of certain serious or chronic conflicts and which can be found in:
- The increase of the group's cohesion;
- The risk of the appearance of an authoritative leader;
- The concentration on the activity and the group's tasks;
- The amplification of the loyalty;
- The apparition of certain consequences with negative effect such as:
- Misleading perceptions;
- The polarization of the opinions, values and attitudes;
- The worsening of the communication and of the reciprocal providing of information.

Based on the numerous studies conceived, we present in the following a guide for the practice of a non-conflictual management in the public administration management.

The results of an institution mostly depend on the degree of practice of a non-conflictual management.

The managerial science from nowadays sustains, based on research and detailed experimentations, that the exercise of a non-conflictual management is recommendable and efficient in every institution.

The present guide aims at using certain guiding principles for the practice of a non-conflictual management.

Surely, some of the principles contained in the present guide are known by the public servants, but they are not applied in the day to day work that they develop. This fact does not eliminate the necessities of a systematic guide, which presents at least three advantages:

- It reunites, in a logical order, all the main aspects of the matter, on the whole ;
- It underlines the importance of the psychological – social aspects of the work with persons for the combat and prevention of the conflictual states,

showing not only their practical utility, but also the theoretical founding;

- It acknowledges a daily practice, it attract the attention of every public servant on the necessity of proceeding with greater attention and of seeking a continuous improvement of the conflictual states prevention practice.

What characterizes the effort of the public servant in the practice of a non-conflictual management is that it is influenced by certain actions that we present as follows:

- Every public servant obtains the task and consequently the right and the duty of forcing or commanding the persons who are subordinated to him, with the precise purpose of determine them, through different means (dispositions, orders, regulations, etc.) to accomplish the duties expected of them, meaning to develop their job, without conflictual states and in the conditions of an increased efficiency;
- An often neglected matter in the domain of the hierarchic relations with effects over the state of silence / conflict is that of the collaboration between the public servant, the manager and its subordinates. Through his professional position a subordinate or a substitute must second or replace a manager at every needful moment. He must identify as much as possible with the manager's optics and collaborate with him not to embarrass him, but to enforce him and to ensure him an additional efficiency, beyond his own possibilities;
- In order to prevent the conflicts, the public servant must establish precisely the purpose of the tasks, to underline them and to mention their importance to the institution, to underline correctly each person's competence and responsibility, to coordinate the drawn task with other tasks and to control the stages of realization of the drawn task.



On the other side, it is necessary for the public servant, in order to collaborate efficiently with his subordinates and this way to prevent the conflictual states, to acknowledge the following recommendations:

- To grant the collaborators sufficiently large competences in order for them not to feel obliged to demonstrate continuously their need of amplification, but not too large because, in this case, they would often have to justify the unfulfilling of certain tasks;
- To underline with skill the competences of all the subordinated managers, in order to make a simultaneous and equivoque appreciation of the qualities;
- The responsibility degree of the collaborators must be in accordance with the level of their authority, verifying that the attributed tasks are real;
- To grant the department and section managers the liberty of dividing the tasks to the people, as they know better the possibilities of each one;
- The establishment of real tasks for every subunit and the taking into consideration of the entire events on the market and on the institution, given the fact that the smallest modification can influence the accomplishment of the tasks handed over to every manager;
- Not to exaggerate in the adoption of his solutions as being optimized;
- The prevention of the conflictual state must be directly connected to the training of the public servant in the assuming of the effective responsibility regarding every subordinate and every professional activity developed under his lead. In this matter, the public servant must know exactly the processes of service performances as well as the tasks and the capacities of the collaborators asked to develop them;
- In order to avoid the conflict due to the failure of meeting the expectations, it is recommended that the public servant reduces the number of claims demanded from his collaborators, makes fewer promises, clearly expresses his expectations, reviews and actualizes his expectations and uses them as the basis of a periodical retrospective analysis, for the prevention of the conflictual state;
- The persistence over the detailed knowledge of people, which can be obtained in various manners: with the help of science, with the help of certain observations and systematical verifications, accomplished mainly during the concrete activities and, finally, through impression and intuition;
- Regarding the way to reaction of the public servant to the disagreements among other persons, he or she should not let himself or herself to be implied in such situations, in which he or she does not deserve to be implied or which can be solved by them. In some cases, the public servant is recommended to appeal to a third party for mediation or negotiation. Other measures may also have results, such as: eliminating the situation which produced the conflict, solving of misunderstandings, attracting parties in a general interest objective or real issues, highlighting that everything is a simple misunderstanding;
- Every public servant must analyse by his or her own his or her preoccupation in managing without conflicts, establishing if the organization of the effort corresponds to the aim so that in the end, to be able to combat the conflictual states and ensure the institution's development.

Management without conflicts has as a last objective the mobilizations of all the personnel in order to achieve the economic and social tasks, to take part with maximum efficiency to

the economic and social life, to the transition to the market economy.

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## ESSENTIAL ISSUES IN APPLYING AUDIT STRATEGY

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**Abstract:** *Financial audit expresses, as its main aim, an opinion on the extent to which the financial statements present a true and fair view of the entity’s economic affairs at the balance sheet date and the results for the year ended, in compliance with the laws in force and practices in the country where the entity is established.*

*To achieve this objective, the audit process requires an examination management and methodology to ensure an independent opinion, so as to equally protect all the users of the accounting information: shareholders / partners, state, employees, banks, debtors, customers, suppliers etc.*

**Key words (keywords):** *management, audit mission, financial audit, accurate picture, audit strategy, audit plan, audit report.*

### 1. INTRODUCTION

*Every audit mission involves an efficient management to bring a plus of value to the audited entity.*

An audit mission is a separate and identifiable activity which is completed when the auditor issues *a point of view, statements or opinions* recorded in a report on an entity’s accomplishment of some clear and well defined aims. While carrying out the audit, the auditor must have a reasoned opinion on the following two aspects: the validity and mechanism of the internal procedures, approved by the entity’s management, regarding its internal control, internal audit and appropriate, clear and complete image of its transactions and other events that are materialized in assets, liabilities and equity belonging to the entity at the reporting date.

### 2. ANALYSIS OF THE FINANCIAL AUDIT MODEL

Regardless of its objectives, an audit mission can be regarded as *a system* that includes the following steps, each being after a particular model:

- a. *precondition (preplanning);*
- b. *planning;*
- c. *working;*
- d. *reporting*
- e. *post reporting.*

#### 2.1.PLANNING THE AUDIT

By "*planning*" we understand building a general strategy and a detailed approach regarding the nature, duration and extent of the audit mission. The effectiveness of an audit mission depends exactly on how the planning is done.

International Standards on Auditing 300, “Planning an audit of financial statements”, refers to the auditor’s responsibility to plan an audit of the financial statements. The auditor’s objective is to plan the audit so as to be conducted in a more efficient manner.

Planning varies from one entity to another, depending on its size, complexity of the audit, the auditor’s experience and knowledge of the work undertaken by the entity.

Audit planning, materialized on the mission, includes its two first stages, namely the *preliminary stage* or *the preplanning and the planning stage*.

The preliminary or preplanning stage of the audit mission includes the following activities to be conducted by the auditor:

- understanding the audited entity;
- preliminary assessment of the internal control and accounting system;
- defining the objectives of the audit;
- initial assessment of the needed resources and the establishment of the auditing schedule.

### 2.1.1.THE PLANNING STAGE

ISA 300 “*Planning an audit of the financial situations*” establishes standards and provides instructions regarding the considerations and activities applicable to planning the financial audit. ISA 300 establishes detailed planning processes that an auditor should run.

In short, the planning activities should include:

- a. establishing a *general strategy of audit*;
- b. developing an *audit plan* to reduce audit risk to an acceptable low level;
- c. continuous *updating of the general audit strategy and the audit plan* during the audit mission;
- d. *communicating with those charged with governance and management (of the entity that is audited)*.

### A.ESTABLISHING THE AUDIT STRATEGY

Firstly, the auditor establishes a *general audit strategy*, which sets the scope, time and management of the audit, which will provide the basis for *the audit plan*. At the *general audit strategy* stage, the auditor conducts the following activities:

- identifying the characteristics of the audit mission and defining its coverage;
- evaluating the audit mission’s objectives of the reporting in order to plan the period for conducting the audit and the nature of the required communications;
- identifying the factors which, based on the auditor’s professional reasoning, are significant for effectively helping the audit team;

- taking into consideration the results of the preliminary audit mission and the knowledge accumulated in previous audits;
- establishing the nature, period and level of resources necessary to carry out the mission.

### B.ELABORATING THE AUDIT PLAN

Based on the general strategy of audit, the auditor develops an *audit plan*. Before starting the detailed planning of the audit, it is imperative that the auditor acquire extensive knowledge of entity’s activity. This is necessary because it would be impossible to achieve a solid evaluation of the level of risks without fully understanding the entity and its business environment. So the audit plan includes the strategy to be followed in carrying out the mission, based on the auditor’s understanding of the client’s activity characteristics and the audit risks arising from them.

The audit plan includes the following:

- a. the nature, extent and period of the assessment procedures of the planned risks, as provided by the International Standards on Auditing ISA 315 “*Understanding the entity and its environment and assessing the risks of material misstatements*”;
- b. the nature, period and extent of the subsequently planned procedures of the audit, at the level of allegations, according to the International Standards on Auditing 330, “*The auditor’s procedures in response to assessed risks*”;
- c. other planned audit procedures that should be made so that the mission is in accordance with the international auditing standards in question.

The *audit plan* is also the framework according to which the resources of the audit mission (hours / man) are assigned to different stages (parts) of the commitment.

For the documentation of the audit plan the entity will pursue the following procedures:

- a) knowing the audited entity’s business activities;

- b) assessment of the audit risk and its components;
- c) establishment of samples;
- d) evaluation of accounting estimates made by management;
- e) analysis of errors and fraud;
- f) calculation of the threshold of significance;
- g) assessment of the principle of going concern;
- h) conducting a preliminary analytical procedures

➤ *Knowing the entity's activity* is a continuous and cumulative process of gathering and evaluating information, which includes both an analysis of the general economic factors and the conditions specific to the economic activity that affect the audited entity and the management's competence level.

➤ *The preliminary conduct of analytical procedures* is a prerequisite for understanding the activity and identifying the areas of potential risk. The auditor is required that, while acquiring knowledge of the business entity's activity, to conduct a preliminary analysis of the balance sheet, the risk indicators, liquidity, activity, profitability and results, information which will lead to understanding the financial information.

➤ *Preliminary assessment of the principle of going concern.* The financial audit depends on the preliminary assessment of business continuity. Where business continuity is no longer safe, the auditor will examine all areas on which this would have an impact (International Standards on Auditing 570, "The going concern principle").

➤ *Calculation of the threshold of significance.* The relevance of the financial information is equally affected by the threshold of significance of that piece of information. Determining the threshold of significance is a subjective activity, and the auditor should use their professional reasoning in evaluating this, because, in practice, it is improper to define it by a mathematical formula, as long as it aims at both quantitative aspects and qualitative aspects.

➤ *Analysis of possible fraud and errors.*

➤ *Checking accounting estimates made by management.* A part of the financial statements can not be measured accurately, but only estimated. "Accounting estimation is an approximation of the value of an item in the absence of precise methods of estimation". In order to express an appropriate opinion, the auditor must develop an independent model of evaluation of the estimates and compare the obtained results with the accounting estimates made by entity's management. Where there is a difference between the auditor's assessment and the estimated amount included in the financial statements, the auditor must determine to what extent this difference requires an adjustment.

➤ *Evaluation of the audit risk and of its components.* The assessment of risk is an important step of any audit tasks. The approach of this evaluation is presented in the Minimum audit norms, F1-F3 sheets, the assessment of general inherent risk being based on a set of questionnaires, each question being asked in such a way that the YES answer represents a risk index, the ultimate goal being the determination of the sample size.

➤ *Finding the level of sampling and selection of these samples.* Based on data gathered by the auditor at this stage, the nature and scope of the work to be carried out by the auditor during the mission will be determined and organizational measures necessary for their performance in terms of maximum efficiency will be established.

### C. THE AUDIT PROGRAM

The auditor develops *audit programs* as part of the audit plan which set out the nature, duration and extent of the planned audit procedures required to implement the audit plan.

The audit program consists of a set of instructions addressed to the members of the audit team and a means to record and control the audit activity.

The program also includes the objectives for each area and a timetable for each area of the audit procedure.

## D. CONTINUOUS UPGRADING OF THE GENERAL AUDIT STRATEGY AND AUDIT PLANS

In practice, it was found that there aren't two identical audit missions. Therefore, the audit strategy and the detailed planning procedures for auditing the entity's financial statements will differ from those performed in any other audit. Finding an audit strategy and audit planning are (in general) dynamic processes and the auditors should be aware that it is possible that the audit procedures, which are part of the initial strategy or plan, may not be implemented or, conversely, may be extended as a result of the initial test results. For example, during an audit the auditor can discover that fraudulent activity was carried out by a director of the company. This may probably lead to a change in the strategy for what remained of the conducted audit.

## E. COMMUNICATING WITH THOSE CHARGED WITH GOVERNANCE AND MANAGEMENT

The auditors should bear in mind that, regardless of any regulatory directive, they should communicate with the directors in relation to the audit planning. Communication is necessary to improve *efficiency and effectiveness of the audit*. The members of the audit team who communicate with the audited entity's governance should be aware that managers should not have any influence on the audit strategy or audit plan.

An audit mission can not achieve its role if the audit team does not thoroughly understand the following elements:

- the overall objectives of the audit;
- the responsibilities the auditor has during its mission;
- the specific objectives that the auditor tries to reach.

Without understanding these issues, planning the audit and collecting the elements proved throughout the mission will have no relevance.

## 2.2. WORKING STAGE (APPLICATION OF SUBSTANTIVE PROCEDURES FOR GATHERING THE AUDIT SAMPLES)

To understand the importance of gathering the proving elements, the auditor must define the following specific objectives of the audit mission:

- understanding the auditor's objectives and responsibilities;
- segmentation of financial situations in cycles;
- requesting the management their statements on the accounts;
- knowledge of the general objectives of the audit regarding the categories of transactions and accounts;
- knowledge of the specific objectives of the audit regarding the categories of transactions and accounts.

An audit mission on financial statements involves their segmentation into smaller and, as far as possible, homogeneous parts. This segmentation allows a more efficient management of the audit mission, thus facilitating a rational allocation of tasks to audit team members. In audit practice one can meet different *methods of segmentation* of an audit tasks. An effective method, widely spread in the professional practice, consists of the *employment, in the same segment, of the types of transactions and account balances closely correlated*. This technique is known as *the method of cycles*. Thus there are the following groups of cycles:

- the sales - receipts cycle;
- the buying- payments cycle;
- the staff remuneration cycle;
- the stocks - storage cycle;
- the capital operations cycle.

According to the method of cycles, auditors perform audit missions by applying audit tests on transactions constituting the final sold of the accounts. From the practice of auditing one thing has resulted that *the most effective auditing method of the accounts is to obtain a certain combination of insurance on each transaction as well as the final sold of the account associated with those operations*. From the above, we can draw the conclusion

that the auditor should follow the following objectives:

- audit objectives related to transactions;
- audit objectives related to sold;
- audit objectives related to the management's statements.

After the auditor goes through all procedures for each account of the financial situations, the obtained information should be gathered and analyzed in order to draw an overall conclusion regarding the accurate picture presented in the financial statements. When the mission ends, the auditor issues *an audit report* which must meet a number of technical conditions.

### 2.3.THE REPORTING STAGE

The final result of the audit work is for the audit coordinator to develop or approve *an audit report* on the financial statements, based on the obtained results and conclusions in which the opinion is clearly expressed.

The auditors have the legal obligation to make a report to shareholders on the accounts examined by them and on the balance sheet and the profit and loss. The auditors' report must say whether, in their opinion, the financial statements give a true and fair view of the financial position of the entity at the time of reporting, of the entity's results of its activities and cash flows for the audited period, in accordance with the regulations.

According to the national standards, the audit report may take one of the following forms:

1. *standard financial report*, which contains an opinion without reservations.

2. *amended financial audit report*, which, depending on the seriousness of the encountered situation, may be:

a) *report without reservations*, but with a separate paragraph,

b) *report with reservations*;

c) report which contains the refusal to express an opinion (*the impossibility of expressing an opinion*);

d) report with unfavorable opinion (*contrary opinion*).

### 3.CONCLUSION

The audit report therefore represents the final stage of the audit mission, the product of the auditor's work, which presents the final conclusions following the examination of an entity's financial information of, the auditor's opinion, the financial statements being prepared or not, in all significant respects, in accordance with an applicable financial reporting framework. Although the auditors are not guarantors or institutions that offer absolute assurance of the accuracy of the accounting information contained in the financial statements, they assume an important responsibility regarding the need to inform the users if their financial situations are credible or not. All those mentioned in this article emphasize the role of the financial audit management throughout the financial conduct of the audit mission.

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## ENERGETICS STRATEGY OF ROMANIA IN THE FOLLOWING DECADE

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**Abstract:** Nowadays, the most important energy source is constituted by petroleum, natural gases and derived products which are obtained from them. These vital resources for the mankind are limited quantitative speaking and, more over, it is estimated that are going to be exhausted within several decades. Because the petroleum and the natural gases are produced in certain geographic areas, many countries are dependent of their importation from a limited number of states. Sometimes, these resources are being used not only as economic means, but also as politic. In the latest period of time it is recommended the diversity of the energy sources, including biofuels, hydrogen, eolian sources, solar etc., concomitantly developing the storage capacity of the petroleum and gases, useful in a possible crisis. According to a report of the Ministry of Economics and Exchequer, the petroleum and natural gas resources of the country are sufficient for the next 15 years.

**Key words:** energy, strategy, reserves, future.

The worldwide energy demand has the tendency of growth, particularly because of the economic growth to a record in developing countries, notably China and India .

Within three decades, the demand for primary resources of energy of the countries with economies in continuous development has increased from about 20% for the year 1970 at almost 40% in 2003.

It is estimated that the total demand of energy in the year 2030 will grow by about 50% compared with 2000. In addition, at the current level of consumption, the known oil reserves are sufficient in the next three decades, and those of natural gas are sufficient until around year 2070 .

Instead, the world coal reserves ensure a period of at least 200 years, even if the level of service would increase. To be mentioned is that, estimates made for the next decades, indicates an economic growth, which automatically cause a bigger consumption than the current one of the energy resources.

The estimates on the matter shows that nearly a quarter of its consumption of primary energy resources, at a worldwide level, will be covered in coal and, in parallel, will increase the share of energy renewable sources, in the future decade.

At European level, in 2007, the EU has drafted new energy policy in which it is argued that the energy is an essential factor of the European Union development. In parallel, are taken into account a series of problems related to the dependence increasing on imports of energy resources, the increase of energy prices and in addition, the impact the energy sector has on climate change, given the fact that it is, at EU level, one of the main producers of natural gas with a greenhouse effect .

It is to be mentioned that a third of the electricity production of the European Union is assured of nuclear power plant, which is on the other hand, one of the biggest resources of energy without emissions of CO<sub>2</sub>.

Having regard to the issues mentioned, in the New Energy Policies of the EU are



provided a series of targets for the next year, as it follows:

- The increase of weighting renewable energy from almost 7% of the total renewable energy in 2006, to 20% by 2020.
- The drop by 2020 with about 30% of the gases emission with greenhouse effect, compared with 1990.
- The growth, by 2020 of the bio-fuels share at a minimum 10% of the total fuel used.

Our country has the resources of various primary energy, but not in significant quantities. We have relatively modest, coal, crude oil, natural gas, uranium ore and renewable resources. Since 1976 when it reached a production record of nearly 15 million tones, it was found a steadily decline of the domestic production of crude oil, belonging to previous years to around 5 million tons annually.

In terms of natural gas production, that was dropped after 1990, arriving in 2006 to about 12 billion cubic meters, representing 69% of the national annually natural gas consumption. Having regard to the reserves of crude oil and natural gas fall, it is expected in parallel an increase of the weighting coal within the balance of the national energy.

From the total resources of carbine in our country, 705 million tons are of coal, and 1490 million tons are of lignite. In terms of uranium ore, it is used to manufacture, in the country, of the nuclear fuel intended to the nuclear-electric units from Cernavoda. It is a real interest for the national economy, having regard to the future development of nuclear energy program.

The renewable energy resources refers to the country's solar energy, that of wind, water, biomass and biogas, and also geothermal energy. According to the latest assessments in this field, made in 2007, the technical hydraulic potential of the country it is situated around 36000 GWh per year from which they can effectively capitalize economically speaking, about 30000 GWh per year.

If we are not considering the hydroelectric plants of high-capacity,

production costs of electricity in establishments which are using renewable sources, are at present, higher than in the use of fossil fuels.

Therefore, programs to encourage the use of renewable sources are supported by responsible authorities in this EU purpose. Another problem on renewable sources refers to the environmental impact. For example, wind units have a negative effect on migration birds, which requires that these units need to be banned in some areas.

Its economic potential to increase energy efficiency in various sectors of the national economy has been stipulated in the National Strategy on Energy Efficiency, developed in 2003. The strategic objective had under this strategy is to improve energy efficiency of the country from the natural resources, continuing with production and transport and ending with distribution and final use.

In 2006, GDP was 40% higher than in 2000, that means 3973 euro per room, being of almost 6 times lower than the average amount of EU countries and 2 times lower than the average value of the 10 countries newly entered in the EU.

Because of the lower level of the economic development, the primary energy consumption per capita in our country is about 2 times lower than the EU member countries. The review structure consumption of primary energy has found a balanced distribution between crude oil and its derivatives (~25%), natural gas (~36%) and coal (~22%).

Although the national production of primary energy remained the same (decrease production of crude oil and gas being offset by increased production of coal), having regard to the rise in consumption of primary energy, it is found an increase in the dependence of our country's imports, from about 22% in 2000 to almost 34% in 2005.

In terms of production of electricity of the country, this had an ascendant trend, being carried out in proportion of ~40% by power plants on coal, 34% by the hydroelectric plants, 17% from power plants on hydrocarbons and only 9% from the nuclear-electric plant of Cernavoda.

It is to be mentioned that from the total consumers of electricity (8 600 000 in 2005) most of it (8 040 000) it is represented by the household consumers.

Referring to the supply with heat it can be affirmed that this is done by thermal power stations (TPS) and electric heating central (EHC). Because of the drop of the industrial consumption, in recent years it is found a reduction in the overall consumption of heat.

According to an assessment carried out in 2002.55% of the dwellings in urban areas and about 30% of the total dwellings in the country are connected to collected systems of production and distribution of the thermal power.

The consumption of natural gas recorded in 2006 was of 17 200 million cubic meters from which nearly 15 % has represented the domestic consumption. From the 17 200 million cubic meters, 12 000 million cubic meters was internal production, the rest of consumption (~ 30%) being assured of import.

The production of crude oil fell steadily also from ~15 million tons annually in 1976 to only 5-6 million tons annually in previous years. In parallel it has been registered an increase in imports. Romania coal production in 2006, of about 34 million tons (31 million tons lignite and 3 million tons coal) was used in full for the production of electricity.

In the state of technical facilities of the plants, we mention the fact that nearly 80% of the thermo-energetic units in the country have been installed by the year 1980, which means that they have store duration "of life".

In addition, they were not equipped with modern facilities for a reduction of pollution, which has caused an upgrading of some thermo-electric centrals. And 37% of the hydro-energetic groups are in the same situation. Some of them have also been upgraded to meet EU norms.

Regarding the nuclear-electric central of Cernavoda, there have been introduced specific programs for managing radioactive wastes and the nuclear fuel burned, in parallel with the designed lifetime extension (for 30 years from putting into service).

Also the electricity networks of distribution are characterized by a deepening

physical fatigue, at which, for 30% of them, is added the moral fatigue having equipment from the 60s. This fact has led to the investment in the transport electricity network, making it a necessary modern infrastructure of management and operation of electricity markets.

A similar situation has been found also in the case of the centralized systems for heating, with high degree of physical and moral fatigue, with insufficient resources for repairs and maintenance, with loss dishes on the network of transmission and distribution and so on and so forth.

This led to higher production costs, to automatic increase of the energy invoices value and, not in the last line, to a lower services quality. Also, within the National System of Natural Gas Transport, about 70% of the pipeline have standardized store period of operation. Also here were made investments to upgrade or replace in 24% of the existing pipes.

Regarding the capacity of storage of the underground natural gas, this had an ancestry tendency, reaching in 2006 to be stored 3775 million m<sup>3</sup> gas within the existing 8 stores. In 1996 was initiated a program of rehabilitation for the National System of Transport of the Crude oil by Pipeline, with a transport capacity of 24 million tons per year, of which it is used about 50%.

Physical and moral fatigue of the equipment is present also in the mining of coal sector, where investments for mechanization are being made, upgrading and monitoring of exploitation. On the other hand, it has been amended the legislation aiming the energy sector, having regard to the country cross to a market economy and, in parallel, EU legislation in this field.

There were established, also a series of regulatory authorities in the electricity domain, that of mineral resources, natural gas, thermal power, the nuclear one and radioactive wastes.

After processing and combustion of fossil fuels, it results the main part of greenhouse gas effect emissions, which means that the energy sector constitutes a source of pollution which is not to be neglected.

As such, the country legislation is permanently altered to comply with environmental needs. In addition, the current technologies by burning coal must be replaced by so-called “clean technologies” with the role of polluting emissions decrease.

Within the EU, the electricity markets liberalization has been held in 1996, and that of natural gas in 1998 through the development of two Directives of the Europe Council. In our country, creating markets for electric energy and respectively gas, had the following groundless :

- the creation of the necessary institutional framework
- restructuring the energy sector, through separation of production by transport and by distribution;
- assuring unrestricted access to the transport and distribution networks;
- the preparation of the necessary secondary legislation;
- the transposition of the Community Directives provisions in this field

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## THE IMPACT OF THE CURRENT GLOBAL FINANCIAL CRISIS ON THE FINANCIAL SYSTEM

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***Abstract** Considering the entire economic cycle, the current financial crisis can be labeled as an imminent but not unusual accident, a consequence of the very low interest rates used over the last years in the United States and Europe. But, looking deeper into the crisis, one can easily grasp the structural causes that determined the crisis. Not only the globalization of the financial markets and the financial innovations in a field governed by inefficient regulations or in a field often lacking any regulation at all, but also a large number of conflicts of interests lay at the basis of the current crisis. As in the case of banks, the others, non banking financial institutions, are expected to have minimal mandatory reserves. Furthermore, the leveraging maximal admitted dimension should be standardized.*

**Key words:** *financial crisis, financial system, globalization, financial markets, recession*

### 1. The economic recession and the reasons for its outbreak

It is more and more obvious that the consumerism society generated the ‘economic crisis’ which we have recently found ourselves in. The first signs of the crisis appeared years ago, but being of a lesser impact they did not generate the convulsions and tensions we see today. The mankind was on to consume more than it produced and, subsequently, almost everybody woke up one day deeply plunged into house mortgages, consumer credits, vacation credits and credits for personal needs.

Consumerism in Romania started with general consumer goods purchased through a system of installments and passed on to a system of credits awarded by the state or by company credit organizations (CAR) which were available before the 89. From this rather empirical system, Romanians quickly moved forward in 90's discovering first the mortgage loans, than the leasing system, mainly for cars, to end up feasting on consumer credits. At first, the consumer credits were applied for and awarded for stated, well-defined purposes

only to explode in credits awarded for no stated purpose afterwards. The consumer credits started to be awarded for no well-defined purpose, turning into interest bearing loans to be reimbursed in installments over a well determined period of time. The loans are paid back with more and more difficulty, they become more expensive because, to start with, any delay in reimbursement means additional costs for the debtor who, eventually becomes insolvent. People live better today on tick, but they are oblivious of what lies in store for them.

The recession is already a reality in U.S. The diagnostic was revealed. Some of the most pertinent voices even speak of a long and severe decline.

The causes of recession in U.S. are the following:

- ✓ Relaxed monetary policy;
- ✓ Faulty investment decisions;
- ✓ ‘Investors’ euphoria’ generated by an exuberant optimism typical of long periods of economic growth;
- ✓ The dollar depreciation policy, inefficiently used lately;

Approximately three million Americans, the subprime debtors’ market, blew up the entire global financial system.

According to Mortgage Bankers Association and to the current statistics, one in five mortgage loans awarded last year in U.S. was of the subprime type against only one in 50, in 2000. According to Inside Mortgage Finance, the market of subprime credits reached an aggregate of 454.7 billion euro in 2006, representing 20% of the 2,273 billion euro of the whole mortgage market. The people mortgaged without bringing in solid guaranties that they would be able to reimburse the credit. The banks awarded cash, and after they corroborated more mortgages and sold them to the investors. The average value of this type of credit is 130,000 dollars, which the banks sold for 100,000 dollars to get cash that they also placed on the subprime market. The crediting institutions cashed in on titles, thus eliminating risky loans from their balance sheets. Investors were pleased to make more money than they paid on the same titles and clients were pleased because this way they could get the houses of their dreams. The buyers of risky mortgages were exactly the American governmental agencies with, in pole position the Federal National Mortgage Association (Fannie Mae), which acquired the necessary funds by selling debentures to Americans. The first signs that the borrowers would eventually fail to pay back the loans started in the second half of June 2007. The snow ball effect made refinancing impossible and brought about an increasing mistrust. As a consequence people sold shares on the decline, causing the stock exchange quotation to collapse. The demand for cash, along with the lack of trust among bankers, led to a cash fever the obvious outcome being the ongoing increase of the interest rates. The central banks responded by cash infusions in order to stop a crisis that threatened to penetrate other markets as well.

The credit crisis spreads across Europe, being directly influenced by the lack of cash. The current credit crisis could be compared, through its span, with the one in 2001 but having however, a smaller span than the ones in 1973, 1982 and 1991. Another aspect of the cash crisis is that the rate of delayed payments from companies intensified rapidly. As opposed to the aforementioned crises, this

time the emerging countries contributed a lot more to slowing down the spread of negative effects. Growing risks led to an important fall of country ratings. The initial channel of the crisis was, at first, the real estate market that violently hit the companies in countries with critical situations close to burst such as Great Britain and Ireland. The worsening of the financial crisis has uncovered new transmission channels. This significantly contributed to damaging the confidence in the major economic agents. The crisis reaches now the Euro zone, ravaging Italy and France. In Great Britain, Ireland and Iceland the drop of the real estate sector was the main cause of the crisis.

## **2. The Romanian financial system**

Due to the present economic situation, the Romanian financial system remains insufficiently developed and is dominated by the banking sector, despite some important steps made over the last 2-3 years. The Romanian banking system knew a spectacular quantitative development over the last decade, from a banking system excessively centralized, with the majority of functions operated by the Romanian National Bank and by some other specialized banks (B.R.C.E., Investment Bank, Agricola Bank), to a banking system governed by the demands of the market economy.

The main positive aspects in the evolution of the Romanian banking system are:

- diversification of banking products and services;
- diversification of means of record and control;
- data transfer system updating;
- regional network modernization;

The main negative aspects of the evolution of the Romanian banking system are:

- shortage of skilled personnel;
- shortage on the level of the whole system of professional banking managers;
- economic recession;
- lack of capital concentration;
- the maze of legislative and economic measures generating behaviors with no horizon;

- insufficient adaptation to the movements and trends of the Romanian market;
- lack of judgment in choosing clients;
- lack of direction towards enhancing efficiency and profits.

It is well known that the banking sector was consolidated through the privatization of national banks, over the last years, and through the opening to foreign banking and non banking capital. Nonetheless, the transformation of the domestic banking sector has still a long way to go, because the extent of financial brokerage is very small to be able to efficiently benefit real economy, the one that really matters. Over the three years to come, Romania is expected to continue to have very low rates of banking assets, of the gross domestic product, and of the internal loan of the same GDP. The banking sector will further suffer in the meantime, because of a high percentage of low-return loans and because its crediting activity is impeded by the faulty management of public and private companies, by the fact of their huge debt to the government and to other partners being tolerated, by the fragility of the financial institutions, by the inefficient and incoherent legislation and by other general problems, such as: corruption, faulty legal system, low degree of political, economic and social transparency etc. The evolution of the stock exchange is subject to the influence of numerous factors, of which the most important are: political stability and predictability of the business environment, completed by regional and international influences, as well as the emotional factors of market investors.

### **3. The effects of the financial crisis on the Romanian financial system**

The financial crisis generates both direct and indirect effects on the economic system. In Romania, the indirect effects like panic and ‘nervous breakdown’ can have major repercussions. Romania is not being directly affected by the crisis, the factors that led to the unrest of the international system, *i.e.* the ‘toxic products’ being inexistent in Romania.

The advantages of the banking system could be grouped as follows:

- ✓ Nonexistence of call options, namely the possibility of withdrawing loan before the due date;
- ✓ Nonexistence of a liquidity crisis on the banking market;
- ✓ Segmentation of the banking sector;
- ✓ Availability of a higher compulsory minimal reserve, as compared to other E.U. countries;
- ✓ Nonexistence of a fixed exchange rate;

The risks that could entail the outburst and spread of the financial crisis:

- ✓ Repatriation of dividends;
- ✓ Deceleration of exports;
- ✓ Drop in profit reinvestment;
- ✓ Volatility of exchange rates;
- ✓ Acceleration of inflation;
- ✓ Increase of prices on imported goods;
- ✓ Slow down of economic increase;
- ✓ Pressure of salary increase;
- ✓ Increased costs of external financing;
- ✓ Diminished trust of investors in the financial markets with stronger effects than the lack of cash availabilities.

### **4. Conclusions**

It was ascertained that central management adversely impacts the real development of the economy. Nonetheless, is it always beneficial to reject any form of planning? The market keeps the manufacturing processes and goods circulation alive but what remains to be done with the crises and bankruptcies it engenders? Another aspect that has become very clear lately is that private property stimulates the creative activity of generating material values but, here again, we must question the beneficial character of keeping the natural resources in the public patrimony or not.

Questions on the configuration of the banking system assumed for the restructuring of national economies strictly restrained by dogmatic thinking thought infallible are, obviously, part of the ample questionnaire possible on some fundamental problems. Mobilizing the financial means required to relaunch the World economy, putting in place and securing a healthy circulation of the funds, transition to currency convertibility, opening towards the world and effective

integration into the world economic system could remain dreams without efficient actions taken by an assembly of consolidated financial institutions. However, the banking organization system to be established is still an open issue.

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## THE NECESSITY OF THE FORESIGHT ACTIVITY IN THE TROPICAL CONTEXT

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**Abstract:** *Being in a permanent expansion, the economy has generated at a certain moment a concern for finding some development laws of the economic processes .*

*It was born the theory of driving economic initially at a micro-economic level, presently in the entire national economy, that of macro-economic.*

*The Management applied on the economy is intended to use economic resources available to resolve issues that makes interests, aspirations or individual human needs or of some social groups.*

*The Management meets a series of positions .Starting from the statement of H. Fayol that the leading activity involves to provide, to organize, to command, to coordinate and control, we can say that although he was referring to the leadership at a micro-economic level, from the experience of up to now we can say that these functions can be extrapolated at a macro-economic level, too.*

**Key words:** *forecast, strategies, programs, techniques.*

In the process of leadership, the office of forecast occupies an important place.

This involves anticipating changes in time of a system, using certain means and methods. The initial phases of business forecast or when are necessary long forecasts on deadlines , when safe elements of safe reflection are missing, it is roughly sketched, what is to achieve, or otherwise said it predicts future development of the analysed elements.

The forecasts of the complex nature where are taken also into account the mandatory items , achieving several options and finally choosing the version with maximum degree of credibility, called pre-determinations.

Carrying out various kinds of predictions, be they *strategies, programs, plans or predictions* these can be made only through rational reconciliation of the

They can track several types of forecasts, according to the share elements with which deterministic and probabilistic elements are acting, namely:

- a) forecasts in terms of *risk*, in which are anticipated the results and the degree of risk, but not knowing exactly the level of the forecasted results.

determination elements with the probabilistic ones.

Elements of determinant nature are the result of the cause-effect interactions (certain causes always determine the same effect).

This type of elements are being dimensioned through quantitative techniques .

Random elements occur irrespectively of certain predicted causes. These elements can be divided in two categories as it follows:

- random elements who may have taken place in the past, whose frequency is not sure and which can be probabilistically estimated .

- random elements who did not occur until such time taken into account and which constitutes unpredictable risks.

- b) forecasts in conditions of *uncertainty*, case in which there is no sure knowledge upon the all results that may arise nor the chances of the appearance of these results. In such situations, decision-makers are forced to use additional information to determine the limits of the occurrence probability of a result.



c) forecasts in terms of *ambiguity*, situation in which the uncertainty is determined by the lack of information which would make possible the estimation upon the likelihood deployment of the economic process at which the reference it's made.

### 1. THE FORECAST ACTIVITY BETWEEN BEING NEEDED AND BEING POSSIBLE

The forecast always accompanied the human actions, being an expression of its natural way to behave.

As the French philosopher Auguste Comte said "to find means to provide in order to be able" (in original "savoir par prevoir pour pouvoir").

Through his nature, he represents beforehand, mentally, any activity which follows to be started by him.

The *Necessity* of the forecast is shown by the analysis of several aspects of economic and social life as it follows:

- While some resources are limited some of them being exhausted, the social needs are continually increasing, that implies an intensification of concern upon the future, to establish certain priorities and optimum ways of solving the problems that arise.

- As the economic activity involves a growing number of human resources and materials, becomes absolutely necessary for merits decisions, to be developed the forecast activity.

According to some experts in this area we are witnessing at present to a decline in the importance of the "present" on the future.

It is necessary to anticipate the future, even roughly, in order to diminish at least the threats to foresee the address of human society.

There are in addition, a series of factors which determine the need for an action existence of activities to forecast as it follows:

1) the pace accelerated population growth, the output of goods, and the number of publications in scientific sphere

2) The change of the living conditions and partially of habits

3) shorter duration of several occupations, which was practiced in the past by several generations

4) the existence of social entropy which may counter with the help of certain mechanisms for adjusting

On the other hand, forecast is *possible*, having regard to a series of factors such as:

- shorter distances between present and future concurrently with the increasing distance between past and present.

- accelerating transformations on the conditions of life, by using the modern technology and in parallel by expanding the capacity in the knowledge of the men

- diversification of the economic-social activities

### 2. TYPES OF PREDICTIONS

There are several types of activities and forecast instruments which are used to anticipate the future development of the economic-social life of the society

Activities	Instruments
Forecasting	Forecasts
Programming	Programs
Planning	Plans
Design	Projects
Etc	Etc
<b>Forecasting</b>	<b>Forecasts</b>

#### Generic Terms

The anticipating basic form of the future it is represented by the *prospective*.

This represents on short the evolution in perspective of certain phenomena and processes, shows what will happen and less

like or what the large-scale development will question .

In general, analyses represent the basis of the *forecasts* composition.

*Prospectivism* is a mood generated by the need for taking decisions in dynamic .

As science, refers to the study of various causes that determine the evolution of the present world and the anticipation of the processes that may arise as a result of these causes .

Anticipating the probable development of certain phenomena or processes are made through forecast, which is a forecast activity that takes into account the following:

- the changes expected to take place in the future
- present and future requirements;
- achieved experience;
- existing trends at present and which are considered to be kept in the future
- the findings of prospective studies carried out above.

The active instrument of forecasting is the *forecast*. It meets several functions as it follows:

- specify existing versions, and also their advantages and disadvantages ;
- appreciates future implications of current trends ;
- offers tools for intervention upon the economic activity, in the case of finding some deviations from the anticipated developments;
- offers information on which to choose the best option ;
- constitutes the basis of achieving some detailed forecasts .

*The horizon of time* associated with an economic forecasts is different in terms of purpose and nature of the situation referred. In this way, there are:

- short-term forecasts (from several months to 1,2 years);
- medium-term forecasts (5-10 years);
- long-term forecasts (10-35 years).

According to their *area of coverage*, predictions are distinguishable such as:

- at a micro-economic level;
- the problems of summary ;
- upon the area;
- upon the brench;
- at a macro-economic level;
- at an international level.

*Economic strategies* are based on some prospective studies and forecasts. The economic strategy represents a set of provisions, of major objectives which are pursued in the medium or long term, taking into account of:

- fundamental trends of prospects;
- economic laws;
- probable behavior of competitors;
- expected effective .

There are different *types of strategies*, such as:

- of development;
- restructuring (referring to the economic system);
- recovery (after a period of recession);
- consolidation (after restructuring and recovery).

### 3. MANAGEMENT AND STRATEGIC PLANNING

Economic strategies are applied through *strategic management*. It is a process by which the managers :

- set the objectives specific to each stage in part;
- decide the direction of medium-term action or long of the referred economic system;
- take into account the internal and international situation from that moment;
- shows the routes of the existing action .

Regarding the programming of the macro-economic activity, this refers to achieve a certain route whose final purpose is to constitute the objective took into account also taking into account the ranking priorities .

Programming can be realized in two ways:

- a) *mathematical programming*, situation in which are used numerical methods to optimise some objective-functions, with variables which satisfy a system of restrictive relations.
- b) *euristic programming*, which is based on empirical rules, whose results are acceptable.

As a tool of forecast, *the program* constitutes a system of actions, operations spread in time, with fixed duration and having certain resources allocated for each operation in hand.

Programs may be of different types, namely:

- of organisational measures, financial, technological etc. having operational character;
- of operational coordination, on micro level;
- territorial, the exploitation of resources ;
- sectoral, when the problems are of national interest;
- macro-economic, referring to national strategies;
- mondo-economic, at international level.

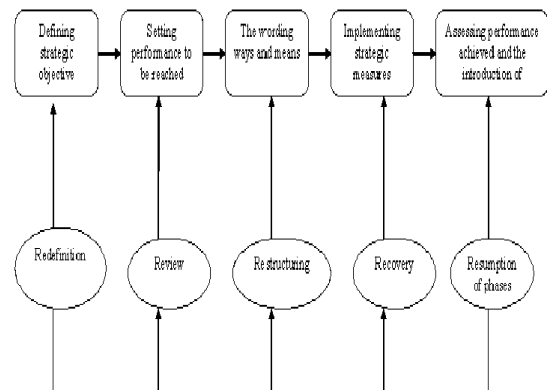


Fig.1. Strategic management process

Source : A. A. Thompson Jr. A. J. Strickland : Strategic management. Concepts and case, BP/IRWIN, Fourth Edition, Homewood, Illinois, 1987, pag. 13.

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# LEAN, A MANAGEMENT TOOL, USED FOR HAVE AN COMPETITIVE PRODUCTION SYSTEM

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**Abstract:** *To survive on a global market, in continuous economic growing the production systems have to be competitive. A factor which is influencing the competitiveness is the production systems management. The Lean Management is a modern management tool, which correlates quality, waste disposal and employees' involvement, and is using a well structured management. The Lean management is using the Lean philosophy at all levels, Lean Supply chain Management, Lean Maintenance, Lean Manufacturing, etc. Lean is a business system to organize and manage product developments, operations, suppliers, and customer relationships. Business and other organizations use lean principles, practices, and tools to create precise customer value—goods and services with higher quality and fewer defects—with less human effort, less space, less capital, and less time than the traditional system of mass production.*

**Key words:** *Lean Management, Lean Manufacturing, competitiveness, production system, work tools, Lean indicators.*

## 1. INTRODUCTION

Globalization of markets has led to increased competition which requires businesses with a high level of competitiveness, to remain to act on these markets.

Each firm must meet customer demand with an offer as good, both in terms of price, quality and promptly, but also in terms of the services attached to the product.

These considerations are the reason that the companies, firms, organizations in the area of industrial and logistical planning, but also the economic and social area, should know and apply Lean concepts that underlie the management of production and means of survival a global market.

Business system for organizing and managing product development, operations, suppliers, and customer relations. Business and other organizations use lean principles, practices, and tools to create precise customer value—goods and services with higher quality and fewer defects—with less human effort, less space, less capital, and less time

than the traditional system of mass production [1].

## 2. LEAN MANAGEMENT CONCEPT

Lean Management is the American approach of the concept of Kaizen, respecting the same rules and principles [2]. Lean applies to any type of organization and all areas of business. Essentially, Lean is an approach that incorporates a faith about quality, waste disposal and employee involvement, supported by a structured management system [3].

Lean Management is based on five ways of thinking [3]:

- a prospective thinking - to deepen and to shape future action by forecasting;
- a sensitive thinking - understanding the environment with all available detectors and react to adapt;
- a global thinking - taking into account the effect on the whole and show courage in the face of complexity;
- a dynamic thinking - to exploit and use all available resources;

- a thinking thrifty - to avoid losses, to manage with economy.

Lean Management is based on the following working principles (i.e. Fig 1. Lean Management working principles):

Customer oriented manufacturing	Quality company in all fields
Continuous flow of materials (just in time, kanban)	Total Quality Management
Quick and safe development, launch of new products	To win and keep customers
Studies synchronized	Marketing prospective
Growth and achievement capacity	To integrate the company harmoniously into
Strategic undertaking of capital	Enterprise is a family

Fig 2. Lean Management working principles [3]

- teamwork - the tasks are not performed by a person but a whole team;
- personal responsibility – exist a person who is responsible for each activity. That person has the priority of getting quality through the work submitted;
- feedback - every act should receive a response. Reactions received serve to guide future actions and their optimization;
- costumer satisfaction - all activities shall be mobilized in favor of the client. Customer desires are top priority in the enterprise;
- priority of the added value - the activities with value added are top priority in the enterprise. This concerns any type of available resources;
- standardization - formalizes and standardizes of the different operational phases / processes are made through simple presentations, written and with images;

- continuous improvement - daily reflections causes continuous improvement of all production processes. There is no definitive objective, but only steps in a good direction.

- immediate removal of the causes of defects – in the first step should be removed the defect and then must be removed the case;
- to provide, to plan - must be provided potential problems and not removed;
- small steps control - development should be made through small steps well controlled. Feedback after each step command next step. The speed increases because of acceleration in the sequence of steps.

Lean transformation is oriented to principles such as [3]:

- clear, positive communication;
- ensuring a culture "without fault";
- working with transfunctional teams;
- staff involvement at every stage;
- the visual representation of the process is open for comment;
- elimination phases, points of transfer and recovery loops that do not add value;
- obtain unanimous agreement on the principles of design;
- resolve the case, no symptoms;
- ensuring that the solution supports departmental interfaces;
- incorporation of continuous improvement.

An important concept of Lean Management is Lean Manufacturing.

### 3. LEAN MANUFACTURING

Initially create for Toyota, the lean manufacturing is made to create the necessary parts for the right place and right time, with a less consumption and major flexibility and adapted to changes. These steps will reduce the scrap values, improve the productivity flow and insure a high quality control.

More than just to insure a good productivity flow, Lean Manufacturing is sending to technical specialists modern management capabilities to a more efficient team co-ordination and the possibilities to develop a work culture [4, 5, 6].

Lean Manufacturing is meaning a more complex approach in process management within organizations. To implement the Lean

Manufacturing a strategic thinking has to be made more steps have to be made [7]:

- analyze the initial situations;
- actions which have to be done;
- start the actions above;
- measure the results.

In Lean Manufacturing is a concept which explains the production which is pulled. This concept meaning maximum flexibility and eliminate the waste.

Lean manufacturing is different from the traditional production system where the production is "pulled" not pushed like in traditional production systems.

The traditional production systems are using the continuous material flow in production, to maximize the efficiency and minimize the big batch production costs. The production is planned scheduled and to succeed a mixture between the demand and the planned one, and the orders are pushed from the factory and kept in stock. The suppliers are working to finalize the planned orders and the stock are high enough to maintain a certain limit, making products on stock, not the production in line with the orders [8].

In traditional production systems the time and the cost to change the production processes are equally long to planned and keep them on stock. In this way the result is a large useless quantity of products on final stock stocks finished (fixed capital and spaces), while in the lean controls are drawn, based on actual demand on the market.

The Lean Manufacturing concept is not based on planning, but is using the continuous improvements for processes which is leading to a stock items reduction on supply chain, short delivery time and a good feed back from the customers. This kind of approach is giving the purchasing signal, mixed production processes and flexibility for planning the different kind of productions.

The objectives for the "Pulled" production systems are to optimize the production flow, eliminate wastes, as an overview for the all factory. By loss understands the general waste and by optimization understands the products flow through processes. By waste understands each element which concludes to a high

production costs, without any plus value to the customer. The losses could be caused by various factors as: machine layouts, high set up time, non competitive production process, poor predictive maintenance, un-controlled production methods, lack of training for the production personnel, production planning, poorly organized work flow, quality failures, lack of responsibilities, sending defects through the production flow, lack of communication, overproduction, high stock levels, non productive time etc.

The 7 signs for waste had been coded 50 years ago, at Toyota (Taiichi Ohno):

- overproduction - is the produce more than it's needed. Is the worse way of waste, because is determining the other 6 type of wastes;
- transportations - moving the products through processes in unusuelles way, as ex from the production place to the store house and than back to the production place. The next process should be next to the firts production process;
- motion - operators make not necessary moves and not needed - such as searching for parts, equipment, documents, repeated removal of tools, etc;
- waiting - the operators are stopping the production because the machines are not working propely, the equipements arriving after a long time/drawings/missing intermediate products;
- overprocessing - using un necessary operations on improper ways caused by poor equipments and lack of attentions;
- inventory - keeping a stock level, higher then is neccessary, to mantaine a „pull” type of production;
- defects - inspections, machining, scrap.

After the Lean Production is implemented the results will be visible as [8]:

- reducing to half the working time on production flow;
- reducing to the half the scrap value;
- drop to 1/3 the set up time;
- reducing to 50% the production area to realize the same amount of products;
- keeping the unfinished products down to 10%.

#### **4. LEAN TOOLS**

Eliminating the losses is based on a program supported by management and applying various techniques such as 5S, 4M, JIT with kanban, SMED, s.o.. The base condition is the adoption of basic principles and philosophy of continuous improvement (Kaizen), at all levels of organization [9].

Analysis of ABC: It is a tool that serves at the parts sharing of the necessary production groups, depending on the demand for these items. Lean Specialists use these tests to decide which pieces to form the stock and how big it is. Parts of type A are very often required in the production process, parts of type B are required for a medium level and parts of type C are least needed;

Andon: Andon is an electronic audio and / or visual device. The most common codes of visual signaling are: Green: normal operation, yellow: change or maintain or the planned production; Red: abnormality, defective car. These codes of visual signal are usually combined with coded auditory signal;

Kaizen workshops: Represents activity of a group Kaizen (which usually lasts 5 days), where the team identifies and implements improvements in a process. After improvement, the process is standardized, and the Kaizen team reported to the management level the results;

The 4M: The factors that a production system it uses to produce value for customers. The first three factors represent resources and the last mean value for the customer. Lean system, the 4 factors relate to:

- materials - no defects or failures;
- machinery - no failures, operational deficiencies or unplanned stops;
- workers - adequate employment skills, skills needed, reduced absenteeism and punctuality;
- methods - standardized processes, maintenance and management;

The 5 S: 5S is a structured program of resulting the organization, cleanliness and standardization in the workplace. The contents of 5S are as follows:

- seiri (sort) - removal of unwanted and unnecessary materials from the workplace.

Main idea is to ensure that absolutely any material left in the workplace is essential for work;

- seiton (stabilization, cleaning) - is about efficiency. This step is about storage any element in an advance determined location, to have easy access to it;

- seiso (brightness) - is about of cleaning the workplace, making it "to shine". Cleaning should be carried out by each person employed, from managers to operators;

- seiketsu (standards) – is about defining the standards to be reported to the personnel in measuring and maintenance the degree of cleaning;

- shitsuke (supporting change) - means the maintenance of the all above actions and their continue improving;

Deming Cycle (PDCA - Planning, Building Control and Action): PDCA Cycle is used to coordinate efforts to continuous improvement, that efforts must begin with careful planning, should be materialized in the actual activities and conclude with the results, then the whole cycle to repeat.

Heijunka: Is leveling type and quantity of production for a fixed period of time. Through this production effectively satisfy effective the customer demand, minimize inventory, capital costs, labor costs and total production time, over the entire value stream.

Jidoka: Contribute automatically stopping the flow of production at detecting errors (none). Is to provide machines and operators the ability to detect an abnormality occurred in the system so that it can immediately stop the process.

Just In Time (JIT): A production system that produces and delivers just as much as is needed, only when is necessary and only the necessary amount, as requested by the client.

Kanban: A method of controlling the quantity of product to flow (by organizing a system of cards, signaling methods, buffer stocks ...).

Total Productive Maintenance(TPM): A number of methods, originally designed to ensure continuous operation of machines involved in production, so production will not be interrupted ever. TPM includes the following policy maintenance: corrective, preventive, predictive and detection.

Muda (Waste): Any activity that consumes resources without creating value for the customer. Within this general it is useful to distinguish between two types of muda: type 1, consisting of activities which can not removed immediately and type 2, which activities can be eliminated quickly through Kaizen activities.

Poka yoke: method which eliminates the chance of committing mistakes.

SMED: SMED - Single Minute Exchange of Die, is a fast and efficient method to change manufacturing. SMED method is used for setting and adjusting a process to bring him up to normal operating condition, with minimal losses for a given product.

## **5. LEAN INDICATORS**

In production environment there are four key elements: productivity, quality, safety and costs. Typical indicators for Lean production related to these four elements and consist of the time from receipt to dispatch your order, stock rotation, the duration of obtaining the first product of a particular way, percentage of deliveries on time, overall equipment effectiveness (OEE).

Total productivity is a ratio between the quantities of products (outputs) carried out a system for a period and amount of resources (inputs) used in the same period. Productivity is the measure of quantitative results obtained by the use of those resources: Total output / Total entries.

Partial productivity is the ratio between output and input for the separate factors. Thus, it can cause:

- Labor productivity: total output / man-hours used;
- Productivity of used materials: total output / consumed materials;
- The productivity of capital: total output / cost of capital;
- Energy productivity: total output / energy consumption.

Productivity reflects the ability to produce what is necessary, when necessary, where appropriate, and in the volume required in the most efficient financially manner.

Quality is measured by actual performance of the equipment and can be determined by several methods, but a safe and correct estimate is the overall effectiveness of the equipment (OEE), whichever applies specific methods TPM (Total Productive Maintenance) [9].

To calculate OEE take into account the availability (as percent of overall effectiveness of equipment is the availability), process efficiency (as percent of the overall effectiveness of the equipment represents effectiveness) and the percentage of good product (as percent of overall effectiveness of equipment is good products).

## **6. CONCLUSIONS**

Management Lean is a system of organization and management of production, oriented of product development, production processes, relationships with customers and suppliers, so as to require less human effort, less space, less working capital, less time for products realization.

Following application of the Lean system, resulting products with fewer defects and better meet customer requirements.

Lean Manufacturing is a component of the concept of Lean Management and is a philosophy of production that determining the reduction in the duration of the customer order to product shipment by eliminating waste.

These concepts are measured through indicators and through the monitoring aims continually optimizing. It is necessary to implement the concept of Lean Management because a company becomes more competitive and may act on a globalized market.

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## MANAGEMENT AND COMPETITIVENESS OF PRODUCTION SYSTEMS, WITH THE PARTICULARITY OF PRODUCING MOLDS

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**Abstract:** Nowadays there is a market globalization tendency, there are a lot of competitors on the market, the products and services life cycles are much shorter, and the customers are more educated and aware of the quality requirements. That's why a production system to be successful have to be competitive. The production systems competitiveness is influenced by a lot of direct factors (where production systems are influencing) and circumstantial factors (influenced by the production systems). In this way the central points are concentrated on process, products and a whole production systems management, which can be used as a weapon to strengthen the position on the market.

**Key words:** production system, management, competitiveness, manufactory management, molds, labor productivity, know-how.

### 1. GENERAL CONCEPTS REGARDING THE PRODUCTION

Production systems to exist and function, there must be rooted in a whole, as part of a series which answer of an economic system request. Organization should be undertaken so as to achieve required product, at the required quantity and quality, required in the desired time and under conditions laid down, with minimum effort and maximum satisfaction. Their basis is formed by the continuous evolution of the technique and technology, evolution assured by increasingly diverse and constantly changing.

The production system is a complex system, part of the organization, which transforms inputs, i.e. material resources, human resources, financial resources and information's in output, i.e., products / services and information resources [1, 2]. In Figure 1, it is observed that system production is in direct relations with the microenvironment component, in indirect relationship, with the microenvironment component and market relationships with customers and potential customers (i.e. Fig. 1

System production relations with the environment).

Each production system is distinct trough activity that it carries, his organization, the manner in which management is applied, how the components interact with its environment, environmental policy, the mix of marketing applied, but there are common factors which in general can be applied to any production system.

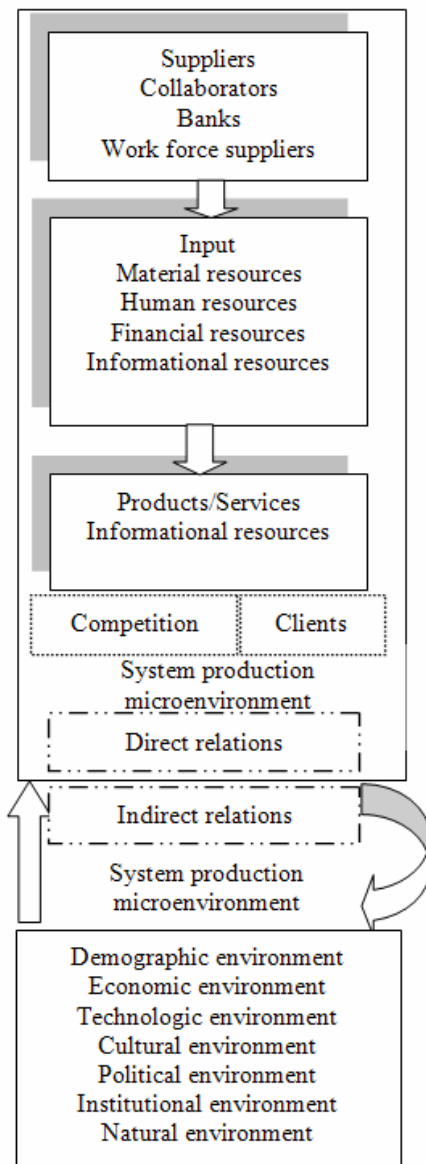


Fig. 1 System production relations with the environment

## 2. MANAGEMENT OF PRODUCTION SYSTEMS THAT PRODUCES DIES

The practice management is a main feature of all systems of production.

Generally the production of dies resulting falls in the group of SMEs. In this case, we can say that manager has the central role. Such the practiced management is influenced mostly by subjective factors such as experience, emotional intelligence, skills and management style of the manager. However, lack some and how the manager can make them combine may be increase or decrease

the competitiveness of the production system [3].

This is somewhat subjective and depends on managerial skill, experience, management style practiced and strategies pursued.

The last two are characteristic of the organization where the system belongs, and are correlated with the system objectives, factors potentially who affecting the system, logistics and technology flow product and internal organization of the system.

A manager, for better organization of the production system, must take into account a number of factors related not only to the system of production, and the external factors, which are not belong to the production system and can not be influenced by it.

Management is based on production function, supply, the financial accounting, human resources, supply, marketing, sales, etc [1].

Molds are complex products, with a production cycle higher, so the management of supply is particular, and production management require special attention. Preparation of production consists of two stages [1, 4]:

- technical training;
- preparation of material-organizational.

Technical training includes [1, 4]:

- product design;
- technology training;
- implementation, testing and approval of prototype and series zero.

Characteristic of these products is that supply manager of the production system can not command the necessary implementation, only after receiving the firm command from the client. This is because mold blocks are made of steel of a particular form (rectangular, square, cubic, etc.) and size. Suppliers must be chosen very carefully, because the reliability of deliveries depends on the accuracy of their execution time of die, it is sent to customers.

Once the order arrived, the project is directed by the Technical section, where technologist and standardize men, based on standards and professional knowledge,

provide technology implementation and the number of hours required molds execution.

Develop technology implementation consists of the preparation of technological sheets comprising stages of execution for each landmark, equipment which is processed, full time and cutting regimes. Also technology execution provides takeover mode, in the package or piecemeal.

Once completed development of technology, it is taught along with all the technical documentation, of foremen, that coordinates the work. The team includes: tool man-die maker, miller, turner, grinding, people from SIP.

In this organizational structure, foremen assure liaises between all links that determines mold manufacturing. He pulls out from the warehouse receipts on the basis of warrants consumption established by technologist, the material required to be cutting. With tool man - die maker coordinates these materials by performers: revolution piece by turner, miller by other benchmarks.

Tool man- die maker monitors and directs the material which is processed from a performer to another, establish tolerances that which is processed so that the parts mold assembly to be functional. Designer provides the rules under certain dimensional tolerances and tool man is performing physical matches between these landmarks.

Any activity must be planned taking into account with the objective's system and the management is practiced on three levels (i.e. Fig. 2 The management levels). At the base is the strategic management, based on strategic planning (planning for years), then middle management based on overview planning (on monday) and operative management based on operational planning (in weeks and days) and a executive planning (per hour).



Fig. 2 The management levels

Management activities in the small production systems changes can change relatively easily because the production systems have the high adaptability degree and high flexibility due to high speed movement of information within their and due to their complex prepare for that the whole staff, so that they can quickly change the function, passing to the performance of other functions, the imposed by changes of the market [3].

Also because of simpler structure, climate of creativity is more effective, involvement of human resources is done in all activities and decisions, so is practice a type of participatory management [5].

Communication between manager and staff is frequent and direct, making the information should be clear and to move quickly. Another advantage is that the manager knows the use and effectiveness of labor, machinery and spaces used [3].

### 3. COMPETITIVENESS OF PRODUCTIONS SYSTEMS THAT PRODUCE DIES

General feature of all systems of production is their competitiveness. In general competitiveness of a production system is determined by the competitiveness

of a country in which they operate, and is evaluated through image and position that the system of production and the market competition and its structure.

Competitiveness of a production system is influenced by a number of direct and indirect factors. By direct factors I am refer to factors that may control or direct influence of the production system and indirect factors are those which are not related to the production system and can not be influenced by it (except through political lobbying).

Among the indirect factors that influence the competitiveness of production system in Romania include the development of the country, price increases in utilities, access to credits for investments, ergonomics systems, informatics system use, that system has or not the Quality Management System and commercial relationships production system in international markets (Fig. 3 The indirect factors that influence the competitiveness of production system in Romania).

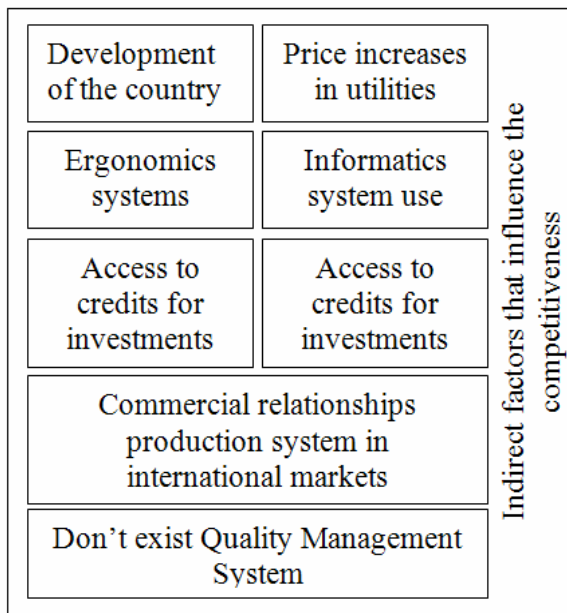


Fig. 3 The indirect factors that influence the competitiveness of production system in Romania

Among the factors directly affecting the competitiveness of production systems in Romania include labor productivity, determination of the production capacity, production scheduling, management and inventory control, research development,

innovation, products competitiveness, technological potential of the production system and the impact of the environment (Fig. 4 The factors directly affecting the competitiveness of production systems in Romania).

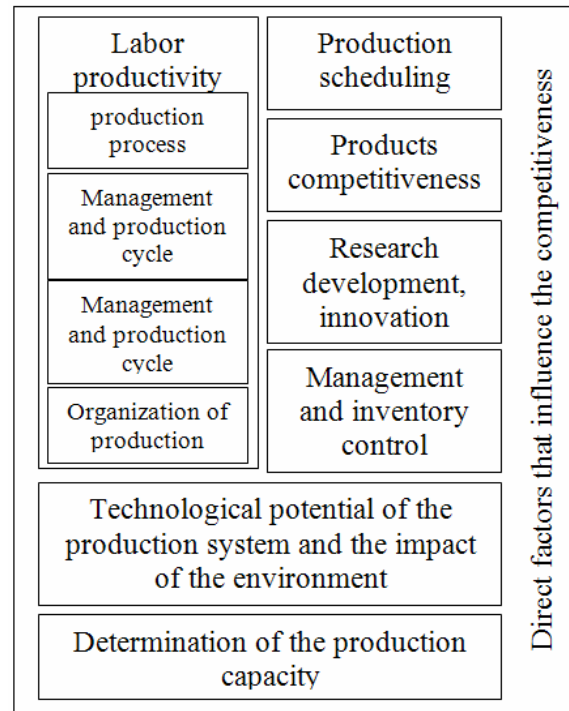


Fig. 4 The factors directly affecting the competitiveness of production systems in Romania

In turn productivity is influenced by factors such as the production process and how his organization, management and production cycle and production policies used. Products competitiveness is also influenced by the quality, price, performance products, and especially new products that appear on the market.

Technological potential is the most important competitive factor in production system and is influenced by the theoretical base, machinery tools and equipment and know-how owned by the system. Also an important role as the technological potential has the acquisition and transfer of technology.

In the case of systems production who produce molds a combination of factors related to the market acting on it, and at the

clients and it serves, factors relating to development and product and factors related to production and supply, define and influence the competitiveness of these systems (Fig. 5 Factors who define and influence the competitiveness of die system production).

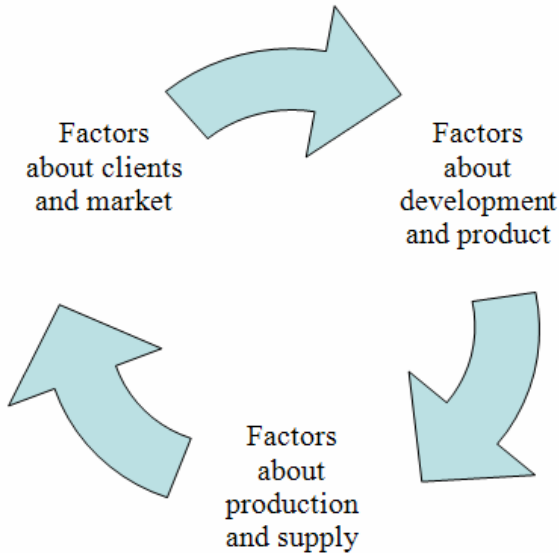


Fig. 5 Factors who define and influence the competitiveness of die system production

Among factors related to customer and market is continuing continuous pressure on prices and permanent consolidation of the market, increasing the sensitivity of the customer on short delivery time, increased fidelity in meeting delivery deadlines and flexibility to changes made to orders, demand for individual products for each client, compress cycle time of the product.

To control these factors is necessary to support a continuous reduction of costs in all the system processes, is indicated standardization and synchronization of all processes, standardization of processes made inclusive with suppliers and customers processes, is mandatory to respect the deadlines set for the delivery of products, the fidelity of the delivery (when established, the quantity and quality required, by the faithful observance of contract) and greater flexibility to market requirements and customer feedback.

Among the factors related to product and development are the great requests for innovation, reduction Time-to-market, complexity of technology in increasing and large of the products. To have control of these factors, the processes should be standardized, should make production only at the request of customers, to exists processes of change fast and efficient, high quality of the products and processes.

Among the factors related to production and supply, including mass customization / production individualized for the client, focusing on based component, development and suppliers of modular system (on standard items), the globalization of production and supply. To have all this should ensure the production programs, to establish clearly the responsibilities of each, to establish management capabilities throughout the system, to apply obligation the recognition problems in the whole system, to exist an extend standardization of processes and interfaces with customers and suppliers and flexibility on the distance and time of transport.

#### 4. CONCLUSIONS

Production systems to exist and work there must be rooted in a whole, as part of a series that meet the needs of any economic system. Their organization should be undertaken so as to achieve the required product, at the required quantity and quality, in the desired time and under conditions laid down, with minimum effort and maximum satisfaction. Their basis is formed by the continuous evolution of the technique and technology, evolution assured by the demand more diversified and constantly changing.

In order to maintain the globalized market, in continuous growth, the production system must take into account all factors that influence competitiveness. This requires a competitive management.

How a production system is managed, how the processes are carried out, how to adapt to market requirements, and reaction speed with which the requirements of customers, management style adopted, the

management tools used, define the degree of competitiveness.

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## FINANCIAL CRISIS, MORAL CRISIS OR SYSTEM CRISIS? IT IS POSSIBLE A CRISIS MANAGEMENT?

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**Abstract:** *The international financial crisis is the one of the biggest challenges for worldwide economy. It spreaded from USA to Europe and nobody knows where and when it stops. The financial crisis „is one of the most difficult experiences that European Central Bank encountered in its’ ten years of existence”, said President of ECB, Jean-Claude Trichet, qouted by AFP.*

**Key words:** *financial crisis, system crisis, bank system*

### 1. THE MOST IMPORTANT WORLD ECONOMIC CRISIS

The world was turmoil with four major economical crisis:

- first crisis was between 1815-1818;
- second, most powerfull, between 1846-1847, and determined the important revolutions from 1848;
- then, from 1859, started with a boom of the capitalist economy, but in 1847 a new economical crisis began, and the result was the first world war;
- the most profound crisis of the capitalism economical system, the depression, was between 1929-1933, until now. It started in USA, with the colaps of the NY stock exchange markets . A financial crisis occurs when there is a disorderly contraction in money supply and wealth in an economy. It is also known as a credit crunch. It occurs when participants in an economy lose confidence in having loans repaid by debtors. This causes lenders to limit further loans as well as recall existing loans. But this was only the beginning of the crisis, the surface signal, as it is happening today. The real crisis is in

the deep, in the fundamental structure of the economy.

### 2. NOTHING NEW! ADAM SMITH, THE FATHER OF THE MARKET ECONOMY, SAID IT LONG TIME AGO, ABOUT 250 YEARS AGO.

Adam Smith(1723-1790), was a great scottish economist and statesman, who can be considered the father of the market economy and a pioneer of political economy. He based his theory on the fundamental economical law: demand and supply, in wich the state impact in economy is restraint, or excluded.

Smith is the author of *The Theory of Moral Sentiments* and *An Inquiry into the Nature and Causes of the Wealth of Nations*. The latter, usually abbreviated as *The Wealth of Nations*, is considered his *magnum opus* and the first modern work of economics. Adam Smith is widely cited as the father of modern economics.

Smith proposes a theory of sympathy in which the act of observing others makes people aware of themselves and the morality of their own behavior<sup>1</sup>.

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<sup>1</sup> Wikipedia.org



Smith said that is not sufficient that people enjoy their own wealth, they must be involved and invested in the benefit of entirely social system. So, the rich man should be fair given the society who enriched him, otherwise you can get economical and social convulsions. Generally, Smith's ideas are presented in economic books, but not the *The Theory of Moral Sentiments*. Maybe, if we had considered his rigorously analysis, the world economic crisis that turmoil all around the globe could be avoided.

### 3. THE WORLD ECONOMIC PROBLEMS WILL GROW GRATER NEXT YEAR

The economical crises started at the end of 2008 is not an usual crisis of the capitalism system, and it will be bigger in next year, as the economy experts said. The crisis started from the avidity of humans and the greedy of Wall Street bankers. They granted high risky loans, so called the toxic loans. The result was enormous growth in the power and influence of Wall Street and the big banks over the rest of the economy. The era of leveraged mergers, acquisitions, and buyouts was the predecessor of the disaster of today with the unfolding fiasco of equity, hedge, and derivative funds in the process of collapse.

So, this imoral crisis is supported by USA and other country? Why.. because the global economy. The world bank system is so tight, so globalized and the shut down of one could colapsed the entire system.

The experts says that the actual crisis is far more complicated, is not tipical, so hard to manage. After the collapse of socialist system, the bankers of developed contries started to give huge loans, without substancial colaterals, pushing comerce and the consumers, so more virtual money in the system. The result was a false capital accumulations, without a real money-merchandise relationship, only to grow their comisions.

We knew things were bad on Wall Street, but on Main Street it may be worse. Startling official statistics show that as a new economic recession stalks the United States, a record number of Americans will shortly be

depending on food stamps just to feed themselves and their families.

### 4. MARX, THE VISIONARY

In his fundamental paper, Karl Marx, the political economist, political theorist, and revolutionary credited as the founder of communism, said.

„Owners of capital will stimulate working class to buy more and more of expensive goods, houses and technology, pushing them to take more and more expensive credits, until their debt becomes unbearable.

The unpaid debt will lead to bankruptcy of banks which will have to be nationalized and State will have to take the road which will eventually lead to communism.”  
(Karl Marx, *Das Kapital*, 1867)

### 5. ANALYZE THRU TIME, MIHAI EMINESCU

In 1882, in newspaper *Timpul*, , the official newspaper of the Conservative Party, Mihai Eminescu, the journalist, said<sup>2</sup>:

*”Even writers with outstanding political views have given up the idea that state and society have a conventional nature, originating in that free mutual contract among citizens. No one, but the scum of ignorant journalists may claim that free vote, sessions and Parliament are the foundation of a state. Be this true or false, state must exist and it is a subject to natural laws that are immutable, implacable and with predictable consequences. The difference can be seen within constitutional context when, led by the social groups endowed with elementary education, the struggle for existence gets a positive feedback, while in absolutist state this struggle is overseen by a higher authority - the monarch is interested in of all classes prosperity, as well as in their fight being benign for one another”.*

### 6. CONCLUSION

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<sup>2</sup> [http://www.mihaieminescu.ro/en/literary\\_work.htm](http://www.mihaieminescu.ro/en/literary_work.htm)

Although America's housing collapse is often cited as having caused the crisis, the financial system was vulnerable because of intricate and highly-leveraged financial contracts and operations, a U.S. monetary policy making the cost of credit negligible therefore encouraging such high levels of leverage, and generally a "hypertrophy of the financial sector"<sup>3</sup>

The crises in real estate, banking and credit in the United States had a global reach, affecting a wide range of financial and economic activities and institutions, including the:

- Overall tightening of credit with financial institutions making both corporate and consumer credit harder to get;
- Financial markets (stock exchanges and derivative markets) that experienced steep declines;
- Liquidity problems in equity funds and hedge funds;
- Devaluation of the assets underpinning Insurance contracts and pension funds leading to concerns about the ability of these instruments to meet future obligations;
- Increased public debt public finance due to the provision of public funds to the financial services industry and other affected industries, and the
- Devaluation of some currencies (Icelandic crown, some Eastern Europe and Latin America currencies) and increased currency volatility<sup>4</sup>.

The economy Nobel Prize winner, Joseph Stiglitz, analyzed the five fundamental motives, that lead us to the actual crises:

- The replacement in 1987 of Paul Volker, from president of FED with Alan Greenspan, who open the monetary politics without respect the second rule of financial system of national bank, to regulate the system.

<sup>3</sup> [http://en.wikipedia.org/wiki/Financial\\_crisis](http://en.wikipedia.org/wiki/Financial_crisis)

<sup>4</sup> ibdem

Greenspan was involved in two financial bubbles: the IT and housing bubble in subprime sector.

- Destroying the barriers: The costs of abrogation of Glass-Steagall-Act, from 1933. The banks were strictly divided in commercial and business.
- Bush administration cut the taxes for the rich people, and increases the credit.
- The financial scandals of the most important companies, like ENRON.
- **The final cut.** Bush administration and Central Bank authorization for Paulson's The Emergency Economic Stabilization Act of 2008

He said that "We are now facing a liquidity problem, a solvency problem and a macroeconomic problem" Here's a five-step, comprehensive approach:

- **Recapitalize banks.**
- **Stem the tide of foreclosures.**
- **Pass a stimulus that works**
- **Restore confidence through regulatory reform**
- **Create an effective multilateral agency<sup>5</sup>**

Another analysis, different from the mainstream explanation, is that the financial crisis is just a symptom of another, deeper crisis, which is a systemic crisis of capitalism itself. According to Samir Amin, an Egyptian economist, the constant decrease in GDP growth rates in Western countries since the early 1970s created a growing surplus of capital which did not have sufficient profitable investment outlets in the real economy. The alternative was to place this surplus into the financial market, which became more profitable than productive capital investment, especially with subsequent deregulation. According to Samir Amin, this phenomenon has led to recurrent financial bubbles (such as the internet bubble) and is the deep cause of the financial crisis of 2007-2009<sup>6</sup>.

<sup>5</sup>

<http://www.time.com/time/business/article/0,8599,1851739-2,00.html>

<sup>6</sup> ibdem

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## INFORMATION MANAGEMENT AND CRITICAL INFRASTRUCTURES PROTECTION

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*Abstract:* Different kind of infrastructures are planned, carried out and exploited in order to ensure a better order of the human society. Some of it, called infrastructures of major importance, become „critical” when, accidentally, are out of action and only then it is realized its’ necessity in the normal process of human life. But information can help us anticipate the moment when an infrastructure becomes critical and taking urgent preventive measures is required in order to eliminate risks and threats. Also, information, used by the opponent, can put out even the most protected infrastructure.

**Key words:** information management, critical infrastructure, national security, cyber space, critical informations

### 1. INTRODUCTION

We live in a world with a rate and dynamics of development unknown until now in human evolution. The financial and economic crisis started from USA, the world economic model, hits the economies all over the world like a tsunami.

The lack of real informations on high and strategic level caused analyse and evaluation errors of the world financial system, together with the unbalanced energy and resources consumer, lead to this uncontrolled crisis. So, it is imperative to reevaluated the risks and threats on national and international security. One of the major and urgent problem, is the sustainable development of the countries at national, regional and global level, finding the means and technological way to ensure the infrastructure protection involved in the development.

The infrastructure, the set of systems within a place or organisation that affect how well it operates, is defined as ” the ensemble of material elements (such as constructions, equipments, installations, means of transportations), structures (transport and

communications networks, energetical systems, procurement, leading, educational, health, relationship systems) and information systems (data, informations, information circuits and flux, proceedings and techniques) of a social macrosystem”. If the infrastructure is inefficient managed or protected can developed critical situations leading thru structure crisis and deep problems in national security<sup>1</sup>.

### 2. THE USA PATRIOT AND HOMELAND SECURITY ACTS

In response to the terror attacks of September 11, 2001, Congress passed the USA PATRIOT Act of 2001. The PATRIOT Act was intended to “deter and punish terrorist acts in the United States and around the world, to enhance law enforcement investigatory tools, and for other purposes<sup>2</sup>.”

In USA used „critical infrastructure” to describe, to define the “systems and assets, whether physical or virtual, so vital to the

<sup>1</sup> „International Journal of Critical Infrastructures”, vol. 1, nr. 1/2004

<sup>2</sup> Executive Summary. p 1. Section 1016 of the USA PATRIOT Act (P.L.107-56), passed October 16, 2001

United States that the incapacity or destruction of such systems and assets would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters”<sup>3</sup>.

The issues of critical infrastructures are vital specially after possible attacks on critical informatics infractures<sup>4</sup>.

In USA according to E.O. 13010, these critical infrastructures were<sup>5</sup>:

- telecommunications;
- electrical power systems;
- gas and oil storage and transportation;
- banking and finance;
- transportation;
- water supply systems;
- emergency services (including medical, police, fire, and rescue);
- and, continuity of government.

Following the terror attacks of September 11, 2001 the Executive Order 13228 defined critical infrastructures as<sup>6</sup>:

- energy production, transmission, and distribution services and critical facilities
- other utilities
- telecommunications
- facilities that produce, use, store, or dispose of nuclear material
- public and privately owned information systems
- special events of national significance
- transportation, including railways, highways, shipping ports and waterways
- airports and civilian aircraft
- livestock, agriculture, and systems for the provision of water and
- food for human use and consumption.

<sup>3</sup> Homeland Security Act of 2002,(P.L. 107-296 , Sec. 2(4)) establishing the Department of Homeland Security (DHS).

<sup>4</sup> Andraşiu, Mircea, colonel dr., Considerații privind unele riscuri și vulnerabilități ale societății informaționale și de cunoaștere, în „Impact strategic”, nr.4-5/2002, p. 151.

<sup>5</sup> Executive Order 13010—*Critical Infrastructure Protection*. Federal Register, July 17,1996. Vol. 61, No. 138. pp 37347-37350. Reference is on page 37347.

<sup>6</sup> Executive Order 13228—*Establishing the Office of Homeland Security and the Homeland Security Council*. Federal Register, Vol. 66, No. 196, October 8, 2001. pp51812-51817.

In USA, The National Strategy for Homeland Security. listed the following critical infrastructure sectors<sup>7</sup>:

- Agriculture
- Food
- Water
- Public Health
- Emergency Services
- Government
- Defense Industrial Base
- Information and Telecommunications
- Energy
- Transportation
- Banking and Finance
- Chemical Industry
- Postal and Shipping<sup>20</sup>

In UK, CPNI (Centre for the Protection of National Infrastructure) an interdepartmental organisation, provides integrated (combining information, personnel and physical) security advice to the businesses and organisations which make up the national infrastructure. Through the delivery of this advice, the centre protect national security by helping to reduce the vulnerability of the national infrastructure to terrorism and other threats.

CPNI was formed from the merger of the National Infrastructure Security Co-ordination Centre (NISCC) and a part of MI5 (the UK's Security Service), the National Security Advice Centre (NSAC). Although CPNI was only formed on 1 February 2007, providing security advice has always been part of UK government strategy to disrupt threats to national security.<sup>8</sup>

CPNI advice is targeted primarily at the critical national infrastructure (CNI) - those infrastructure assets (physical or electronic) that are vital to the continued delivery and integrity of the essential services upon which the UK relies, the loss or compromise of which would lead to severe economic or social consequences or to loss of life.

Also, after 2005, CPNI will assume the lead for providing protective security advice to the national infrastructure within Northern

<sup>7</sup> U.S. Office of Homeland Security. *The National Strategy for Homeland Security*. July 16,2002.

<sup>8</sup> <http://www.cpni.gov.uk/aboutcpni188.aspx>

Ireland, particularly relating to the delivery of advice to CNI operators covering physical, personnel and information security<sup>9</sup>.

In Romania, before 1989, we have Law 23/1971 for the vital assets for the communist state.

Now, in National Strategy for sustainability development of Romania, the critical infrastructures are mentioned:

- transportation: highway and national route, railways, shipping ports, harbours and airports
- energy: energy production, transmission, and distribution; building new power station, modernizing and ecological existing power station, new sources of alternative energy (wind, solar, hydrogen source)
- water and waste; systems for the provision of water, irrigations, flood, etc
- Information and Telecommunications, and the new infrastructure based on IT& components (computer networks, Internet and electronic means of information).

On 25.11.2004 the Law no 535, against terrorism, was adopted. This law established the terms of critical infrastructures, strategic units, governmental and state units, transportation systems.

Lately, with the development of the IT&C sector, we can talk about informational infrastructure. The terms consist in informational resources, including communications systems, institutions or personnel involved. We can talk about defence informational infrastructure, national informational infrastructure and global informational infrastructure.

For ensuring the security of information through global informational infrastructure, we must elaborate the strategy for secure vital infrastructure.

The state infrastructure consists in private and public institutions from agricultural, alimentary, water, public health, transportation, finance and banks sectors, chemical industry, mail services and maritime sector. The core of

this system infrastructure is cyber space, thousands of interconnected computers, servers, routers, switches and the communication systems: optical fibres. So, the working together as a unit of the cyber space is crucial for any economy and national security.

Each state and government has the goal and obligation to develop his own cyber space security strategy, due to the explosive development of global informational networks and the interconnections between the national information networks infrastructure and the global one.

Highly risks on information security are bigger than ever and global. So, by attacking a national network we can affect the global network.

The most eloquent example is the broken of the CERN site by the hackers in the very day of the most important experiment. The informational system of ENRO (European Nuclear Research Organisation) from Geneva was broken by hackers, only to prove that they are the better than the informatics specialists from CERN.

### 3. CONCLUSION

The security of the cyber space is very difficult, concerning coordination and focus of the entire society, governments should work together identifying the threats, vulnerabilities of the systems, and established the measures to improve the cyber space security.

The speed of the cyber attacks, anonymity of the hackers, and the terrorists and criminal attacks at state levels, is difficult to find the authors.

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## IMPLICATIONS OF THE SUSTAINABLE DEVELOPMENT FOR CONSUMERS BEHAVIOUR

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**Abstract:** *This paper had as an emerging point the consumer behaviour definition and the sustainable development concept and aims to provide a comprehensive review of the many perspectives on consumption and try to identify key insights as they relate to sustainability.*

*This paper intended to develop a Conceptual model of sustainable consumer behaviour, taking into considerations three elements: motivations, social and cultural determinants.*

*As a main conclusion, we suggest that there is an opportunity to develop an integrated strategic programme of research and actions that builds on existing work about aspects such as lifestyle theory, the sociology and social psychology of consumer behaviour, and value change in modern society.*

**Key Words:** *sustainable consumer behaviour, sustainable development, motivations, social and cultural determinants.*

### 1. CONSUMER BEHAVIOUR CONCEPT

Consumer Behaviour is defined as being a *dynamic interaction between feelings, knowledge, behaviour and events from the environment, through whom, customers conduct aspects regarding changes in their life.* By generalization, consumer behaviour represents psychology behind marketing and a manner of consumer behaviour in marketing environment. Tacking into consideration multitude of definitions proposed by prestigious specialists, *consumer behaviour* can be defined, in a overview approach, as representing *wholeness of the decisional acts at individual or group level, directly connected with obtaining and use of products and services, in view of gratification of the actual and future needs, including decisional processes which precede and determine these acts.* [1]

Being a multidimensional concept, *consumer behaviour* was approached by many researchers, as a system; an edificatory synthesis of this approach was realized by Philip Kotler, by its transposition in a cybernetic language [2].

From a multitude of definition of the *consumer behaviour*, we can distinguish some basic processes, which are merged to define this concept [3]. These processes refer to: *perception, information, attitude, motivation and effective behaviour.* Even these have many acceptances for specialists. Although process of the effective behaviour can be independently studied, it is not an autonomous process, but it is a specific resultant of a system, built by interdependence of the other above mentioned elementary processes.

The most theories consider that consumer behaviour is only a function determined by social-cultural factors and personal aspects. Culture, social class and position, family behaviour and reference group represents the most important social-cultural factors for performing a marketing strategy.

### 2. SUSTAINABLE DEVELOPMENT CONCEPT

*Sustainable development concept* represents maintaining of a delicate balance between the human need to improve lifestyles and feeling of well-being on one hand, and, on other hand, preserving natural resources and



ecosystems, on which we and future generations depend.

*Sustainable development is that meets the needs of the present without compromising the ability of future generations to meet their own needs* [6].

Sustainable development implies economic growth together with protection of environmental quality, each reinforcing the other. The essence of this form of development is a stable relationship between human activities and the natural world, which does not diminish the prospects for future generations to enjoy a quality of life at least as good as our own. Many observers believe that participatory democracy, undominated by vested interests, is a prerequisite for achieving sustainable development [4].

### 3. IMPLICATIONS OF THE SUSTAINABLE DEVELOPMENT IN CONSUMER BEHAVIOUR

Sustainable development offers a frame for communities for an efficient use of the resources, in order to create new commercial activities, to protect and improve the life quality, to create new commercial activities which consolidate their economy. It can help to create a healthy community, which can sustain even the actual generation, and the next one. The concept of the environmental degradation unplumbed from the economical growth by eco-efficiency promotion and by interpretation of the high standards of environmental protection as a challenge to innovation, new markets and new business development, if we take into consideration the fact that a healthy environment is essential to ensure welfare and quality of life,

*Sustainability principle* designates the gear of three dimensions – ecology, economy and social sphere. Mixing up *the consumer behaviour* with the ecological dimension of sustainability is very important. Economical development and social welfare are possible on long term, only in a well established frame which involves nature as a vital element. The economical and social aspects are important in order to make ecology becoming feasible: ecological manufacturing and consumption are elements that can be realized only if consumer is able to afford them and if both are realized

under acceptable social guidance. *30-40% of the environmental problems are based directly or indirectly on some prevailing consumption models* [7].

In this context, new strategies must propose a way for the sustainable development:

- Quality and preservation of the environment and natural resources essential elements of the sustainable development;
- Management of the manufacturing flow, so that, tacking into consideration the finite character of resources, to facilitate and encourage reutilisation and recycle at an optimum level, in order to avoid loses and depletion of natural resources;
- Modification of the plain society concordant to confined character of the natural resources, so that their consumption or use to be not made in another's detriment, so that exploitation by a generation of the natural resources to not confine consumption possibilities of the future generations.

Environmental policies components must endorse reglementation sphere, but also of the consumers and producers.

*Components of the environmental policies must endorse reglementation sphere, but, also, changes in producers and consumers behaviour and of the whole civil society, by financial measures and resorts. Problems of Know How transfer and communication in the environmental area must be added these above mentioned.* [9].

The reglementation policy tools must be chosen so that they to outcrop a matched mix of their, adapting them for specific application situations. They include:

- *Persuasion policy*, which assumes promotion of the ecological technologies and research, awareness and education and use of market mechanisms;
- *Information transfer policy* encompasses tools for social communication - education, mass-media and public relation – informational systems affordable for public.

At traditional policies pursuing minimization of the environment harmfulness, policies

having as main goals demand satisfaction with a minimum input are added, in manufacturing area, production policies with a minimum output of wasted resources and, also changes in the demand profile.

Nowadays, urban environment became more and more crowded especially by increasing the frequency of the transportation activities. Urbanities specialists are highly concerned with problems of the territorial use. Planning of the territory use needs to be closely correlated with regulations for activities of the transportation services, which must accurately reflect costs of the needs of environment rehabilitation and social costs of maintaining or development of the transportation infrastructure.

A more deepened knowledge of the premises of consumption structuring for other goods and services, is, also, necessary, as a response of the multitude of needs expresses by different consumers' categories. For instance, option for replace an old product with a new one can be underlined by many motivations – that the old one can't be mended, that the new one has superior properties, that there is a use for periodic shopping. Emergency of the consumerism era, in occidental countries, was possible just as a complexity of the consumption behaviour of modern people and his leaning to newness [5].

*Paper* is a consumer good, which manufacturing depends, essentially of the exploitation of wooded lands. Paper consumption, clearly reflects level of civilization and economic development for a country. But the industry of cellulose and paper is not only the biggest wood consumer in the world, but, also the third industry in the world in respect of the financial results, being, in the same time among the first ten most polluting industries. Therefore, in the next 50 years there is expected a hundred percent increasing of demand for cellulose and paper [11]. But, by the other hand, there are still over a billion of illiterate people and over 100 millions of children who don't yet benefit of primary school education.

Generally, encouraging of goods and services demand, mass-media and advertising industries play a decisive role. Mainly, advertising industries affect consumers' motivations,

having a decisive role for consumption structuring and modelling of the concepts regarding goods and services. Some recent studies of the consumption habits sustain that manufacturing response for some consumption needs can become more sustainable, by encouraging the tacking up some services destined to contribute to the raising of sustainability of the goods already purchased, instead to encourage purchasing of new goods. These kinds of practices lead to diminishing pressure of the extractive industries to the environment that can lead to a new conceptualization of the life quality increasing. Some recent analyses of companies affirm that consumers' loyalty for a brand seems to be more encouraged by a bid for services destined to extend the life of the goods in use and less by encouraging of the purchasing new products.

Sustainable consumption and manufacturing models represents an important determinant for the environmental problems at every level, from the local level to the global level. For this reason, a main object in Agenda 21 (The World Conference in Rio de Janeiro, 1992) was *Changing Consumption Patterns*. Sustainable consumption represents a very wide area, requesting an interdisciplinary approach. The change of the consumer behaviour is a process involving many social groups: ménages, which represent the biggest group of consumers, authorities, economy, educational institutions, NGOs and many others.

A change of the consumers' behaviour means primarily a fundamental transformation of the values and life style. The change of the thinking and acting kind of the consumers can't be imposed by the authorities. The emergence of new and durable traditions in consumers' behaviour requests a wise informing and consulting campaign. As regards of the consumer, goods and transportation ways must become more transparent, price of the ecological true need to be clearly expressed and those alternatives for the environment protection must be as soon as possible shown.

#### 4. AREAS OF ACTIVITY OF THE SUSTAINABLE CONSUMPTION

Question about the concrete measures for the implementation of the sustainable behaviour regarding consumption appears only in a

second stage. A very important role was allotted for areas as:

- Avoiding of the waste products accumulation;
- Energy and water consumption;
- Mobility;
- Feed;
- Reuse of the objects.

In order to attain a sustainable growth, material consumption of the industrialized countries must be diminish. This is possible because in the last period goods having a low content of raw material was introduced in market, for the automobile industry, for the equipment industry and for that of the wrapper. There are motives for which a decrease of the material and energy consumption doesn't necessarily lead to a diminution of the total consumption. Thus, increasing total quantity of the used merchandise cancel savings obtained in technology of their realization. Secondly, motivation for producers to realize ecologic goods is related mainly with economic interest, which operationalizes the new sustainable technologies. The classic case is represented by the fridge with low energy consumption, but more expensive than the conventional one. Another solution for the sustainable consumption consists of realization of goods having long term of working. This is only a part of the new approach, which imposes a new vision to merchandise, according consumers' needs.

There are many problems: it is not clearly how the consumers are prepared to accept prices of the ecologic goods. A strict legislation in this area imposes serious pressures to the economic agents.

They began to understand that not only attention paid to different goods separately seen. This imposes a new approach, named metabolic, which approach the whole anthropic system.

They began to understand that there is not sufficient the attention paid to different goods separately seen.

Some specific studies showed the ecologic impact of the services, building concept of *services efficiency* meaning to offer a maximum result for consumers by use a minimum

quantity of raw materials and energy. The most important feature of this concept consists of the fact that in our days, satisfaction is generated not only by the products, but even by services which they provided. In other words, products offered represent only tools for services obtaining.

## 5. IMPLICATIONS TO THE ELEMENTARY PROCESSES WHICH DEFINE-CONSUMER BEHAVIOUR

All the same, consumer behaviour is influenced by numerous variables acting tightly. Consumers' Behaviour is influenced by many factors:

1. *Direct observable influences*
  - *demographic factors*
  - *economic factors*
  - *factors specific for the marketing mix*
2. *Endogenous influences*
  - Perception
  - Information/learning personality
  - Motivation
  - Attitude
  - Exogenous influences
  - Family
  - Membership group
  - Reference group
  - Social class
  - Culture
  - Sub-culture.

In the last two decades, *social analyses, focused on goods and services consumption of the occidental people changed significantly, as regards ideas and general sense of the message*, leaving pro-consumerist messages for those anti-consumerist.

Some papers published after 2000, underlined a new criticism current in the area of consumption patterns in occidental area, highlighting more clear tendencies of some social categories, to engage in activities less oriented to consumption. Some authors, as *Zavestoski (2002), Schor (1999) or Hamilton and Mail (2003)* was concerned even to initiate market studies for anti-consumeristic attitude or for return to some extremely simple consumption practices, protective with maintaining the environmental ecologic equilibrium. There are analysts of the consumption patterns like *Lunt*

& Livingstone (1992) or Humphery (1998), who study a new orientation of the consumers – to limit satisfaction of the consumption needs by different good and services markets, as a consequence of the highly critic attitudes.

▪ *Perception*

The most important feature of perception is the fact that is selectivity, as being complementary for needs, because of the consumers' features.

A useful concept is *the difference just indistinguishable*, for instance, in cases of price increasing motivated by different factors, such as *green tax*. If the increasing of price doesn't exceed *the difference just indistinguishable*, it is possible that demand for a specific good to be not affected.

*The need to comprehensive reglementation*

The ecological manufacturing and sustainability can gain a certain influence against consumers' decisions, but the price still represents the key variable. All researchers agree this. Nobody will pay, for instance, fourfold for a fridge just for its less energy consumption. Central administrations need to establish specific reglementations, to recommend minimal prices for the *unfriendly goods for the environment*, in order to make certain the fact that they are not cheaper than those being *friendly for the environment*. These could increase consumers trust.

*Feelings and emotions consideration*

There is a real potential in this area, for instance that demonstrated by the success of some brands in cosmetic industry. Companies should recognize opportunities and gains generated by the sustainable goods and shouldn't only pertain to risks and costs.

Another example in this area is represented by the fact that some studies demonstrated that those advertisings which highlight the fact that the good had in sight doesn't encompass children' work, are irritating for consumers, because they assume a priori that manufacturing is correctly from the point of view of the policies. Furthermore, terms like *children exploitation* have negative connotations and can cause damages to the positive experience of goods or its purchasing, irrespective of context.

In marketing terms, it is vital, the fact that green goods meet their goals, this making consumer fell that do the right things.

Selection of the consumers' perceptions is much influenced by their attitudes in the moment of their reception.

*Consumers' expectations* are closely linked to the process of perceptual selection, implying them percept goods and their performances from the point of view of the benefits they expect to obtain. Market researches show that consumers consider first personal benefits and not these for the environment. For instance, in a supermarket consumers don't wonder first: *Do I the right thing buying this?* but: *If I will buy this, it will be good for me?* Thus, they are ready to pay more for this kind of goods. And only after that, they consider that the good must be manufactured in ecological conditions.

*Reasons* can play an essential role, too, in perceptual selection, being known the fact that people perceive good related their needs and desires. An intense need determines a person to ignore some perceptions and select only those are related to these satisfaction.

▪ *Information*

Perception is first, related to the *awareness/learning process*, which represents an ensemble through people know goods.

In awareness process, specialists pay attention to information sources.

Researches upon consumers' behaviour and attitudes in last decades showed a real interest of them for problems of environmental harmfulness. But there is still a long distance from attitude to their transformation in practices. In real life, consumers almost don't poses information about present and future effects of consumption decisions to environment or to other people.

In the same time, consumers manifest their decisions in a world where merchandise already are in last processing stage a major change being hard to obtain. The observed changes in consumer behaviour can be seen only in tight areas; they must be supported by strong awareness campaigns in order to become dominant market behaviour being significant for producers. But there is another dike: market is already saturated by advertis-

ing messages that increase chances that these campaigns be fast forgotten.

Generating important changes will occur only after a radical change of consumers' attitude. This requests a redesigning of prices policies in order that non-harmful for the environment goods to be chosen and opposite policies to be punished. These request other policies for consumers' information. A study performed in 1990 by Winkler and Voller identified a correlation between consumers' attitude and environmental impact of goods. This correlation was revealed related domestic energy consumption which decreased in those countries where ecological attitude increased, Holland, Germany, Denmark and Sweden.

- *Attitude*

Attitude was accepted more and more as a multidimensional concept, as a syndrome of constant reactions against social objects [8].

An interesting fact is that, in fact, consumers are not concerned directly in reducing energy consumption, but in a specific choice about buying daily goods. Consumers take decisions when use or discard concrete goods. This means that concrete manifestations of these mental attitudes need to be analysed.

Globally, specific studies identified phenomena of take-over consumption models from developed countries by the developing countries; there is a problem regarding this because first habits related goods having most important impact against environment (cars, steel, and electricity), whilst consumption models for less harmful goods are less convincing. Though, solution consists of modeling consumption attitudes.

Care for environment protection is confronted with interest for personal satisfaction obtaining.

*Investments for Sustainability*

Transparency and accessibility of goods and producers are essential both for consumers and stakeholders. Many companies accomplish increasingly sustainability criteria. A specific degree of this criteria knowledge can determine consumers of the goods they offer to identify themselves with these companies' values.

- *Motivation*

Motives have a broad multidimensional character, being built between biologic and social, between internal manifestations and knowledge, between subjective necessity and values as reference system, between objects and their linkages with people. Because of these they can't be reduced only at a determinant factor. In order to design an efficient marketing policy, it is important to concern that motives are learnt and they have stability in time, being hardly changeable.

- *Effective Behaviour*

Effective behaviour is not an autonomous process, though it can be studied relatively independent; it is a specific resultant of a system constituted of the above-mentioned elementary processes.

*Avant-gardist demand*

There are practically demonstrations of the fact that avant-gardist demand establishes trends which involve most of the consumers. In this respect, female consumers play a decisive role as follows they manifest much more responsibility and involvement in buying acts. They stand on utility, longevity and social or ethical standard.

### CONCLUSIONS

Operationalizing studying of the needs, values, behaviours, psychology or aspirations of goods and services consumers is a laborious and complex process because every chapter of people consumption as well as market dynamic of every good or service follow specific laws and there are necessary separate investigations for every good or consumption chapter, in order to explain or forecast general or sequential behaviour of the consumers.

*Nowadays, there is no exhaustive understood of consumption components or of real motivations for adopting specific consumption practices, even in this area there already are accumulated many studies, observations and methodical researches.*

But it was never possible an investigation totally satisfying in respect of the rationality of the consumers, so much the less in respect of the unconsciousness impulses lying the effective consumption behaviour. Anyway, the social and economical theory of consumption mad important steps in respect of the delimita-

tion between rational and emotional motivations of goods and services purchasing.

Changes dynamic in goods and services markets was very high in the last two decades. In those countries having market economies, where profile of demand rapidly changed, these lead to a rapidly change of the offer parameters and default changes of some elements of the research methods and techniques of the consumption patterns.

Adoption of some sustainable practice of consumption involves use of correlated goods and services which answer to satisfaction of basic needs, under conditions of minimization of the natural resources exploitation, avoiding resources waste and polluting emissions, along an entire life-cycle, so that these don't affect life chances of future generations.

Desirable changes of some features of the consumption patterns as follow as new exigency imposed to manufacturing processes involve:

- Promotion of the examination of those consumption patterns which block sustainable development, as well as of the modalities of changing these behaviour, at global level, endorsing especially those people having a consumerist life style
- Identification of the most efficient policies and tools for break-up the unsustainable consumption/manufacturing patterns, including by information dissemination and ecological alert
- Performing a more equitable distribution of developing resources inside and between countries.

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## POSSIBILITIES FOR GROWTH OF THE ROMANIAN FIRMS COMPETITIVENESS BY BENCHMARKING METHODOLOGIES APPLICATION

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**Abstract:** *This paper emerged from the Porter's Competitive Model and from the Philip Kotler's point of view related to the competition' analysis process and to the competitive advantage looking for. In order to these, this paper intent to explain the reasons what for, the benchmarking can be a useful appliance for the value analysis. This management technique offers an important advantage, enabling the measurement and comparisons with other areas leaders' performances.*

**Key Words:** *benchmarking, performance, competitive advantage, competitiveness*

### 1. INTRODUCTION

Although relatively recently introduced in management's lexicon, benchmarking imposed a series of interesting definitions, which expressed, essentially, an idea, with little variations reported at the authors' opinion. In the *Benchmarking and competitiveness in European Industry* Communicate, benchmarking is defined as *an instrument that assists the enterprises, industries and public authorities to improve their performances in those critical processes, dimensions and zones that affect competitiveness.*

### 2. WHAT IS BENCHMARKING IN ECONOMY GLOBALISATION CONDITIONS?

The new millennium beginning brought an increasing globalisation of the economies, with companies competing more and more on a increasing number of diversified intern and international markets. In time what the globalisation led to growth of the efficiency, as a consequence of the competition consolidation and a more favourable allocation of the resources, the organizations get trust in them possibilities to penetrate new markets.

By political point of view, the governments increase the efforts for helping the organizations, on the basis of multilateral commercial accords at the level of the countries members of the E.U. benchmarking, reported to frame – conditions is applicable for the key elements of these, which affect the attractiveness of the regions, states members of the E.U. and of the whole E.U., as a destination of the investments, and the business medium, where the companies operate. The frame – conditions benchmarking allows the evaluation of the efficiency of the public authorities' policies and the identifications of the steps claimed of their improvement. Although the policies aim, mainly, the internal market, they must be elaborated in a global context, therefore, in the globalisation conditions, benchmarking is necessary for gaining a competitive position on the market.

M. Porter identifies five sale forces - see figure. 1 [5], and Ph. Kotler notices that in the analyse process of the competition and in the competitive advantage searching the value analyse for the client is used, that, because of the technical progress and of the economical climate changes, will be changed. [4] The economical climate change determines a

change management, which requests abilities such as improving and innovating.

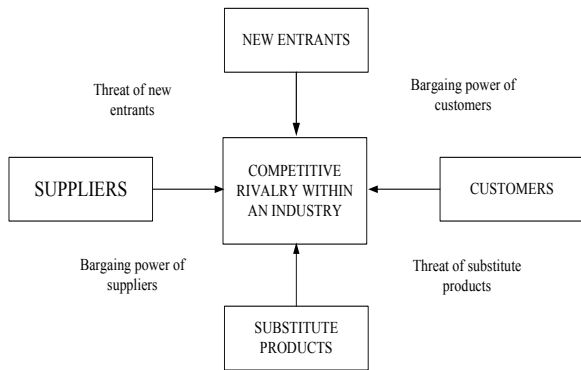


Figure 1: Porter Model

### Porter's Model of Industry Competition Structure

In recent years, industrial organization economics began directly influencing corporate strategy. The most representative of this influence can be seen in Porter's model of industrial competition. Porter's model lays its claim as a comprehensive approach for evaluating the competitive relation between industries and for forecasting economic performance. Porter developed the concept of competitive advantage, and through it he provided a number of insights into the firm's growth and development. According to Porter's reasoning, competitive advantage is only possible through competition strategy (differentiation strategy, focus strategy, and cost leadership strategy) attained through analysis of industry structure. In structural analysis, the firm must understand its current situation and its progress relative to other players in the industry. Competitive situations such as barriers to entry and mobility must especially be understood in industry analysis. In his famous Five Forces Model, Porter described competition-inducing forces as: the bargaining power of purchasers and suppliers, entry threats of potential competitors and exit threats of existing competitors, threats of substitutes, and rivalry among competitors. [5]

In competition, it is important to create value by satisfying buyers' needs. This value is created in line with the firm's value chain of primary activities and support activities. In providing value, formulating and

implementing strategies becomes a central source of competitive advantage. The focus of Porter's model on external shocks resembles Adam Smith's concept of the "invisible hand." Porter's model is excellent in forcing the firm to investigate what it needs to do in order to survive and prosper.

### Resource-based Management Theory

This theory emerged in 1984 and treats the firm as a collection of resources rather than a collection of products and market position. This theory understands strategy as the creation of competitive advantage through resources which offer distinctive competence.

In the basis treatment of firm's performance (profits), while industrial organization economics explains profit by relating it to the selection of industry, resource-based management theory tries to explain the difference between firms from the resource standpoint.

Resource-based management theory is Ricardian in nature, inasmuch as differences in firm performance are understood as not being caused by differences in market power but rather by differences in a firm's capabilities (seeds). The emphasis of this theory is that it is the inimitability of resources and competence in the long run that provide competitive advantage. The analysis of this theory, at the firm level, utilizes resources as the basic unit. Of course, 'resource' can be either physical or non-physical. Also, this theory is equilibrium-oriented rather than process-oriented. Prahalad and Hamel re-designed the concept of distinctive competence into the core competence concept in the 1990s. In this theory, corporate success is determined by the core competence of the firm. [3]

The most notable contribution of core competence was its idea that distinctive technology and hidden techniques are critical for success.

Despite its rapid progress, resource-based management theory still has many weaknesses. For one, it is difficult to determine which combinations of resources are most critical for obtaining success. Even if this determination is possible *post hoc*, it is difficult to do so beforehand.



Porter (1991) claims that resources have value only in cases where the firm can create competitive advantage in certain markets.

Another weakness in the lack of a framework for dynamically explaining the interaction between resources and the environment, it is that it is possible for an advantageous resource, without undergoing change, to lose value with the flow of time. Concerning this, Teece-Pisanoo-Shuen and Mahoney-Pandian (1992) studied the organization's capabilities and resources from a dynamic standpoint, but it should be kept in mind that their theory is still static in nature.

One of the core concepts of this theory, i.e. sustainable competitive advantage (SCA), is an equilibrium concept. This theory assumes that the firm pursues advantage through the accumulation and utilization of inimitable resources. However, it lacks a mechanism which connects resources to the dynamics of the market. Moreover, it has not yet established a framework for explaining the accumulation and operation of resources which create sustainable competitive advantage.

• *Strategic Management Theory*

Adam Smith's theory took to life again in Strategic Management Theory, which utilizes his ideas of labor division (specialization) and the invisible hand (market mechanism). Strategic management theory, which grew rapidly in the 1980s, argues that performance is affected by particular attributes of the industry and the firm's distinctive competence. Strategic management attempts to determine the performance of firms as a function of competitive advantage. Modern strategic management theory says:

*performance = Industry-specific characteristics, Firm's distinctive competence,*

or

*performance = sustainable competitive advantage.*

However, it must be admitted that modern strategic management theory does a poor job of conceptualizing the ideas of industry-specific attributes and distinctive competence. In addition, the concept of sustainable competitive advantage is still underdeveloped.

Benchmarking has in sight the partners – clients from industry, too, those who secure goods for market and the individual users of the goods and services – who are involved, in sense that they will supply information about the market's trends (they play an important role as sale force).

There are organizations that are destined to failure and because of they are not abreast of the events with all the changing which affect their domain of activity, relying on unverified or insufficient information. Other cause for failure can be represented by the managerial incompetence.

The estimation of the performances of a company comparing with other one from the same activity domain and the reference point used for the evaluation of the organization performances represents *benchmarking*.

Benchmarking has in sight the customers – business partners, from industry, but, also, those who secure goods for sale and individual users of products and services, who are involved, in sense of information supplying about market's trends (they play an important role as sale force).

*Benchmarking* is an organizational change process directed toward deficiencies correction, a continuous process for searching the best practices with the aim of increasing some aspect of performance. Through benchmarking the organizations looking for the best methods to improve their performances, but also the manner in which these methods are integrated in the working mechanism. Benchmarking is not a simple comparison method between indicators; it represents that study of the processes, practices and methods used by the organizations that obtain performances in their activity sector. Therefore, it is not limited at the information obtained relating to direct competitors. Much more, innovation through benchmarking is looked for, beyond the activity domain of an organization and, also beyond the national boundaries (it is spoken about benchmarking having as a purpose a competitive European economy and society).

Advantage of the benchmarking for a company:

1. A better understanding of the wants (expectations) of the customer because it is based on the reality of the market estimated in an objective way;
2. A better economic planning of the purposes and the objectives of the company by centring on what takes place outside controlled and mastered;
3. A better increase of the productivity: resolution of the real problems. Understanding of the processes and what they produce;
4. Better current practices. Search for the change. Many decisions practices of break;
5. A better competitiveness thanks to solid knowledge of the competition strong implication of the staff new ideas on practices and tried techniques.

Benchmarking has consequences which are beyond the process itself: it reforms all the levels of the company; modifies the process of manufacture of the product leads (drives); also, reforms the hierarchical organization of the company, the product itself, and the state of mind of the employees.

Benchmarking of those factors, which contribute to a superior economical performance in some countries, allows the identification of the determinant elements for competitiveness:

1. High quality of the infrastructure (energy, transports, telecommunications);
2. Access costs to this infrastructure – taxes system;
3. Quality of the settlements related to labour force employment.

In the globalisation conditions benchmarking must have in sight the new competitiveness factors, which include: innovation, informational society, human resources, education sustainable development, environment, small and medium size enterprises' (SME) role and public services.

*Innovation* also represents a key – factor. A revolution in informational society and informatics services is in proceeding, especially in electronic commerce and new business services, which represent very important domains, which claim priorities in

policies. The national innovating system of the E.U. states involves, mainly, the organizations, the research public and private institutes, the governmental institutions and other public entities which are influenced by factors like: financial system and corporative government, legislative frame, educational level, professional preparing level, labour force mobility degree, industrial relationships and actual management practices. Benchmarking could play a major role in using of the opportunities offered by this revolution for the organizations.

*The human resources development* in knowledge based society – and, also of all involved institutions (schools and universities) – represents a crucial factor, which is the fundament of the competitiveness. The rhythm of change, the actual society knowledge based, the need of permanent learning – continuous education model, the mode of free time spending, all of these impose to pass from a rigid, static system, to a flexible and innovator labour organization system. Social partnership and growth of participating methods at national and international level and informational flux improvement represent determinant factors for this modernization achievement.

*The sustainable development* imposes non-polluting manufacturing processes application and, also an ecological behaviour, efficient for limited resources exploitation. The competitiveness growth of the European industry must be not in contradiction with a high degree of environmental preservation: healthy policies elaboration should and could lead to competitiveness growth and to new labour places. The challenge consists of using benchmarking to support this process. The sustainable development problem must be approached by the best practice applying, so that it could be guaranteed the long-term viability of the production activities.

The services ensured by the public institutions – educational and healthy institutions, settlement or licenser authorities – are parts in the conditions which influence the businesses development and they must be had in sight for the best practice related to efficiency and quality, but, also the customers'

satisfaction. Therefore, the public sector should be encouraged to use benchmarking as a current policy. Benchmarking in public sector could have long-term effects, stimulating the permanent learning; the knowledge and models existing in the E.U. countries should be capitalized. The innovating projects definition and selection, human resources development, sustainable development, SME development and new forms of labour structure should represent the object of benchmarking application.

### 3. BENCHMARKING METHODOLOGY IN GLOBAL COMPETITIVENESS CONDITIONS

*Benchmarking* is a multi-level strategy, which aims efficiency growth, quality improvement and changes initiation in these respects. The requested conditions for change resistance exceed and for obtaining support for those activities which determine change, are represented by total engagement from the executive management or from those who elaborate the industrial policies.

*Benchmarking* in E.U. institutions could be applied to the policies objectives and therefore should be understood like an instrument helping to the policies elaboration. Its methodology consists of some elements and procedural steps. Benchmarking should be supported by the research and it should use quantitative and qualitative marks for the best practice analyse. The benchmarks show the performance level and the requested target.

The best practice demonstrates how this target could be touched. The best practice knowledge could be a good opportunity, but, also a stimulant for those who elaborate the policies, for their performance improvement and even for exceed the targets.

From the moment of the objective defining to the implementation phase, benchmarking, as a process of comparison with the best in the world requests some steps.

Four levels and some steps can be identified:

1. Total engagement for the activities improvement: identification of the target problems and of the decisional factors of the domain;

2. Supportive structures: key - quotes of performance, the best practice existing in the E.U. countries analyse, the own practice with the best practice comparison, improving and learning mechanisms, improving potential identification, changes implementation;
3. Monitoring mechanisms: report about the progresses.

These steps represent basement for a universal benchmarking methodology.

Because benchmarking developed in organizations in scope of the performances and productivity improvement, imposed by the globalisation of the competitiveness, this methodology is applicable and accessible especially at the organizational level, where the improvement possibilities can be easily identified and implemented. In the private sector, theoretically there are not limits for this methodology approaching. It is applicable for the inputs, for the outputs, for the methods, processes and short and long term objectives.

The available types of benchmarking are applicable at the internal level (comparing units of the same entity), but, also at external level (comparing entities with similar characteristics) and for products, operations (comparative analyses of specific operations, functions or processes) and for strategies (establishing the targets and objectives).

There is not a methodology with general applicability. It is more difficult to compare activities, efficiency and production for the public services or in political sector, than in private sector.

The governmental institutions having responsibilities in the infrastructure domain should consider benchmarking being an instrument for the performances improving, but task of the identification and implementation those elements requested by changes is much more complex. The simple copying of a factor or a policy could not lead to the obtaining of the desired performance. What is important at the benchmarking application is the identification of the steps requested for each factor.

Benchmarking requests a consistent set of definitions for all components of the numerous factors involved in process and, also

a correct understanding of the purpose and of the supportive policies.

The philosophy and the concrete steps of the benchmarking activity are almost similar for different activity domains. Yet, the SME could apply more rapid the improving measures as a result of benchmarking application. In addition, new methods for labour structure are had in sight in case of the institutions of design, as a response to the necessity of the initiation of the improvements asked by the key – sectors as a result of the benchmarking application. [1]

Actual structural inflexibility in the governmental act (public services and afferent institutions) slows down improvement of the frame – conditions for the key domains established by benchmarking. In addition, there is a shortage of political power at European level and often at the level of the E.U. countries, for immediate implementation of changes orientated toward the best practice. The key strategy at this level is preparation for the implementation.

This indirect implementation is very important at European level and especially for the E.U. countries. The competitive postponements recognition and cost in economical and social terms of these should show those who elaborate policies the importance of the strategies and structural changes implementation.

At European level, benchmarking for the frame – conditions for industrial competitiveness could constitute, basically a problem of information and communication

with those levels where the changes are implemented, for the best practice encouragement.

In these terms, we could talk about a benchmarking of the competitiveness, which aims as a long-term objective a sustainable welfare setting. Benchmarking is bad understood if it is seen just as an instrument for costs reducing on short term. This kind of interpretation discredits even the benchmarking concept in conditions of an innovation and economical development society designation.

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## INCREASING THE PRODUCTION QUALITY AS A RESULT OF CONSTRAINTS IMPOSED TO THE SUPPLIERS

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**Abstract:** *The competitiveness and position of a manufacturer in the market is decisively influenced by the quality of its products. The faultless quality and reliability of purchased products (components, raw materials) utilized during fabrication, have a direct influence on the quality of the company products as well as achieving the intended quality objective of "zero defects". The minimum requirements that are placed on the supplier's quality management system represent an indispensable step for a future business relationship between manufacturer and its suppliers.*

**Key words:** *quality, manufacturer, supplier, management, system, product.*

### 1. INTRODUCTION

The term *quality* means different things to different people such as: "*Quality is the degree to which a specific product satisfies the wants of a specific consumer*"[1], "*Quality is fitness for use*"[4], "*Quality is the degree to which a specific product conforms to a design or specification*"[3], "*Quality is the degree of excellence at an acceptable price and the control of variability at an acceptable cost*"[2] etc. The main way to increase the quality of the product/production is to improve the quality system management, to involve all personnel into the act of quality and to get the best materials/components during the process of production. Having in view the last way to increase the production quality, it is useful to create a relation between manufacturer and its material/component suppliers, which supposes to have some restrictions regarding the quality system of the supplier.

### 2. SUPPLIER'S RESPONSIBILITY FOR THE QUALITY OF HIS PRODUCTS

The main responsibility of the supplier is to provide the manufacturer with products free from defects which are in accordance with the agreed technical documents. The supplier must check that the documents are complete and correct and, if any issues are unclear, request

further information from the manufacturer. If the supplier places orders with subcontractors, he is under obligation to implement the same requirements in relation to his subcontractors according with he's obligations to the manufacturer. The quality strategy of the supplier must be oriented towards continuous improvement of his processes. The objectives are "zero defects", 100% delivery performance and the reduction of costs.

The supplier has the whole responsibility for the product supplied by him.

The supplier also undertakes to meet promised deadlines, e. g. for delivery of samples, introduction of corrective measures, etc.

The material/components supplier is mandatory for to be ISO 9001 certified and/or to have other requested quality certification.

In order to be classified as a strategic supplier and thus special consideration when orders are placed, the supplier undertakes to develop his quality management at least at the level of the quality system required by manufacturer.

In individual cases, additional certificates can be contractually agreed for certain sectors (e. g. military), depending on the product application.

***Evidence of the quality management system***

The supplier must notify the manufacturer regarding any changes of the quality management system or after expiry of the period of validity or withdrawal of certification.

***Checking the quality management system, process and product quality***

The supplier must conduct internal process and product audits at regular intervals.

If the supplier is found to have quality or system deficiencies, the manufacturer has the right to check compliance with his quality requirements. Depending on the situation, this check can be carried out in the form of a technical or quality discussion or of a system or process audit as agreed prior to implementation.

Where necessary, the manufacturer is also entitled to examine the supplier's quality assurance measures following prior agreement of an appropriate date.

The supplier shall grant the manufacturer access to the relevant areas and permit viewing of the corresponding documents.

**3. FUNDAMENTAL PRECONDITIONS, PREVENTIVE MEASURES AND CORRECTIVE**

In order to anticipate the defects on the fabrication process, specific preventive measures must be introduced before starting the production. Defects occurring in production must be detected in good time to allow the introduction of suitable immediate correction measures.

***Technical documents***

The quality characteristics must be complied with the technical documents, such as drawings, material specifications, procedures and delivery conditions, design briefs and design specifications from the manufacturer. The manufacturer shall always provide the supplier with the latest technical documents. The supplier is under obligation to ensure that production and inspection is carried out in accordance with the documents

available to him and agreed with the manufacturer.

***Production process***

In order to ensure that the requirements associated with the mass production of products which conform to specification are met, the production process must take place according with relevant documents, records and initial mass production samples.

For initial production sampling, and thus prior to mass production release, the supplier is solely responsible for assessing the effectiveness of his mass production process. A trial production run takes place to establish whether the existing mass production process is capable to manufacture the products to the customer's required quality with the agreed production capacity, for a stipulated period of time.

Initial mass production samples are products which have been manufactured in full using standard operating materials and under standard conditions. They must be taken from a batch size which is representative of the mass production process.

The supplier must prove that all features correspond with the manufacturer's specifications including corresponding technical delivery conditions and specifications, by specifying the inspection results in the inspection report for initial mass production samples. Deviations must be clearly shown in the inspection report.

***Statistical process control and volume production inspection***

A consistent quality level can only be achieved through a stable, statistically reliable process. In this respect, the supplier must use suitable control methods, such as records generated parallel to mass production.

The supplier is under obligation to take random samples at regular intervals, to conduct the analyses and to document the results. For a lot to be accepted, the random sample must not contain any defective products ("zero defect" principle).

Statistical process control (SPC) based on manufacturer agreed methods, is mandatory in the product process. The process capability for

the agreed characteristics shall be made available to the manufacturer.

***Detection of defects at the supplier's premises***

During fabrication, if the product to be supplied is found to have a defect, the supplier must interrupt and correct the process immediately. In this instance, all products manufactured since the last random sample inspection that gave a positive result (last good part) must undergo a 100% inspection. Defective products must be secured without delay and stored in a safe place ("quarantine store") until the cause of the defect has been resolved. All corrective measures introduced must be clearly documented in the records.

If, following a subsequent inspection, the defective products cannot be reworked then these must be scrapped. In the event of rework, all stipulated volume production inspections must be carried out.

***Request for special release***

In the event of deviations from the product specification (drawing, technical delivery condition, material, material properties etc.), or from the approved process, the supplier must apply to the manufacturer for a special release before the products are despatched.

***Request for modification approval***

In the event of planned changes regarding products, processes, materials, tooling or production site (transfer), the supplier is under obligation to submit an application to the manufacturer.

***Detection of defects at the manufacturer's premises***

If defective products are detected only once they have reached the manufacturer, the supplier is under obligation to introduce appropriate measures immediately to contain the defect.

The manufacturer notifies the supplier of a complaint in writing and they are incorporated into the supplier evaluation, which represents an important decision-making criterion for the manufacturer in the placement of new orders.

***Escalation process***

In the event of cumulative quality problems or repeat concerns, the manufacturer

is entitled to place increased demands on the inspection of goods at the supplier's premises or to introduce other measures, which may even culminate in terminate of the contract.

***Packaging and marking***

The supplier is responsible for protecting the products supplied by him and must use suitable packaging / external packaging and means of transport. At delivery, both the (external) packaging and the products themselves must be marked in accordance with the agreements made with the manufacturer and the manufacturer's valid packaging specifications.

***Requalification inspection***

All products must undergo a full verification, performed by the supplier in accordance with the control/inspection plan, whilst taking account of the manufacturer specifications for material and function. The results must be made available to the manufacturer on request.

***Evidence of material properties***

As evidence of the material properties of a volume production product, the supplier must prepare inspection certificates based on the technical documents agreed in writing and send these to the manufacturer.

***Archiving of records***

For the purposes of traceability in the event of a quality defect, the supplier is under obligation to store quality records generated parallel to production, e.g. measurement records, material test certificates or other test results, in a safe place after their creation according with the manufacturer agreed period. Documents and records for characteristics requiring documentation must also, be stored in a safe place. Characteristics requiring documentation are clearly marked in the technical documents (drawings and specifications).

***Inspection equipment***

The supplier is under obligation to equip himself with inspection equipment which allows him to check all product characteristics. If an external audit company is used, this must be appropriately accredited to carry out inspections. Where necessary, inspection

equipment and inspection methods should be matched between the supplier and the manufacturer.

***Environment, safety, recycling***

An objective of the manufacturer is to eliminate negative effects on people and the environment due to his products and those purchased by him. The supplier is under obligation to comply with the relevant valid laws and directives.

***Checking of contractual products supplied***

The supplier is responsible for delivery of the contractual products ordered in accordance with the specification. The supplier is notified of any detected deficiencies.

***Delivery performance***

The supplier is under obligation to comply the agreed quantities and dates. Deviations from the agreed delivery date and agreed quantity can be also fed into the supplier evaluation, which represents an important decision-making criterion for the manufacturer in the placement of new orders.

The supplier must assess his delivery performance to the manufacturer on a regular basis – including cases associated with additional freight costs. This data must be made available to the manufacturer on request.

**4. CONCLUSION**

In order to increase the quality production of the manufacturer it is necessary to have some compulsory requirements of the materials/components suppliers regarding the quality system.

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## „APPLICATION NEW TRENDS OF MANAGEMENT DEVELOPMENT TO MILITARY EDUCATION“

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**Abstract:** *The article dealt with some aspects of education and manager preparation in special military environment in Bologna process spirit. The article confronts new modern knowledge society on education system with present education on universities. With details analyzes new trends in management development and their implementation to education in military environment*

**Key words:** *Theory of management, education, implementation, military environment, needs of labour market, knowledge society,*

Making of knowledge society is made from Lisbon strategy in Slovak republic condition. It is one priority which is in program declaration of government SR. Modern understanding in knowledge society know society, which prosperity is on market knowledge economics which make material base for high level of human quality of life. We know knowledge economics like generation and using knowledge for make surplus value.

Main conditions in knowledge economics making is:

1. Make complex condition for knowledge organization development.
2. The better quality of education.
3. Make the better quality of research base.
4. Make quality in IT structure.
5. Effective functioning of public administration.

These conditions make ideal status in education area:

- Effective spend resources to quality education system
- Education system have to provide high quality of labour power
- This status have to adjust of businessmen interest and school absolvent

Analysis of nowadays status – university study

Nowadays system of university education is not good for needs of knowledge society and we don't realize transition from traditional to modern system of education(1).

External appearances are for example:

- Excessive increase number of universities – 33 and others are waiting for accreditation,
- Today we can not define elite university in Slovak republic
- Teaching least one subject in foreign language is only praying ambition, which quality of knowing foreign language in general is on poor level
- In making scale of school rating in international measure is our result very low.

Absolvent's in condition of market economics leave schools without basic law and economic knowledge. These external appearances is with high probability make by situation in university teach staff, where system prefer stagnation, because there isn't relation between achieve results of "product" i.e. quality of absolvent. We unapplied system to evaluation of quality university results using abroad, for example monitoring of refuge salary of students which are in their first work , in choosing manage worker is on desert and general accept principle.

Some limitations hold over and are not seemly solution:

- Low cohesion of education contents to long – time needs of labour market and making knowledge society, like result of absence long – time vision or strategy in economics and social development in Slovak republic
- Relative low quality and effect of education for needs of knowledge economics
- Low participation of resorts, self – government, social partners and relevant institution of business sphere to make contents of education
- Accretion separateness system of education from economics needs
- Deforming labour market, which needs only chosen type of qualification
- Low participation GDP using for education, science, research and development
- Low language knowing by teachers and research workers
- Low level of remuneration pedagogical and research workers
- Absence invested stimulus for knowledge economics and education support.

To very big limitation belong monitoring new trends in management and following their implementation in education process. In the last 25 years rise row of theories which we can define in following way(2):

MBO – management by objectives. MBO we can make by using package of target or plans. MBO can keep SMART criteria, i.e. that target in MBO have to be SMART:

- Specific
- Measurable
- Achievable
- Realistic
- Time – specific

Main principles of MBO:

- We have to make target of organization by cooperation with subordinate
- Task, which follow on target and by using strategy is dealing before entry and is import in written form
- Periodical scoring executed targets and deduce of result if we fail – for company and for worker – need correction in chosen strategy and in chosen plan.

CRM – customer relationship management

Target of CRM is making that relationship with customers which are useful for company.

KAIZEN

Before it were Japanese philosophy of management which is based on improvement in personal, social and work life for which are responsible all company workers. Accent is given to quality control and improvement.

Kaizen is approach, which is based on two words:

1. Improvement – we can improve all – quality, fill terms, costs, productivity
2. Continue – nothing is defined in the world, everything is in continued development and is changing – markets, products, customers and employees.

CPM – corporate performance management

Corporate performance management means continued beating up of company by improving his each part (part of company, level of management, people and so on). Sense of CPM is to fill company vision with continued all internal process. Primary part of CPM is make plan, which improve output chosen organization, especially make target and results, which organization have to achieve and

next assurance of instrument, which can help to fill target of organization.

#### IDS Scheer

Company IDS Scheer was arising in 1984 by professor Augusto Wilhelm Scheer. This company offer strategic guidance for company process improvement and complex result of supporting information systems. This system helps to optimize internal process in chosen organization and connect supplier and consumer chains with ERP (Enterprise resource planning) support. ERP is managerial information system.

#### CSR – Corporate Society responsibility

In complex perception of economics and general approach to life and work we can forget on responsibility of individuals, teams and organizations. Their behavior and way of negotiation have influence to whole society. Concrete answer to expression of responsibilities is social responsibility of organization (Corporate Society responsibility). Negotiation by individuals is in harmony with their principle, teams make concrete version and organization realize it.

#### Corporate Governance

The term “corporate governance” is using in special literature like term “society governance”. Corporate governance introduces completion of relationship by management, board of director, stock – holders and other stakeholders. Corporate Governance is structure of organs, which make decision about company targets, about instruments, which we use to achieve target and which monitor output of company.

#### Core business

Core business in simple means concentrate manufacturing program to very narrow area which make competitive advantage. Concentrating to main business activity, company focus on activities to make value

and eliminate activities which don't make value for company. At this base we can divide company process to main process, which are necessary for core processes and to non – core processes.

#### Shareholder value

Shareholder values start up in 80ties years in 20.century in USA. Base target of company in this conception is making value for owner. Value in this conception isn't in making profit in accounting, but measure realistic value for owner.

#### Just in time

System JIT has extraction in Japan. We know about it because this system uses Toyota. Target of JIT is reduction of cost whole need of goods and material flow in company.

If we use JIT effectively, we have:

- Small or narrow supply
- Supply strict quantity
- Supply in strict term
- Supply in one hundred percent of quality
- Small lead time in manufacturing
- No one deformity during manufacturing
- Minimal reserve of ready products

#### TQM – total quality management

We can characterize TQM like philosophy, which systematical and consistently asserts methods which are concentrate to kind and satisfaction of consumer. Target of TQM is raising productivity with following reductions loss in non – qualitative manufacturing. This predicts higher satisfaction of customers.

#### BSC- balanced scorecard

BSC methods solve problem of financial accounting. At he base of financial accounting is company evaluating. This method joins monitoring of financial measure with long – life competitiveness. Extend to vision and strategy of company, which are formed to measure of company efficiency. BSC with harmony of complex approach measure efficiency of company with four perspectives: financial, customer, internal company process, education and growth.

Six Sigma – method of improving company processes

Six Sigma is more popular in area of improving quality. If the company implemented this strategy they have best results. This method is adapted to real praxis. It not depends on largeness of company and its specification. Improving company process can be established in international companies like in small companies. This method works with strict data, which eliminated defect and losses in management grade of manufacturing and services.

Reengineering

This is radical change, radical reinterpretation, and whole redesign of company process. Radical cut to movement in organization with target to dramatic improvement critical measure of efficiency, which are for example costs, quality, fast or services.

Outsourcing – severance non – effective process

Outsourcing is one of very popular style of growing effects. Organizations retire for competences non – effect activities and these activities make external company. Target of this method is decrease of costs, increase effects and following competitiveness. Before was outsourcing concentrated to fixed area of manufacturing, but later they find out that has his place in marketing, human resources management or transfer. Between companies is multilevel cooperation.

Benchmarking – compare efficiency

The Xerox Corporation use term benchmarking in 1979 like tool of management, which redound their popularity. The main person of benchmarking is Robert C. Camp, whom interprets benchmarking like “finding the best approaches in business, which make the best results.” We can compare efficiency each companies and used practice, process and progress.

Lean production

Removal loses and unnecessary activities, lean company, lean process, hinting of production and optimized material flow (POKA YOKE, KANBAN, JIT, SIX SIGMA), make production time shorter and maximal utilize sources. For identification aspiration of elimination loses and waste in company and in company processes, like to identification tools we use term lean.

Controlling

Point out to integration in planning, control and manage. In foreign economics is term controlling one of key tool for make conditions to have long – life prosperity every quality company. Controlling like one of base sub – system of manage system with coming capital from abroad has more interest, because company work under pressure of competitive.

Project management

Project management is process of planning, coordinating and managing task and sources for achievement of target, for chosen time with defined sources and narrow price. Base principle in project management is concentrate to project plan, project organization, budget of project and control of consumption sources and time, manage risk, manage quality, manage change and project documentation. The base target of project management allowed finding optimal configuration between sources, budget and time – table to fill customer requirements.

Crisis management

Crisis management is pack of knowledge about risk, reason of risk, results and about principle, methods and progress of their solving.

Implementation inscribed theory to military environment

When we look to many management theories we have many question:

- Is this teaching with request of army forces?
- Which of these theories we can use for teaching in specific environment?
- What is the area of teaching in study program?

- Is realization of this teaching with filling Bolognese process?
- What does the implementation of this theories means for resort education?

I try to shortly answer to these questions. Answer for the first question we can find in reference condition of executive officer, which define skills which ranker of Slovak republic have to had.

In this condition belongs:

- managerial and leadership skills
- law forwardness
- technical skills
- language skills
- economic forwardness
- physical and psychical ability.

The condition in area of management and economic are given in that way we

have to get under new information and methods of manage. Methods of decision result we can evaluate from economical (financial) side. Developed economic knowledge is new theory and ability of manager (commander) gives this knowledge into praxis.

Answer to the second question I put to the table. This table shows level of implementation of theories in study program of bachelor study. Management is portative study program at Armed Forces Academy of gen. M. R. Štefánika (AOS) in Liptovský Mikuláš. In this program study 55 % students of AOS (50 % of study groups) and which are provided by Management department by 80 % of teaching. In the table there are theories, which we teach in subjects (wide teaching), in cap of themes and post about each subject (average teaching) and which we don't teach (deficient teaching).

Area of implementation new theory of teaching	Theory	Number of implementation from whole count
Wide teaching	Knowledge management	5/21 17%
	Out sourcing	
	Controlling	
	Project management Crisis management	
Average teaching	Lean production	9/21 45%
	MBO – management by objectives	
	CRM - customer relationship management	
	Kaizen –	
	JIT – Just in time	
	TQM – total quality management	
	Six Sigma - quality improving	
	Reengineering Benchmarking	
Deficient teaching	CPM - corporate performance management	7/21 38%
	IDS Scheer	
	CSR - Corporate Society responsibility	
	Corporate Governance	
	Core business - concentration of production to narrow area	
	Shareholder value –theory of value manage	
	BSC – new model of financial accounting	

Table 1: Implementation of management theories in study program Management

From the table no. 1 results, that teachers, which assure teaching process follow trends in management area and know new

information implemented to teaching. If we make detail analysis of problem they know give reasons why four theories we don't have in our teaching process (CPM, IDS,

CG, SV) and only in three cases they don't know nothing about theories (CSR, CB, BSC).

Answer on the fourth question in simply, because study program Management from study specialization 3.3.15 Management come out from group of study specialization Management and economy which is teaching in many universities in Slovak republic. Similar study program are realized in whole world. It is natural that new trends in economic area or management area have to be clear in teaching activities of universities. Implementation of this knowledge make prestige place of work, cap assumes for successful accreditation of study program (3).

Answer for the question what does the resort education mean implementation of new theories is hard. We can let know continuity with realization of terms in armed resort and with filling Bolognese call is military teaching between two stones. On the one side there are request of armed resort, which uninterested of Kaizen, MBO or BSC theories, but professional which is ready to fill task in military, in peacekeeping missions or alliance operations. On the other side there is request, which issue from axiom and rules of accreditation commission, which go in Bolognese understanding, but sometimes harder. When we add to similar problems in area of research and development, when project of military resort and project of school resorts meet is the situation more complicated.

## Conclusion

Where we can find starting point from this situation, like new trends in management implemented in teaching process in military schools. Apparently we have to habituate for universality of department, I am thinking about science – pedagogical staff, where will be diffuse skill from military and ability to apply new skills from academics theories to military condition and on the other side academic part which will operatively react to new theoretical skills from education and research area. One is sure, that considering to transformation process in military school, above in army of small countries it will not simple.

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## ETHICAL DIMENSIONS ON HACKING ISSUES

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**Abstract** World financial crisis and economic recession have introduced major work ethic issues to our virtual international bank. Employees perform unethical acts primarily due to a desire of maintaining job security, and to ensure competitive advantages in the job market. Increased hacking issues have also caused damage to client confidence as customer base is declining while litigation issues rise. The problems are further complicated when the bank steering committee decided to outsource IT and help desk departments to IBM.

Legal implications to bank hacking issues included research on Computer Misuse Act, Evidence Act, Statutory laws and common laws between Bank and Client. To ensure financial systems are secured, our bank must vigorously apply policies and controls. The bank must implement a business continuity plan to integrate previous records and financial statements, as well as back up of transactions and proper receipts.

### INTRODUCTION

World financial crisis and economic recession have impacted bank revenue. Our online bank is a large size international bank. We have faced increasing hacking problems, loss of customers, as well as litigation issues. Additionally, our IT and help desk departments need to downsize and begin to layoff staff. Our bank has limited security resources to monitor and protect value customers' information. Due to serious financial and legal issues, the IT executive committee determined that the bank cannot afford to hire full time in-house security IT staff to work on hacking issues. Therefore, outsourcing our IT department as well as our help desk is our only viable solution. The impact of outsourcing would introduce major ethical issues for bank's employees.

#### **Scenario**

The IT and help desk departments compose of 300 employees worldwide with headcount burden costs of \$50M operating annual expenses. These IT data centers and help desks are located in US, Canada, Hong Kong, Japan and UK. The goal of the IT executive committee is to reduce the size of worldwide

IT and help desk operations to a centralized management team of 10 people and outsource comprehensive IT and help desk functions to IBM. The term of contract will be 10 years. Terms will be negotiable every 2 years to allow adjustments to market conditions.

The IT executive committee understands the legal, financial and ethical dimensions and impacts to the bank's operation and our employees. We are inviting IBM to sign non-disclosure and confidential agreements.

The bank has several major requirements:

1. We request IBM to develop a comprehensive transition plan to protect Bank's information assets from hacking including internal employees of our Bank as well as IBM.
2. We request IBM to provide a comprehensive business and technical proposal to satisfy Bank's IT and help desk requirements. These will include description of IBM outsourcing business plan and network architecture drawings.
3. Identify any financial, legal and ethical risks of outsourcing plan.

## **LEGAL ISSUES IN ONLINE BANKING**

The legal issues in online banking arise from current events, activities, and actualities, all of which will have to be treated in our agreement with the contractor IBM. Some legal issues that need to be resolved are the determination of local jurisdiction for IBM and the bank, where data and/or telecommunication equipment terminate. In addition to facility property, there are other tangible properties to include applicability of contractual obligations and probative value of digital documents. This leads to direct discretionary ownership of electronic evidence, and should convey a dialogue of handling electronic money.

Other legal issues include careful consideration with statutory laws and common laws for the bank and its clients (see appendix E). If there were fraudulent activities and hacking events in which occurred, the bank must retain their image as a credible bank. Even if hacking occurs in which no fraud was committed, the bank must support a legal obligation to provide the notification and prevention of a possible attack. In 2007, Commerce Bank suffered a serious intrusion in which 3,000 customer profiles were obtained, and Commerce Bank had to inform all the clients whom profiles were obtained. Though not many were used in fraudulent activity, the unaffected others received protection in the form of credit monitoring for 24 months. (Kirk, 2007) Other legal issues include the obligation of the bank to provide protection of privacy from the IBM contractors. When IBM employees are working on the bank's property, such as day-trading facilities, what transparencies and walls need to be in place for the IBM employees to function and perform IT and help desk support while bank employees perform their functions? At the same time, this issue spans across to the virtual realm as well, including visibility of web marketing of lending services, and electronic bills of lading. Other vital information such as internet stock offerings, and electronic determination of titles also should be considered sensitive information that needs to

be protected. Some electronic banking functions are already outsourced, and this becomes a legal issue if IBM needs to access information systems which IBM has no allegiance to. Another legal issue that may arise would be about the dismissals of the current IT staff supporting the system. (Boatright, chapter 9) The current employees may have contractual agreements with the bank that needs to address when considering dismissing those employees. Naturally, the existing employees would be transitioned out as IBM employees become more familiar with bank's system. For term contracted employees, those employees would not receive renewed contracts. The contracted employees must be considered with all legal requirements of that contract. One solution would be to offer considerable severance packages in exchange for them to nullify their contracts.

## **RECOMMENDATIONS FOR IBM AGREEMENT**

Our experts have highlighted a variety of solutions that our online bank should undertake to counteract threats to the online banking system. The most effective way to prevent these hacking issues begins with typical protections including webpage access controls, content filters, malicious code and virus Protection, and firewalls. In addition to the typical protection settings, IBM can provide further comprehensive security strategies including other hardened processes such as analysis and hardening tools, for identity authentication, and virtual private networks with encryption, PKI and digital certificates. A stringent network administration can be setup, and client systems to use trusted operating systems. IBM-Business Service Management (BSM) tools (see appendix C) will be used for assuring operational success through improved service visibility.

Aligning IT with the objectives of the business requires a transformative change in how IT operates. IBM's BSM – Tivoli Service Management solutions provide the tools to help with that transformation by providing



essential business context from the top to the bottom of the online banking business service delivery chain.

However, while the technical aspects of the server-side security may be beefed up constantly to the latest cryptographic standards, more often than not, security threats to the system are human in nature. Likewise, our employees have also been identified as the worst security threats of an organization. While technological sophistication is still the keyword, certain key principles can be followed to ensure the security of a computer system including human resource management whereby sensitive and critical procedures are not under the purview of one person and duties are segregated and access controlled within the organization itself. (BankInfoSecurity, 2005) Our banks should put in place specific internal administrative policies in this regard and also specific policies with regarding the IT contracts.

Further, the education of the customers and of the employees is an integral part of ensuring that the combination of the online vault is safely beyond the cyber-safecrackers. Customers must be educated to set up client side firewalls as well as to secure their respective username/passwords. At the same time, customers should also be dissuaded from using a generic pass phrase for every single one of their accounts given that the compromise of one system may inevitably compromise all other accounts. Furthermore, any potential security holes should be readily identified and patched with the assistance of the IBM contractors.

## **FINANCIAL ISSUES**

Financial issues already plague the Bank with cyber-liability issues, and guidelines must be developed to ensure certain laws are in place. Some financial issues must address how daily work would be able to perform while the IT system is being integrated with IBM service solutions. For auditors, the transition must be as seamless as possible as to not disturb cash-flows, as business banking is

time dependant (monetary differences in world currency exchanges).

### ***Policy Statements***

Online bank departments are to ensure financial systems have adequate internal controls over the processing of financial information. These controls are explained and described through general policies and controls.

### ***General Policies and Controls***

Online bank departments are to ensure that the functions of initiation, authorization, and recording of transactions and custody of assets are separated to ensure no employee or group of employees has exclusive control over a financial transaction or group of transactions. Online bank departments are to ensure that all inputs to the system are complete and accurate and all transactions are valid and properly authorized. If IBM decides to outsource portions of work, these considerations must also be transposed and applied to the sub-contracted company.

The solution to these financial issues is for online bank departments to ensure that accuracy of data is maintained during processing and computations are carried out accurately. The many different departments are to establish procedures to ensure errors are detected, corrected and corrections are re-entered into the system to minimize mistakes. Also the departments are to ensure the system facilitates tracing of input documents and transactions through to the output reports and vice versa. This would coincide with verification that reports did not get copied or reproduced by external forces. This would require that the system output provides the information needed to confirm all authorized transactions are processed promptly and accurately; and adequate consideration is given to the Comptroller General's requirements respecting accounting records and financial statements. The departments are to ensure that all aspects of the financial system are adequately documented. Finally, backups and transmission receipts must be

created as redundancy for failures and as cyber-liability insurance.

However, using technology to prevent financial fraud and avoid hacking contribute to a small portion of the issue with having outside contractors mingle with bank employees. Most of the ethical issues wind up here where the human element comes to play.

### **BANK FUNDAMENTAL ETHICAL PROBLEMS AND CHALLENGES**

The bank has been confronted with internal and external ethical issues which are described as follows:

#### ***Internal ethical issues***

Because of the economic recession, the bank has intended to outsource the IT department and help desk to IBM. Certain layoff of IT and help desk staff are inevitable. The Bank steering committee is very concerned about ethical issues of the affected employees who may lose their jobs. In a 2008 survey (see appendix G), it found in lieu of the global recession that many workers would perform unethical acts to maintain job security, and secure advantages within the company. It also indicates that employees would abuse their virtual rights to steal sensitive and confidential company information to ensure a competitive advantage if they were to be laid-off. (CyberArk, 2008) The bank steering committee requires a comprehensive plan to mitigate this unethical risk.

Other internal ethical issues include the embarrassment of the reputation of the company if vitally sensitive information was to be penetrated and stolen. This would include personnel information that may be retrieved from a human resources server. Other sensitive information includes business contract deals, and future plans for the company. Without any mitigation, it would be a matter of time before the system would be critically breached. It would be more serious and costly than just having the bank robbed.

#### ***External ethical issue***

Because of testing the security system, IBM employees will require to access bank IT systems, and may potentially access sensitive information and documents. The Bank is challenged with avoiding attacks by IBM employees whom use our information systems. It can be just as dangerous for the bank if hacking occurred as the result of information leaking out as IBM employees phish through the banking infrastructure system. In the case of the World Bank being hacked from the outside by their IT contractors, the certain individuals with the contractor gained complete access to the banks systems and vital information was examined. Passwords and identities were stolen and abused to achieve further infiltration into their systems. Obviously the contractor was terminated, but it took nearly four months before the last contractor left any of their facilities as so internal IT employees could “transfer knowledge”. (FoxNews, 2008) The ethical issue becomes when the bank becomes so reliant on the contractor, how easy would it be to cancel services with them and transition to new contractors.

The bank steering committee requires implementing a comprehensive standard rules and process following the general rules and processes.

#### ***Recommendations and solutions to internal and external ethical issues***

To address both internal and external ethical issues, internal (Bank) and external (IBM) employees require training on following ethical declarations.

#### ***Social Engineering***

The first ethical declaration is reinforcing the basic moral requirements in a work environment. Mostly this must reinforce employees to uphold honesty and integrity as values of professionalism. Both the bank and IBM employees will use that to support their principles of professional operation to uphold professional creditability as well as confidentiality amongst each other and the banks clients. It must be stated that both bank

and IBM employees must be respectful of clients, colleagues and competitors to run an ethical operation in the bank, and adhere to respect and fair treatment for all. This is similar to social engineering in the workplace so that principles of governance and social responsibility can be nurtured. At the same time, management must be in charge of responsible corporate governance to reinforce these declarations. All discretions must be treated as equally as possible regardless if it was bank or IBM employees. Management responsibility is to the shareholders. The bank's management must apply practice to mitigate risks. This is to realize an effective operation and independent audit of business controls.

Social responsibility signifies an ongoing commitment to sustainable economic growth. This is realized through cooperation with employees, their families, local communities and society in order to improve standards of living. It may sometimes not be evident to employees why the bank requires them to be socially molded. The bank must offer reasonable justifications and processes for why these virtues are important to the business. To prevent internal employees from performing unethical acts, the bank must motivate the employees to focus the client. The employees must be viewed as a trusted financial partner from the client's perspective to regain assurance and confidence in the bank.

### ***Protecting Trade Secrets***

Management needs to ensure trade secrets are not disclosed and for involved company employees to keep the secrets. Trade secrets may include contract deals and plans for the future which may be visible once internally. The bank's information is valuable business assets that provide significant advantages over competitors. Our bank must ensure that IBM signs non-disclosure and confidential agreements to protect our information assets from IBM internal hacking.

### ***Dealing with Conflicts of Interest***

The conflict occurs when a personal interest comes into conflict with an obligation to serve the interests of another. This situation may happen to both IBM and bank employees when some tangible interest or personal interests impose to leak sensitive information outside the bank. Therefore teaching and guiding employees to handle the conflict of interests is an important ethical issue. Employees must refrain from all activities in conflict with the interests of the bank or of the clients and make decisions without prejudice and bias. They must reject gifts and unethical benefits and may not imply or express that they expect these. In the case that employees are unsure of any scenario or situation, the bank must provide conflict management guidelines to help the employee resolve the issue. Some issues mentioned in "Ethics and the Conduct of Business textbook" (Boatright, chapter 5) addresses the listed below.

### ***Non-competition Agreement***

Through this agreement, there is a legally restrained relationship between employees and the bank. If the employee leaves the bank and obtains confidential information, this agreement obligates them to protect the bank from sharing the confidential data. However, the terms of agreement must be legal and be in line with the judicial requirements. (The time period specified, the geographic area, the kind of work related to the secret of trade)

### ***Confidentially Agreement***

This agreement requires the confidentiality obligations of IBM employees and internal employees to protect the bank from stealing, sharing or leaking confidential information by IBM employees or internal employees who would leave the bank or want to trade the sensitive information for tangible wealth or career opportunity. The agreement gives legal restrictions to the employees (IBM and Bank).

### ***Actual and Potential Conflict of Interest***

From the bank's ethical perspective, there is a potential conflict because both employees of IBM and the bank draw a possibility to act

against the bank via stealing and trading the confidential information.

### ***Personal and Impersonal Conflict of Interest***

There may be an impersonal conflict of interest when IBM employees work for the Bank as a contractor. The impersonal conflict of interest arises when this IBM employee is obligated to act in the interests of two different organizations, namely the bank and IBM. Directives from Bank and IBM may provide conflict directions to IBM contractor.

### ***Individual and Organizational Conflict***

In certain instance, the policy of the bank and IBM may be different on personal work/life leave (emergency leave). The IBM Life Leave policy was establish to help employees to manage situations, which range from attending a school function, to moving house, to providing emergency care for an elderly relative.

Study Leave - provides the opportunity for employees to sit for exams to attend management-approved courses.

### ***Guidelines***

Employees are required to mandatory certification and recertification to keep them updated on current compliant cases to read and to understand corporate business conduct guidelines using real or near real examples. The conflict management guidelines would be included in business conduct guidelines (that involve the basic situations and operation principle in daily work). Following general policies and controls will outline basic operations of daily work. To ensure that the guidelines are working, the bank must develop and design an exam to check if the employees have understood the guidelines. Management can utilize the results to organize the employees to study their habits. Examples and scenarios can be created through case studies for those who do not clearly understand or feel uncomfortable the guidelines. Representatives comprised of subject matter experts will be provided for clarification and interpretation of the guidelines.

In addition to reinforcing understanding guidelines for employees, the bank must continue to consolidate the study of guidelines among the employees, especially with both Bank and IBM employees together to foster an ethically positive culture. At the same time, report anyone who violates business conduct guidelines and conflicts of interest.

### ***Open Door Policy***

The bank and IBM must develop a channel or open door policy. This is to encourage employees to report other employees anonymously whom violates business conduct. Both the bank and IBM must offer a complete privacy process to protect the employees who freely talk about the unethical actions at the workplace so that the employees will get a sense of safe reporting and respect which will leads to good dynamics.

This could be done by setting up an internal channel or access to provide the employees' the ability and accessibility to report any unethical behaviors that violates business conduct. A vertical management structure could also be made so that a direct manager or superior at work for employees can be addressed if an employee has a issue with their direct supervisor. This strategy would include the head of the Independent Compliance Department of the bank and IBM. A secretary of the Ethical Committee could be created to handle the complaint management system that addresses how to properly deal with the ethical issues or ethical offences that must be defined in the code of ethics and/or business conduct guidelines. To allow transparency for employees whom do not actively turn in ethical issues, but feel that some things could be changed, an interactive assessment system made up of a self-assessments and valuation among the employees so management can gather the moral information and forecast some potential ethical problems before they arise.

## **CONCLUSION**

With all the problems of the economic downturn, the bank is confident that the legal,

financial, and ethical issues of outsourcing their IT and help desk department to IBM can be resolved. By starting with focusing on the bank employees and rebuilding moral standards, the bank can regain confidence with its clients and begin to recuperate its reputation. The relationship with IBM is contractual, but must be treated more as a partnership as most of the technical portions of the banking process will require IBM's expertise and control. IBM's partnership will reduce internal costs and hopefully alleviate the recent rash of hacking issues.

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## LOGISTIC MANAGEMENT OF NATO RESPONSE FORCE OPERATION

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***Abstract:** More agile and responsive logistics operation is required to support NATO's shift from static forces to expeditionary forces and the creation of the NRF. Although it is recognized that a single all-encompassing NATO Operations Logistic management would best meet this requirement, it is likely that future NATO operations will continue to exist with multiple support chains focused around national requirements. This will generate a complex network of support, which will require careful and responsive management. To ensure the most effective Operation logistic management, it is essential that the flow of assets into and out of the Joint Operation Area (JOA) reflect the needs of the operation and the capability requirements of the Deployed Commander.*

### INTRODUCTION

Since the demise of the Soviet Union, NATO has expanded its original mission from collective defence to collective security. Part of this transition includes undertaking out-of-area peace support operations with multinational rapid reaction forces. These new missions have serious implications for logistics. NATO logistics, traditionally an exclusive national responsibility, can no longer be successfully executed in this manner. Stove piped logistics do not achieve an acceptable level of unity of effort to make the best use of limited resources or maximize logistics power. To effectively undertake out-of-area operations with multinational forces in the future, the Alliance requires improved capabilities in mobility, logistical integration and sustainability, and logistics command and control. Furthermore, to make the most effective use of these new capabilities and to efficiently manage the unique logistics requirements of a rapid reaction force operating outside Alliance territory, NATO should establish a standing multinational logistics command.

The Alliance's Strategic Concept, approved by NATO Heads of State and Government in Washington on 23 April 1999, articulates NATO's approach to the securities challenges in the new century. It requires that

the Alliance be able to undertake the full spectrum of its military mission through a common set of Alliance structures and procedures, which reflect its commitment to both collective defence and crisis response.

Subsequently, the Alliance has taken steps to adapt its command and force structures to meet the needs of the evolving security environment. Necessary changes in NATO Command and Force Structure to better fit them for the conduct of expeditionary operations were set out. Defence Ministers concluded in their June 2002 session that NATO must be able to field forces that can move quickly to wherever there are needed, sustain operation over distance and time, and achieve their objective.

The decision by NATO Heads of State and Government at their Summit meeting in Prague on 21 November 2002 included the creation of a technologically advanced NATO Response Force (NRF) designated to be flexible, deployable, interoperable and sustainable, and ready to move quickly when and to wherever they are needed. The NATO Response Force (NRF) is a highly ready and technologically advanced force made up of land, air, sea and special forces components that the Alliance can deploy quickly wherever needed.

The shift to more expeditionary operations has significant implications for NATO logistics policy and posture. In particular, expanding the scope for operations for NATO forces to include defence against terrorism missions enhances the probability of deployment of a rapid military response beyond NATO territory. The deployment of forces to locations with little or no Host Nation Support (HNS), at much greater distances than previously necessary, operating along extended and perhaps very limited lines of communications, places an emphasis on deployable logistic capabilities that were less important for territorially-based defence. In addition to deployable logistic support units organic to combat formations, such capabilities include access to strategic lift and deployable logistic enablers.

The uncertain location of operations and composition of forces to be deployed poses challenges for logistics readiness. Operations of any significant duration also raise sustainability issues, including those related to the logistic force elements required to keep the combat forces supplied and maintained. To reduce the operational logistic footprint and the cost of sustaining the operation, NATO encourages as much multinationality as possible in the delivery of logistic support where it is consistent with maintaining or enhancing military effectiveness. Growth in multinational force structures and modalities needs to be supported by appropriate robust, effective and responsive multinational logistic capabilities and command and control arrangements.

## **1. LOGISTICS IN NATO OPERATION**

### **1.1. Aim and scope**

The aim of this paper is to provide a brief insight into the logistic management of NRF operation. It will be presented the key management features, how the coordination will be accomplished during the operational phases of the operation and at the end I will be made some recommendations.

The logistics organizations residing within the deployed force headquarters will be responsible for operational control of the logistic management. Significant reachback requirements will, however, be placed on the parent headquarter of the deployed force.

The scope of logistic management is broad:

- it must manage asset flow from arrival at NATO Port of Embarkation (or wherever assets first come under NATO authority) to the front-line users;
- it must manage the flow of assets, including personnel, within the operational space;
- it must manage a complex range of activities including asset movement for repair and distribution;
- it must consider the needs of major support chain actors such as medical and engineering support personnel;
- it must function seamlessly across all phases of an operation;
- it must manage within the context of an ever developing operational plan and changing deployed commander requirements.

This management must be visible to the NATO and national users of the system at both the managerial and operating level of the process.

Such a management challenge will require sophisticated and comprehensive information system support. An ability to translate the Deployed Commander's prioritized capability requirements into identifiable assets will be necessary in order to ensure the optimum placement of those assets in the operational space. Total assets visibility on an operation will also be essential, to ensure the best solutions to resolving asset shortfalls (including such lateral support as assets redistribution). This will require the unique identification of a range of operationally important assets, and the application of automated identification technologies, to capture assets information on

a near real-time basis. Assets must be tracked throughout the logistic chain.

## **1.2.Key management features**

In order to manage the flow of assets between suppliers and customers across the couple bridge and within theatre, a number of considerations must be made. The most essential aspect is that the logistic management must not just react to the situation but also actively take into account the requirements placed on logistics by the Deployed Commander and the operational plan. In general the focus would be for the logistics function to translate capability requirements (as defined by time and location) into the movement of identified assets. This movement will be based on the “pulling” of assets to meet their operational requirement, rather than the “pushing” of assets to meet supplier or transportation requirements. Clearly coordination between the Deployed Commander, Sending Nations and Strategic Command will be required, to ensure the overarching operational requirement can be met, and this should be facilitated through the comprehensive asset picture provided by the Logistic Management. Such planning would also need to include pre-planned activities such as the replacement of forces and equipment.

Knowledge of the overarching requirement must then be linked to the overall asset situation. Therefore, such knowledge will need to be linked to the location and serviceability of assets, the assets moving into and out of the theatre, the time-sensitive repair of unserviceable assets, the forecast consumption rate of assets, storage restrictions, the timescale for assets movement and permanent or temporary constraints on that movement in terms of transportation restrictions and hub bottlenecks. This will require the linkage to a wide range of NATO and national logistic information systems. The logistic management will consider the expected future assets situation in order to manage the flow of consignment.

In order to provide support to the evolving operational requirement, the logistic management requires visibility of assets that relate to Reportable Item Code (RIC)<sup>1</sup>; however, it does require the visibility of all operational assets in order for it to be able to manage the logistic support. Therefore, there is an essential linkage between the logistic management and an operational Total Asset Visibility<sup>2</sup>. Moreover, that visibility must extend to all assets (including those of International Organizations and Nongovernmental Organizations) and to assets moving outside NATO, but which will still come under NATO authority once in position.

By providing a tool both to manage all assets within an operation and to manage activity dynamically in relation to the operational requirement, logistic support management generates a significant capability. Thus it will facilitate an answer to the following questions:

- How quickly can I generate a particular capability?
- How much of a particular capability can be generated by a given time?
- What is fastest solution to a deficiency to a capability?
- What are my deficiencies by capability?
- Where are the bottlenecks and what can be done to rework the flow?

The logistic management system should allow the accessing of the information generated at a number of levels (from individual uniquely identified assets, to groupings at the RIC level) and a number of ways from traffic lights systems down to detailed spreadsheets and database records. The method for viewing visibility and the granularity of information provided would be

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<sup>1</sup> The RIC system is developed to categorize and identify mission critical items for NATO's reporting purpose. The RIC indicates the item's operational capability or category for use

<sup>2</sup> TAV is the capability to provide users with timely and accurate information on the location, movement, status, and identify of units, personnel, equipment, materiel, and supplies



defined by the needs of the users, which will vary from higher levels managerial functions down to the needs of process workers.

A particularly difficult issue to address will be the ability of the Deployed Commander to re-assign assets from nations to meet the operational plan. It is assumed that prior to an operation commencing individual nations and NATO will have agreed what assets they will transfer operational authority for and what assets they will permit mutual support with. The greater the level of agreement reached in advance, the greater will be the ability to effectively and efficiently manage the logistic support and coordinate actions across the logistic network. One of its most powerful features, if mutual support were agreed between participants, would be the seamless ability to identify high priority requirements and consider in-theatre solutions across Services and nations rather than generating extended and expensive support solutions based on home-nation support.

Central to the coordination of national logistic support with NATO logistic organization will be the use of standard terminology and procedures. A major element of that will be the use of standard terminology and procedures. A major element of this will be the adoption of a consistent approach to demand prioritization and, in particular, standardized movement prioritization. Whilst nations will continue to use their own priority systems within their national domains, once an item interacts with the NATO organization, it must move in accordance with NATO requirements.

## **2. Logistic Command and control of the Logistic support management**

At an operational level logistic support management is strongly linked to TAV and Operational Planning Process (OPP), whilst at a tactical level there is similar linkage between logistic support management and the translation of the Deployed Commander's prioritized requirements to actual movement of assets. These mean that the logistic support management has a central role in operational

logistic command and control. Indeed, for many logistics activities the logistic support management will become the key mechanism for exerting influence over the full logistic support; it will dictate the pace and flow of general logistic activity. Therefore, the organizational structure surrounding the logistic support is central to overall logistic C2.

In the designing the appropriate C2 structure the management structure must support the managerial aims. The majority of principles governing both the structure of the NATO logistic support and its management are pertinent at this issue. In particular, the emphasis in both sets of principles is on consistent, but flexible, processes tailored to support the needs of the Deployed Commander and the supporting tactical elements. The C2 structure must be able to manage, in a coordinated manner across the full range of logistic activities supporting the full range of operational assets.

The need to develop a management structure that supports the principles of logistic support underlines the view that the focus of logistic C2 within the operation should be centred on the Deployed Commander and his supporting staff. These staffs will have constant and immediate interaction with the participants in the operation. They will also have access to a robust reachback capability with the relevant NATO structure. At the same time they will have established links with the Joint Logistic support Group (JLSG) where tactical level C2 may be best placed. The JLSG will have a range of logistic support management to exert influence directly over the operation of the logistic support and direct C2 authority over many of the personnel who operate it.

Operational Planning Phase is a crucial component of the development and organization of the NATO logistic support management. It is essential that the J4 logistic planning staff operate closely with both J3 and J5 staffs. This will help ensure that the logistic support is best designed to support the planned requirements of the operation. It will also help to ensure that logistics constraints and requirements are reflected in the scope of the

operational deployment and redeployment plans.

The main areas that will require specific planning consideration for the development of the Logistic support management plan to support the operational plan are as follows:

- Identification of the main effort and scale of activity of the operational plan to ensure the most efficient and effective shape and scale of the logistic organization.
- Identification of the required order of arrival of assets to ensure logistic capabilities are in-place.
- Identification of Joint operation Area operating location.
- Confirmation of the logistic C2 organization to be adopted, including the clear identification of responsibilities at strategic, operational and tactical levels.
- Agreement between Sending Nations and NATO on the arrangements for use of the logistic resources – given the potential need for a rapid deployment of an NRF-based operation, standing arrangements in advance of an operation is highly desirable.
- Agreements between Sending Nations and NATO on the arrangements for the use of assets within the operation, including Transfer of Authority (TOA) and mutual support.
- Identification of physical location for Port of Embarkation, Ports of Debarkation, staging and storage areas and the equipment requirements to logistically enable those locations.
- Identification of opportunities to generate logistic economies-of-scale and optimize the logistic footprint.
- Identification of physical and electronic security issues for strategic and in-theatre lines of communication and logistic hubs.
- Identification of Host Nations (HN), Logistics Role Specialist Nations

(LRSN)<sup>3</sup>, Logistic Lead Nation (LLN)<sup>4</sup> and pre-stocked logistic contributions.

- Identification of contractor support to operations, both for specialist platform and general logistic support.
- The allocation by duration of strategic lift assets for the operation
- Identification of political, legal, economic, environmental, social and cultural considerations and their influence on logistic operations and assets requirements.
- Interface and information exchange requirements between NATO logistic structures and specific national logistic information systems and C2 systems.

Within all this the effective use of pre-acquired logistics information and data from recognizance reports is vital. It is likely that over the Planning Phase the currency, amount and granularity of such information will increase. This may well affect the shape of the logistic support management structure and it is essential that planning remains as flexible as possible. It should, at all times, be remembered that the same considerations that shape the logistic support management structure may also require a reshaping of the operational plan itself. A continuous dialogue between J4 and J3/5 planning staff is required throughout the operation and particularly in the Planning Phase.

### **3. Logistic support management during the operation phases**

#### **3.1 Deployment phase**

Prior to the deployment phase, and based around the Deployment Plan, Allied Command Operation is responsible for planning and arranging strategic lift. This is a major task and the securing of assets will

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<sup>3</sup> one nation assumes the responsibility for procuring a particular class of supply or service for all or a part of the multinational force

<sup>4</sup> one nation, based on capabilities, agrees to assume the responsibility for procuring and providing a broad spectrum of logistic support for all or a part of the multinational force and/or headquarters.

involve coordination with many agencies. The realities of obtaining the necessary strategic lift may well require adjustment to both deployment and operational plans.

The prime focus of logistic management at this point is on the physical placement of logistics infrastructure at identified POEs and PODs to manage the initial flow of assets. Consequently, the movement of logistics equipment and personnel will be amongst the earliest assets deployed. However, on a multinational operation the potential requirement to coordinate the flow assets into the theatre from a wide range of national POEs means that the early creation of the Logistic C2 backbone and, in particular, the supporting information systems infrastructure takes on even greater importance.

The mounting process and initial deployment will be managed by ACO and executed by Allied Movement Control Centre (AMCC). However, as capabilities increase within the JOA and visibility of in-theatre logistics activity increases, the parent headquarters logistic C2 element will play an increasing role in managing the deployment process. Furthermore, the Deployed Commander will begin to exert influence on the order of arrival of force elements, as the operation and circumstances within the theatre requires.

### **3.2. Reception, staging, onward movement and integration (RSOM&I)**

The importance of the visibility of activity across the logistic support continues to be a feature of the RSOM&I elements of force deployment. The emphasis at this stage is on the maximum reduction of time to bring forces up to a required level of capability. Therefore, precise management of the logistic support is critical at this stage. Again the emphasis will be on the pulling of the assets to support the overall integration process – extended back to the home bases when required. The RSOM&I will be managed by the parent headquarters logistic C2 element and will focus on in-theatre movement activity.

### **3.3. Sustainment phase**

The major role of the logistic support management will be during the Sustainment phase. It will be needed to support a number of aims:

- the movement of assets for the continued enhancement to capability within the JOA
- priority supply of assets to support current requirements.
- Routine resupply of materiel to support planned consumption requirements.
- Return of assets for out-of-theatre recovery.
- Movement of assets within theatre for repair and mutual support or in support of the operational plan.

Whilst the actual level of logistic effort during this phase may be lower than during previous phases, the logistic support management is likely to operate at its most complex as a support network. The full range of transportation links, storage facilities and repair capabilities are most likely to be employed during this phase. Moreover, the potentially extended duration of this phase will generate pressures to operate in an increasingly efficient manner.

The key requirement to make the logistic support effective at this stage will be well-founded, reliable and comprehensive information infrastructure.

### **3.4. Redeployment phase**

The redeployment phase will generate many of the same challenges for the logistic support management as in the Deployment phase – movement of assets against a desired plan will be the aim of the process. Responsibility for this activity will rest with the parent headquarters logistic C2 element that will have to coordinate the requirements of NATO forces and Sending Nation forces. The drawdown of logistics personnel and equipment will need to be carefully managed in relation to the Redeployment Plan and it is

likely those elements will be amongst the last to leave JOA. In addition, the logistics information systems will need to remain in place for as long as practically possible, to ensure the necessary management and operational visibility of the process.

#### **IV. CONCLUSIONS**

NATO has made significant progress over the past decade transforming itself from an Alliance focused strictly on forward defense against the Warsaw Pact to one willing and able to undertake out-of-area operations for peace support. The Alliance has made a commitment in operational command and control as witnessed by the continuing evolution of its military command structure and the formation of NATO Reaction Force.

The Alliance has established an overarching vision for logistics support. The new operational environment requires fully integrated logistics that is both efficient and effective and that achieves economy of effort.

The best option for managing logistics within NATO's new expeditionary environment, in my opinion, is to persuade the nations to create a permanent multinational logistics command. The NATO structure currently provide a core organization in each Joint Force Command that can be augmented, in case of commitment of NATO forces, to a full structure with personnel selected from different command structure or provided by the nations. But, the nations are very reluctant to provide such trained personnel. Also, the Alliance must give the commander of this organization authority to redistribute national logistics assets as required to meet operational needs. Only a standing NATO Logistics

Command can provide the Alliance centralized planning of logistics requirements and centralized command and control of logistics assets. The command will be able to capitalize on the latest information and technology systems, thereby avoiding the waste associated with duplication of effort and the deployment of excess capability.

Another option would be in my opinion, to provide common founded logistics assets for the critical equipments that, according to the last years experiences, have not been provided by the nations during the Force Generation Conferences. Such critical equipments would be air and sea lift assets, helicopters for intra-theatre transportation, water purification detachments, etc.

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## REPRESENTATIONS ON THE MILITARY ENVIRONMENT

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**Abstract:** *The aim of this study is to determine and to examine the social representations youth have on the military environment. The representations of the military environment and of the armed force, the military psychological profile, individual perceptions of risks linked to the military career, the representations on the military actions for the civil population's benefit are the main dimensions of this study. 146 high-school pupils and college students were questioned on these dimensions. This article presents a descriptive, both qualitative and quantitative, analysis of young people representation of the military environment.*

**Key words:** *perception of risk, psychological profile, military professionalism, military career.*

### 1. INTRODUCTION

As the military organization's main function is that of ensuring citizens security, people place a great amount of confidence in it. According to the latest Eurobarometer study regarding Romanians level of trust in public institutions [3], the army is the second institution people trust after mass-media. But this study, as well as all Eurobarometer studies, does not specify what are the grounds of people's trust in the army. The percent of 70, similar with that found in other European countries, shows that the military institution is perceived as succeeding to efficiently accomplish its role.

Most of the psychological or sociological studies made on the military environment or in the army aimed either the impact military environment has on the military employees' personality, the intention to follow a military career or the level of trust people have in the army. Few studies focused on the representation civilians have on the army and on the accuracy of these representation. Do we perceive the military environment as it is in reality or our representations on the army are biased by the limited access to information?

Assessing social representations of the military environment invites to a broader

debate about the perception that young people have on the human security and on the military professionalism. At present, social representations on the military has changed. The military organization is seen as accessible to an elite public because it implies an activity extremely specialized. Therefore, the results of this research represent a starting point for the improvement of the public image of the military institution.

Each nation's quest for security must move beyond the traditional dependency on military security; real security requires a holistic, cooperative approach that addresses all the inter-linked threats to humanity. Therefore, we examined through this research the aspect of civil - military relations, in order to identify people's representations on the military implication in the life of the community.

### 2. OBJECTIVES

The aim of this study is to determine and to examine the social representations on the military environment.

The main dimensions of this study are the following:

- representations on the military environment and armed force;
- the military psychological profile;

- individual perceptions of risk linked to the military career;
- representations of the military career and military professionalism;
- representations on the military actions for the civil population's benefit.

The present study is an opportunity to reflection on the importance of the military institution's public image and it also highlights the actual perception, the attitudes, the representations and the stereotypes people have on the military environment.

### 3. METHODOLOGY

146 young people answered a questionnaire with both open and closed questions. The questions were elaborated according to the proposed objective. The participants to the survey were high-school pupils and college students from two High-school and two faculties from Brasov. The age mean of the participant was 17,97 years, the two genre were equal represented in our sample. The questionnaire was applied at the beginning of March 2009.

### 4. RESULTS AND DISCUSSIONS

There are several ways in which the social representation of a social category of individuals or of a social problem can be evaluated [1]:

For our study we choose to use an open question in order to find out what are the specific characteristics of the military environment as perceived by youth. We asked every participant to write down the first five characteristic of the military environment he/she thinks off. After a qualitative analysis of the answers we group the obtained characteristics in few major categories and created a hierarchy of them for both high-school pupils and college students (Table 1).

As noticed, most of the respondents characterize the military environment through individual personality characteristics of the military employees rather than by the particularities of the environment itself.

Table 1. The characteristics identified as being representative for the military environment

Category	Examples of characteristics	Percent (%)	
Cognitive abilities of the military employees	<i>Intelligence, the ability to make decision, special abilities,</i>	11.6	6.16
Personality characteristics of the military employees	<i>Team spirit, courage, self-control, risk taking, arrogance, spirit of sacrifice, responsibility, adaptability, self-confidence, patience, solidarity, conformism, loyalty,</i>	43.2	63.7
Physical abilities	<i>Physical abilities, physical power, resistance, agility,</i>	13.7	15.1
Socio – organizational characteristics of the military environment	<i>Authority, discipline, good organization, precise rules,</i>	40.1	49.3
Emotional characteristics of the military environment	<i>Cold, social status</i>	3.42	6.16
Purposes of the military organization	<i>First aid, saving lives, defense, security,</i>	4.79	12.3
Particularities of the military profession	<i>Risk, professionalism, performance, good training</i>	7.53	29.4

The result of the qualitative analysis show civilians represent themselves the army through its member, as a distinctive social category, rather than as a distinctive organization or system.

One of the major objectives of our study was to identify the perception people have on the professionalism of the military forces as well as the efficiency of the military actions for the civil population's benefits. 71.2% of the respondents considered that the army is prepared and very well prepared for facing urgent situation, only 61.7% feel the same way about public order officers, and 63.7% about air forces (Fig. 1). According to youth's answers the firemen are considered to be the most well prepared for managing urgent situations (87% of the respondents evaluated

firemen as prepared and extremely well prepared). One possible explanation for this results is that, in our community, the actions of firemen are much more visible than the actions of others military forces such as Air Forces.

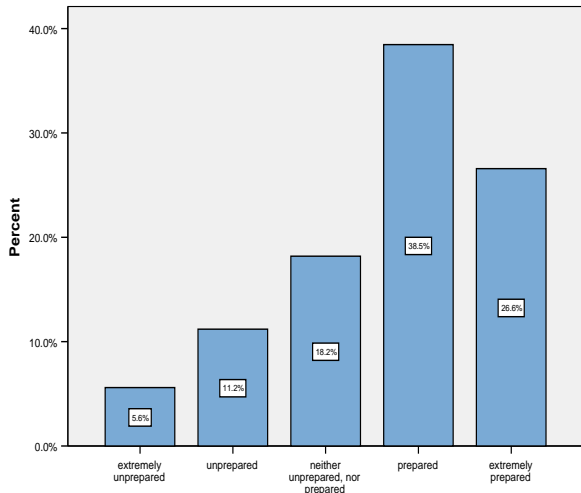


Figure 1. The extent in which Air Forces are perceived as being prepared for efficient intervention in urgent situations

When asked to evaluate on a scale in five points the involvement of military forces in solving the community’s problems, respondents appreciated that this involvement is: useful (M = 3.58), efficient (M = 3.47), professional (M = 3.45), significant (M = 3.42), in due time (M = 3.33), and sufficient (M = 3.14). We must positively notice that all the evaluation are slightly above the mean but this does not mean that the people are satisfied with the degree in which military institutions (such as military forces, air forces, firemen) involve in solving community’s problem. The higher mean was obtained by the “useful” alternative, which means that the population feels the need for this type of interventions.

In order to identify the perceived military psychological profile, subjects were asked to evaluate 13 psychological characteristics according to their importance in following a military career. The characteristics were selected according to the results of empirical studies on personality characteristics on military employees [2]. The 13 characteristic were ranked according to the mean of the received evaluation as follows (Table 2):

Table 2. Ranked personality characteristic necessary for following a military career

Rank	Characteristic	N	Mean	Std. Dev.
1	Courage	144	4.6528	.55871
2	Team spirit	144	4.5417	.58983
3	Physical abilities	143	4.5315	.63694
4	Spirit of sacrifice	144	4.5000	.66899
5	Discipline	145	4.4759	.74613
6	Ability to make decisions	143	4.4545	.86176
7	Self - control	146	4.4178	.71203
8	Ability to take risks	143	4.3986	.62955
9	Consciousness	144	4.1042	.78195
10	Intelligence	145	4.0897	.85730
11	Authority	141	3.8794	.95225
12	Conformism	143	3.6853	.98881
13	Spatial abilities	144	3.3681	1.04277

As noticed, the most important personality characteristic for army employees, as perceived by civilians young people, are character traits (such as courage and team spirit). The intellectual abilities (intelligence, ability to make decisions, spatial abilities) are considered to be less important as well as the traditionally stereotypical characteristics (conformism and authority). Nevertheless, the high scores obtained by most of the evaluated characteristics show that young people, civilians in general do not clearly differentiate between the these characteristics. Perhaps a better way of investigating this aspect would be to put into relation characteristics such as these ones with performance in activity.

We must also notice that the characteristics respondents gave when questioned about the military environment are highly similar with the personality traits necessary for following a military career. This aspect show, once again, that the representations young people have of the army do not cover the entire military environment but rather the employees.

Another aspect of our investigation regarding the representations of military environment was to identify the risks involved by a military career. 8.9% of the respondents

considered that the military career does not involve higher risks than any other career. The possibility of being injured is not one of the major risks linked to the military profession. The higher risk is considered to be that of losing life, 96.6% of the respondents evaluated this risk as being characteristic for the military career.

We also asked participants to the survey to evaluate the benefits and the disadvantages of a military career. Both college students and high-school pupils consider the attractive salary as the main advantage of the military career (Fig. 2).

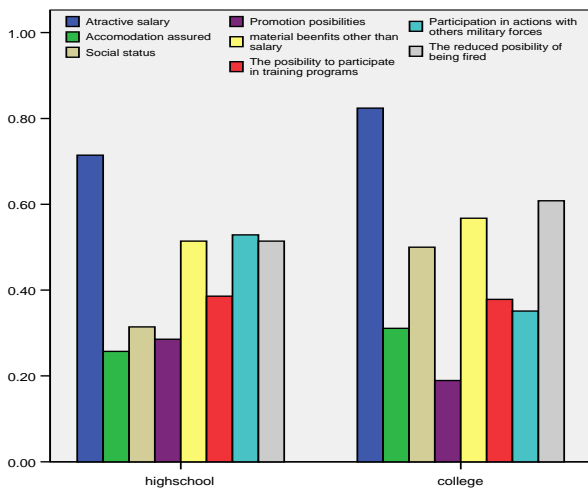


Figure 2. Most important benefits of a military career as evaluated by high-school pupils and college students

But while the firsts are much more interested by the material advantages the pupils evaluate the multiples training possibilities as being more important then college students do who accentuate the benefits of social status and job stability.

Even though almost 97% of the respondents consider the possibility of losing life as the main risk linked to the military career, only 52.7% of them declared personal safety as a disadvantage. Could this mean that

this risk loses its importance when evaluated in term of advantages vs. disadvantages?

## 5. CONCLUSIONS

The obtain results allow us to draw the following conclusions:

- young people's representation of the military institution is based on the characteristics of military employees rather than on the characteristics of the military environment;
- the representation of this social category (military) is much more stronger than the representation of the organization;
- many of the aspects participants in the survey considered to be characteristic of the military environment are positive characteristics; the military career is seen as having only one major risk, that of losing life, while the great advantages of this career stands in the financial benefits;
- the involvement of the military institutions in the community's life and problems is not very clear represented: young people appreciate the intervention of military institutions in such situation as being closed to average at all the analyzed dimensions.

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### 3. SOCIO-HUMANITIES

„LEGAL ASPECTS ON MARITIME SECURITY”, <b>Oana ADĂSCALIȚEI</b>	371
„WRECK REMOVAL-LEGAL PROVISIONS”, <b>Oana ADĂSCALIȚEI</b>	379
„ACTION RESEARCH: A BRIEF HISTORY”, <b>Razvan-Lucian ANDRONIC</b>	387
„MARITIME ENGLISH LEARNING/TEACHING MATERIALS”, <b>Carmen ASTRATINEI, Camelia ALIBEC</b>	393
„AD TERROR AS A MEANS OF EVOKING NEGATIVE EMOTIONS”, <b>Aurelian BĂDULESCU, Cristian DELCEA</b>	398
„KEY ISSUES AND PRESENT REFLECTIONS REGARDING THE NEW INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) IN EDUCATION AND TRENING”, <b>Gabriel Cristian BĂJENARU, Ana MUNTEANU</b>	410
„ROMANIAN ORTHODOX CHURCH FACTOR IN CHANGING LOCAL COMMUNITIES’ ATTITUDE TOWARDS DOMESTIC VIOLENCE”, <b>Iolanda BELDIANU, Daniela PORUMBU, Daniela NECSOI</b>	416
„COMMUNICATION BARRIERS”, <b>Mariana BORCOMAN</b>	422
„THE IMPORTANCE OF PUBLIC RELATIONS IN COMMUNICATION”, <b>Mariana BORCOMAN</b>	426
„THE WATER TRADE IN THE CAPITAL IN THE 19TH CENTURY”, <b>Iulia Cristina BULACU</b>	430
„LAS MENINAS - A POSTMODERN SYMBOL?”, <b>Laura CIZER</b>	436
“PERSONALITY CORRELATES PROMOTED BY MILITARY SERVICE AND CAREER”, <b>Aurel Ion CLINCIU</b>	441
„RECIDIVIST’S CORELLATES OF PERSONALITY”, <b>Aurel Ion CLINCIU</b>	449
„RECOGNITION OF AUTHORITY AND SOCIAL ORDER CONSTATATIV STUDY, ON AN HIGH-SCHOOL AND UNIVERSITY LEVEL”, <b>Cornelia COCAN, Daniela POPA</b>	456
„ECONOMIC ASPECTS OF LEARNING FOREIGN LANGUAGES”, <b>Sorinel COSMA, Simona-Cătălina COSMA</b>	462
„FEMINIST ECONOMICS”, <b>Sorinel COSMA, Simona-Cătălina COSMA</b>	466
„EFFECTS OF TRAINING IN MENTAL ROTATION TASKS”, <b>Laura Teodora DAVID, Aurel Ion CLINCIU, Laura Elena NĂSTASĂ</b>	470
„A FEW CONSIDERATIONS ON POLITICAL CORRECTNESS”, <b>Antoaneta DEMERGEAN</b>	474
„MEANS OF ENCODING FUTURITY IN ENGLISH AND ROMANIAN. A TEMPORAL-ASPECTUAL-MODAL PERSPECTIVE”, <b>Viorela -Valentina DIMA</b>	482
„THE ARMY’S PRESENCE FOR HOLIDAYS AND FESTIVITIES IN CONSTANTA, STARTING WITH THE REINTEGRATION AND UP TO THE INTEGRATION WAR(1878 – 1916)”, <b>Paul DOMINTE</b>	490
„THE HUMAN MOTIVATION: THEORIES AND THEIR APPLICATIONS AT THE LEVEL OF THE HUMAN RESOURCES WITHIN THE TEACHING SYSTEM”, <b>Paul DOMINTE</b>	496
„EUROPEAN DIMENSION IN EDUCATION”, <b>Roxana ENACHE</b>	503
„INTERCULTURAL COMPETENCE – AN ASPECT OF PROFESSIONAL COMMUNICATION”, <b>Georgeta GHIGA</b>	506
„CULTURE SHOCK AND ECONOMIC DOWNTURNS”, <b>Georgeta GHIGA</b>	512
„THE PROFESSIONAL OPTION BETWEEN VOCATION AND SOCIAL DEMANDS”, <b>Diana ILIȘOI, Daniela NAGY, Cristian George CONSTANTINESCU</b>	517
„THE BRITISH MONARCHY IN THE 21 <sup>ST</sup> CENTURY”, <b>Raluca-Georgiana IRIMIA</b>	522
„BREATHING... MASS MEDIA”, <b>Edith KAITER</b>	527
„POSTMODERNIST TRENDS AND ORIENTALISM”, <b>Edith KAITER</b>	533
„BLOGGING FOR ESP”, <b>Delia LUNGU, Mariana BOERU, Gabriela FTIMESCU</b>	541
„WHY INTERCOMPREHENSION? AN OVERVIEW OF CURRENT RESEARCH ON THE TOPIC AND ARGUMENTS IN FAVOR OF CONSIDERING IT WHEN TEACHING AND LEARNING LANGUAGES”, <b>Delia LUNGU, Mariana BOERU, Gabriela FTIMESCU</b>	546

„PECULIARITIES OF ESP”, <b>Magdalena MIHAILESCU</b>	<b>551</b>
“FROM CORRUPTION TO KLEPTOCRACY”, <b>Vasile NAZARE</b>	<b>558</b>
„INTERNATIONAL RELATIONS PARADOXES”, <b>Vasile NAZARE, Vasile-Eugen NAZARE</b>	<b>567</b>
„STRESS AND LOCUS OF CONTROL IN THE ACADEMIC CONTEXT”, <b>Daniela NECȘOI, Daniela PORUMBU, Iolanda BELDIANU</b>	<b>573</b>
„THE INTEGRATION OF THE ROMA IN A MODERN, DEMOCRATIC SOCIETY”, <b>Elena NEDELCU</b>	<b>577</b>
“THE ROLE OF INTERPERSONAL COMMUNICATION IN CAREER COUNSELING FOR STUDENTS”, <b>Maria Dorina PASCA</b>	<b>583</b>
“WHAT IS WRITING?”, <b>Marioara PATEȘAN</b>	<b>590</b>
„ELEMENTS OF CULTURE. AN INTERCULTURAL APPROACH”, <b>Oana-Andreea PÎRNUȚĂ, Ioana Mihaela DINESCU</b>	<b>596</b>
„NATIONAL SPECIFICITIES AND INTERCULTURAL COMMUNICATION IN THE UNITED STATES OF AMERICA AND FRANCE”, <b>Oana-Andreea PÎRNUȚĂ, Ioana Mihaela DINESCU</b>	<b>602</b>
„ABSURD SUFFERING FROM EXISTENTIALISM TO POSTMODERNISM”, <b>Oana POPESCU</b>	<b>610</b>
„RELIGION – AXIS OF COMMUNICATION IN THE EUROPEAN SPACE”, <b>Călin SINESCU, Liliana TROFIN</b>	<b>617</b>
„POWER OF THE WORD IN PSYCHOANALYSIS”, <b>Daniela SOREA</b>	<b>626</b>
„SYMBOLIZATION, SYMBOL AND PSYCHIC ENERGY AT S. FREUD AND C. G. JUNG”, <b>Daniela SOREA</b>	<b>632</b>
„CLASSROOM MANAGEMENT – COMPETITION IN THE CLASSROOM”, <b>Marica TARĂU, Aurica NEACȘU, Elena IORDACHE</b>	<b>638</b>
„THE RIGHT TO BE INFORMED – THE RIGHT OF PERSONALITY”, <b>Dumitru TOADER</b>	<b>642</b>
„PERMENENT EDUCATION THROUGH THE MILITARY ACADEMIC ENVIRONMENT”, <b>Ecaterina UNIANU, Ramona HENTER</b>	<b>646</b>
„A GLIMPSE INTO THE PROCESS OF WRITING”, <b>Dana ZECHIA</b>	<b>645</b>
„NARROWING THE GAP BETWEEN THEORY AND PRACTICE OF TRANSLATION”, <b>Dana ZECHIA</b>	<b>650</b>

## LEGAL ASPECTS ON MARITIME SECURITY

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**Abstract:** *The terrorist attacks of 11 September 2001 in the United States triggered a reconsideration of the security procedures applicable in harbours. The International Maritime Organisation, the European Union, the international Standardisation Organisation and the World Customs Organisation have adopted a wide range of security measures regarding directly or indirectly the maritime field. This article is aimed at detailing the adopted measures.*

**Key words:** *terrorism, security measures, IMO, ISO, WCO, UE.*

The terrorist attacks of 11 September 2001 in the United States triggered a reconsideration of the security procedures applicable in harbours. Later on, the discovery in a South European harbor of a stowaway travelling to North America with confidential information on possible targets on the territory of the United States raised the concern for the risks involved. Particularly the vulnerability of maritime shipping was proven during the terrorist attacks on the American destroyer “USS Cole” on 12 October 2000 and on the oil tanker “M/V Limburg” on 11 October 2002. [1]

USA was the first country to react to these threats. The *Port and Maritime Act* was adopted in December 2001 by the Congress of the United States. The law provides the establishment of a counseling committee on national shipping issues, conducts initial security assessments and harbor vulnerability assessments, establishes local committees for port security, draws up maritime security plans and conducts investigations on employment and restrictions for security-sensitive positions. It also provides the authority to take action related to security risks originating from foreign ports. The *Port and Maritime Act* was appended in 2002 by the *Antiterrorism Act* (HR3983) regarding the conduct of security assessments in foreign ports and the refusal to grant access to USA ports for ships that transit such ports carrying out inappropriate security procedures. These regulatory initiatives against

terrorism have been internationally completed by regulatory measures taken by the International Maritime Organisation, the European Union, the International Standardisation Organisation and by the World Customs Organisation. [2]

### 1. International Maritime Organization

The International Maritime Organisation (IMO) responded in 2002 to the threats on the shipping system security by adopting the following measures: the SOLAS Convention chapter XI was divided into two parts, i.e. chapter XI-1 “Special measures to enhance maritime safety” and a new chapter XI-2 “Special measures to enhance maritime security”; by establishing a new international code for ship and port facility security (The International Ship and Port Facility security - ISPS) in order to support security provisions incorporated in the SOLAS XI-2 provisions. The ISPS Code is divided into two sections: part A is a compulsory section, while part B is nonbinding and has a guiding character whereas it details procedures to follow in the implementation process of Part A and of Chapter XI-2 SOLAS. The Code establishes three security levels (MARSEC) from low/normal (1) to high (3) related to the nature/scope of the incident or security threat perceived. MARSEC level 1 is compulsory and it is inherent on the basis of ISPS A. MARSEC level 2 indicates the existence of a high security risk, while MARSEC 3 pertains

to a probable or imminent threat or a security incident. Both the ISPS Code and the SOLAS amendments were adopted in December 2002 and entered into force in 1 July 2004. [3] ISPS Code applies to all cargo ships of 500 gross tonnage or above, passenger vessels, mobile offshore drilling units and port facilities serving such ships engaged in international voyages. The new security regime imposes a wide range of responsibilities on governments, port facilities and shipowning and operating companies. [4]

The principal responsibility of Contracting States under SOLAS chapter XI-2 and Part (A) of the Code is to determine and set security levels. Responsibilities also include, inter alia: approval of Ship Security Plans; issuance of International Ship Security Certificates (ISSC) after verification; carrying out and approval of Port Facility Security Assessments; approval of Port Facility Security Plans; determination of port facilities which need to designate a Port Facility Security Officer; exercise of control and compliance measures. Governments may delegate certain responsibilities to Recognized Security Organizations (RSO) outside Government. Vessel-owning and/or-operating companies have a number of responsibilities, chief among which is to ensure that each vessel a company operates obtains an International Ship Security Certificate (ISSC) from the administration of a flag state or an appropriate RSO, such as a classification society. In order to obtain an ISSC, the following measures must be taken: designation of a Company Security Officer (CSO); carrying out Ship Security Assessments (SSA) and development of Ship Security Plans (SSP); designation of a Ship Security Officer (SSO); training, drills and exercises. A number of special mandatory requirements in SOLAS chapters V, X-1 and X-2 apply to ships and create additional responsibilities for vessel-owning companies and for Governments. These include in particular the following: Automatic Identification System (AIS); Ship Identification Number (SIN); Ship Security Alert System (SSAS); Continuous Synopsis Record (CSR). [4]

Depending on size, there may be, within the legal and administrative limits of any individual port, several or even a considerable number of port facilities for the purposes of the ISPS Code: Port Facility Security Plans (PFSP): based on the Port Facility Security Assessment carried out and, upon completion, approved by the relevant national Government, a Port Facility Security Plan needs to be developed; Port Facility Security Officer (PFSO): For each port facility, a Security Officer must be designated; Training drills and exercises. [4]

The IMO's Maritime Safety Committee (MSC) has regularly issued a number of guidance circulars to assist in the implementation of and compliance with the requirements of ISPS Code. Among other things: MSC Circular 1111 deals in some detail with the security measures and procedures to be applied at the ship/port interface when either the ship or the port facility do not comply with the requirements of chapter XI-2 and of the ISPS Code. An Annex provides detailed "Interim Guidance on Control and Compliance measures to Enhance Maritime Security". MSC Circular 1130 contains guidance on security-related information, which must be supplied or may be requested prior to entry of a ship into port. It was followed by MSC Circular 1131 which provides Interim guidance on Voluntary Self-Assessment by SOLAS Contracting Governments and by Port Facilities. The guidance contains a questionnaire to allow Governments to assess the effectiveness with which obligations in respect of port facilities are and continue to be fulfilled. MSC Circular 1132 provides guidance on a variety of matters, in particular the setting of and response to security levels, the practice of requiring and responding to requests for a declaration of security and matters relevant to access and boarding procedures. [4] Adopted a guidance circular entitled "Interim guidance on voluntary self-assessment by companies and company security officers (CSOs) for ship security" (MSC.1/Circ 1217); Approved the "Revised recommendations to the safe transport of dangerous cargoes and related activities in port areas" (MSC.1/Circ.1216),

which include provisions intended to address the security of the transport of dangerous goods by sea; Approved amendments to the IMO/ILO/UNECE “Guidelines for packing of cargo transport units” (MSC/Circ.787), to address the need for security procedures to be developed and followed by all concerned. [5]

Began consideration of issues relating to the security aspects of the operation of ships which do not fall within the scope of SOLAS chapter XI-2 and the ISPS Code, including cargo ships of less than 500 grt which travel on international routes. It was agreed, inter alia, that any guidelines developed should be non-mandatory. Furthermore, the MSC agreed to recommend the inclusion, as a high-level action for the 2008–2009 biennium, of the development of model legislation on maritime security. [5]

It should be noted that SOLAS regulation V/19-1 on a Long-Range Identification and Tracking System (LRIT), which had been adopted in 2006, entered into force on 1 January 2008. The regulation applies to ships over 500 GT constructed on or after 31 December 2008, with a phased-in implementation schedule for ships constructed before 31 December 2008. The purpose of the regulation is to allow for continuous monitoring of all vessels over 500 GT in order to help combat any threats to global security. The LRIT system is intended to be operational from 31 December 2008 and consists of the following: Ship-borne LRIT information transmitting equipment; Communication service providers(s); Application service provider(s); and LRIT data centre(s) including vessel monitoring system(s), the LRIT Data Distribution Plan and the International Data Exchange (IDE).[6]

Relevant IMO instruments in the context of the United Nations Global Counter-terrorism Strategy include the amendments to the 1988 Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation (SUA Convention) and its 1988 Protocol, adopted by way of two Protocols in October 2005. Amendments introduced by the 2005 SUA Protocol to the 1988 SUA Convention included the following: A broadening of the list of offences, to include

the offence of using the ship itself in a manner that causes death or serious injury or damage and the transport of weapons or equipment that could be used for weapons of mass destruction and inclusion of new procedures related to the transportation of WMD (Article 3 bis); Introduction of provisions for the boarding of ships where there are reasonable grounds to suspect that the ship or a person on board the ship has been or is about to be involved in the commission of an offence under the 1988 SUA Convention (Article 8 bis); A new definition for “transport” to the effect that it “means to initiate, arrange or exercise effective control, including decision-making authority, over the movement of a person or item” (Article 1(1)(b)). [5]

Amendments introduced by the 2005 SUA Protocol to the 1988 SUA Protocol extended the scope of provisions on the new offences to fixed platforms in the continental shelf, as appropriate. When implementing these amendments, particularly when boarding, States Parties should apply important safeguards, so as to avoid any possible negative effects. These include not endangering the safety of life at sea; ensuring that all persons on board are treated in a manner which preserves human dignity and in keeping with human rights law; taking due account of the safety and security of the ship and its cargo; ensuring that measures taken are environmentally sound; and making reasonable efforts to ensure that a ship is not unduly detained or delayed. The Protocols were open for signature from 14 February 2006 until 13 February 2007. Thereafter, they will remain open for accession. As also noted during the FAL 34 meeting in March 2007, the development of national legislation to implement the 2005 SUA Protocols is somewhat complex as it touches on all of the counter-terrorism conventions and needs to be in accordance with national and international law, in particular human rights law, refugee law and humanitarian law. [5]

It is also worth noting that several important amendments (July 2005) to the Convention on Facilitation of Maritime Traffic (FAL Convention) entered into force on 1 November 2006. They include new

recommended practices to encourage the use of electronic systems for exchanging data and, generally, for simplifying procedures to enhance the facilitation of trade. The new recommended practices include transmission of data, required in connection with the arrival, stay and departure of ships, persons and cargo, to a single point (the “Single Window” concept) and use of pre-arrival data for subsequent release and clearance of passengers and cargo. [5]

In 2006, IMO began considering integration proposals of appropriate procedures for cargo security on the basis of, or according to the SAFE WCO Framework standards in the international legislation such as the 1965 Convention on Facilitation of the International Maritime Traffic, as amended, and the SOLAS Convention, as amended. These proposals emerged in the context of the recognition that there is a gap in knowing and understanding the relations among the ISPS Code, the FAL Convention, the SAFE Framework of Standards and the AEO Guidelines and it was admitted (by the international community) that this gap should be overcome. Although the above mentioned conventions have not been amended, the MSC/FAL Joint Working Group particularly pointed out the importance of communication between ships, port facilities, customs and other competent authorities. [5]

## **2. European Union**

At the European Union level, a new Commission Regulation (EC) No.1875/2006 was adopted on 18 December 2006. By way of amendments to the Community Customs Code, it introduces a number of measures aimed at increasing the security of shipments entering or leaving the EU, including detailed rules regarding AEOs. The AEO Certificate will be granted to reliable economic operators as of 1 January 2008. The main conditions and criteria for achieving the status of AEO, in accordance with EC Regulation 1875/2006, include the following: Place of establishment in the Customs territory of the Community. However, an exception applies for airlines or shipping companies established elsewhere, but

with a regional office in the Customs territory of the Community, and for recognized AEOs established in a third country with which the Community has entered into an international agreement on mutual recognition; Record of compliance with Customs requirements (no serious infringement of Customs rules by responsible persons); Satisfactory system of managing commercial and, where appropriate, transport records (accounting system, access to records, developed logistical system, internal control system, handling of licences, archiving of records, informing Customs in cases of compliance difficulties, information technology security); Financial solvency; Security and safety requirements (buildings constructed of resistant materials, appropriate measures for control of access to shipping and cargo areas, measures for the protection of cargo units, handling of import and/or export licences connected with prohibited or restricted goods, clear identification of business partners, security screening of prospective security employees and their participation in security awareness programmes, etc.).[5]

Other measures introduced in the new Regulation include: A risk management framework for better risk analysis of goods crossing EU borders; Rules on advance electronic information on goods brought into, or out of, the European Community, effective as of 1 July 2009; Rules requiring Customs authorities to exchange information electronically on exports between the Customs offices involved in the procedure (export control system). Like the SAFE Framework, the new Regulation provides that “if the applicant for AEO status is the holder of an internationally recognised security and/or safety certificate issued on the basis of international conventions, of a European security and/or safety certificate issued on the basis of Community legislation, of an International Standard of the ISO, or of a European Standard of the ESO, the criteria provided for in paragraph 1 shall be deemed to be met to the extent that the criteria for issuing these certificates are identical or correspond to those laid down in this Regulation.” [5]

This would suggest that certificates such as the International Ship Security Certificate issued pursuant to the requirements of the ISPS Code would be recognized, but does not appear to have any direct implications for recognition of AEO status conferred by a non-Community Customs administration on the basis of the SAFE Framework, which, as will be recalled, is not an international convention. While recognition of AEO certificates in all EU member States is expressly envisaged by the Regulations, recognition of AEO status conferred by any third country would depend on there being agreements between the Community and the country in question. Regarding mutual recognition of AEO standards with third countries, the European Commission has launched discussions with some of the Community's major trading partners. [5]

In 2006, the Commission has also launched a pilot project on "smart and secure trade lanes" with China, which initially involves the European Commission, the Customs administrations of China, the United Kingdom and the Netherlands, and focuses on three ports, with particular emphasis on sea containers. Once successful, the cooperation is expected to be expanded step by step to the whole of the European Community. Both sides have agreed in the context of cooperation on security to exchange experiences and to develop best practices in order to better understand and prepare the implementation of the WCO Framework of Standards to Secure and Facilitate Global Trade. They have also agreed to pursue the objectives of reciprocity and mutual recognition of measures for security and facilitation between their respective Customs authorities. [5]

A Working Group on Mutual Recognition, composed of Customs experts nominated by both sides, was established in January 2007. This Working Group will, inter alia, prior to the formal implementation of the AEO programme on 1 January 2008, "draft a road map towards mutual recognition", and "shall endeavour to provide recommendations for an U.S.-EU agreement on mutual recognition of their respective trade partnership programmes (EU AEO programme and C-TPAT.)"[5] The

roadmap focuses on six areas that will be addressed by the United States and the EU to achieve mutual recognition: political, administrative, legal, policy, technical/operational and evaluation. It is envisaged that the following tasks will be accomplished by the United States and the EU, in an effort to achieve mutual recognition by 2009: Establish guidelines regarding the exchange of information, including validation/audit results and legalities associated with the disclosure of membership details; Perform joint verifications to determine remaining gaps between AEO/C-TPAT; Explore and test an export component for CTPAT; Exchange best practices through joint visits and conferences; Continue dialogue on legal and policy developments under the respective administrations; Endorse and sign a mutual recognition arrangement; and Evaluate mutual recognition benefits for AEO/C-TPAT members. [6]

On 30 January 2008 the EU and Japan signed an Agreement on Cooperation and Mutual Administrative Assistance in Customs Matters (CCMAA). The agreement entered into force on 1 February 2008. A first meeting of the EC-Japan Joint Customs Cooperation Committee was held in Brussels on 11 February 2008 to discuss the implementation of the CCMAA. The discussions focused mainly on the following topics: Supply chain security -recognizing the importance of mutual recognition of their AEO programmes and security measures and deciding on the creation of a working group that will make recommendations on these matters; The protection of intellectual property rights; and Mutual administrative assistance to fight against frauds and irregularities. [6]

The European Commission, together with the member States, has also undertaken a major review of the role of customs to adapt customs to global trade, and to the new threats of terrorism and climate change. In this context, the adoption of a Modernized Community Customs Code (MCCC) represents a major development, simplifying the legislation and administration procedures for both administrations and traders. A common position on the MCCC was adopted

on 15 October 2007 by the EU Council of Ministers and, after approval by the European Parliament, Regulation (EC) No. 450/2008 laying down the Modernized Community Customs Code was adopted on 23 April 2008. The regulation entered into force on 24 June 2008 but, in respect of a large number of implementing provisions which have yet to be drafted, it will apply at the earliest as from 24 June 2009, and no later than 24 June 2013. The MCCC: Introduces the electronic lodging of customs declarations and accompanying documents as the rule. Provides for the exchange of electronic information between the national customs and other competent authorities; Promotes the concept of “centralized clearance”, under which authorized traders will be able to declare goods electronically and pay their customs duties at the place where they are established, irrespective of the member State through which the goods will be brought into or out of the EU customs territory or in which they will be consumed; Offers bases for the development of the “single window” and “one-stop-shop” concepts, under which economic operators provide information on goods to only one contact point (“single window” concept), even if the data should reach different administrations/agencies, so that controls on them for various purposes are performed at the same time and in the same place (“one stop-shop” concept). The MCCC also assimilates the security amendments resulting from Regulation No. 648/2005 such as the AEO status, pre-arrival and pre-departure declarations and the risk management framework. [6]

### **3. International Organization For Standardization**

The International Organization for Standardization (ISO) has developed a range of voluntary international industry standards on supply chain management systems. It should be noted that the International Organization for Standardization (ISO) has been developing procedures to enhance supply chain security, consistent with the ISPS Code and the WCO Framework of Standards. Its

technical committee ISO/TC 8 “Ships and marine technology” has developed a number of publicly available specifications (PAS) on supply chain security which, after being tested in the marketplace, are expected to evolve into ISO standards. [5]

ISO standards are voluntary, but they are developed in response to market demand, and are based on consensus among the interested parties. To ensure that consensus over time, ISO reviews its standards, at least every five years, to decide whether they should be maintained, updated or withdrawn. In the field of supply chain security, the ISO standards may help in attaining some of the goals set in the WCO SAFE Framework, such as the mutual recognition of national-security-related programmes, and the application, by Customs administrations, of similar measures to companies operating throughout the supply chain. They include the following: ISO/PAS 20858:2004 -Ships and marine technology - Maritime port facility security assessments and security plan development. Published on 1 July 2004, it is designed to assist in the uniform implementation of the ISPS Code.[5] In 2005, the ISO/PAS 28000 series Specification for security management systems for the supply chain was adopted. This series of international standards is intended for application by organizations involved in manufacturing, service, storage or transportation by all modes of transport at any stage of the production or supply process. The aim is to facilitate and improve controls of flows of transport, to fight smuggling, to deal with the threats of piracy and terrorism, and to enable secure management of supply chains [6]: ISO/PAS 28000:2005 -Specification for security management systems for the supply chain. Published on 15 November 2005, it outlines the requirements for enabling an organization to establish, implement, maintain and improve a security management system. The aspects of ISO/PAS 28000 include, but are not limited to, financing, manufacturing, information management and the facilities for packing, storing and transferring goods between modes of transport and locations. ISO/PAS 28001:2006 -Security management systems for the supply chain -Best practices



for implementing supply chain security - Assessments and plans. Published in 2006, it is designed to assist the industry in meeting best practices as outlined in the SAFE Framework. It provides guidance and requirements for establishing and documenting a level of security, and conducting security vulnerability assessments, and assists in meeting the applicable AEO criteria set forth by the SAFE Framework and implementing national supply chain security programmes. ISO/PAS 28003:2006 -Security management systems for the supply chain -Requirements for bodies providing audit and certification of supply chain security management systems. Published in 2006, it provides guidance for accreditation of certification bodies as competent to perform certification to ISO/PAS 28000 or similar requirements. It provides customers with the necessary information and confidence about the way in which certification of their suppliers has been granted. ISO/PAS 28004:2006 -Security management systems for the supply chain -Guidelines for the implementation of ISO/PAS 28000. Published in 2006, it provides guidelines for the implementation of ISO/PAS 28000. ISO 28005 -Electronic port clearance. This is being developed and will provide for computer-to-computer data transmission using XML technology. It is a “one stop shopping” approach for “reporting activities related to ship’s clearance into or out of a port, port state controlled area and related reporting”. [5]

In 2007, the ISO 28000 series of standards were upgraded from their status of Publicly Available Specifications to that of full-fledged International Standards. Maritime and supply chain regular standards published by ISO in 2007 and replacing previous Publicly Available Specifications (PAS) include the following: ISO 20858:2007: Ships and marine technology –maritime port facility security assessments and security plan development. ISO 28000:2007: Specification for security management systems for the supply chain; ISO 28001:2007: Security management systems for the supply chain – best practices for implementing supply chain security – assessments and plans – requirements and guidance; ISO 28003:2007: Security

management systems for the supply chain – requirements for bodies providing audit and certification of supply chain security management systems; references ISO 19011:2002: Guidelines for quality and/or environmental management systems auditing and ISO/IEC 17021: Conformity assessment - Requirements for bodies providing audit and certification of management systems with any necessary security-related modifications or change; ISO 28004:2007: Security management systems for the supply chain – guidelines for the implementation of ISO 28000; ISO 28005: Ships and marine technology –computer applications -electronic port clearance (EPC). This standard is currently being developed. It provides for computer to computer data transmission. [6]

#### **4. World Customs Organization**

In 2005, the Council of the World Customs Organization (WCO) adopted the Framework of Standards to Secure and to Facilitate Global Trade (SAFE Framework), which has fast gained widespread international acceptance as the main global supply-chain security framework. [6] It outlines broad, overarching principles concerning security and facilitation of the global supply chain, and is based on two main “Pillars”, namely Customs-to-Customs cooperation and Customs-to business partnership. Its four core elements are as follows: Harmonizing advance electronic cargo information requirements concerning inbound, outbound and transit shipments; Developing and implementing a common risk management approach; Using non-intrusive detection equipment to conduct inspection of high-risk containers and cargo; Defining benefits for businesses that meet minimal supply-chain security standards and best practices. [5]

The SAFE Framework envisages the certification of Authorized Economic Operators (AEOs), who are entitled to participate in simplified and rapid customs procedures. In June 2006, the SAFE Framework Authorized Economic Operator (AEO) Guidelines were adopted at the WCO; they provide technical guidance for the

implementation of AEO programmes at the global level, and support the effective application of the relevant standards broadly outlined in Pillar II (Customs-to business partnership) of the SAFE Framework. These Guidelines also allow for the inclusion of supplemental national criteria that may be required by any given Customs administration. The AEO Guidelines document identifies certain Customs-identified best security standards and best practices, which members of the trade and business community aspiring to AEO status are expected to adopt, based on risk assessment and AEO business models. A number of elements that need to be satisfied are listed, each of them accompanied by specific detailed requirements applicable to AEOs or Customs, or to both. These elements include: Demonstrated compliance with Customs requirements; Satisfactory system for management of commercial records; Financial viability; Consultation, cooperation and communication; Education, training and awareness; Information exchange, access and confidentiality; Cargo security; Conveyance security; Premises security; Personnel security; Trading partner security; Crisis management and incident recovery; Measurement, analyses and improvement. [5]

In line with the SAFE Framework itself, the AEO Guidelines document reiterates the idea that “Customs administrations should not burden the international trade community with different sets of requirements to secure and facilitate international commerce. There should be one set of international Customs standards developed by the WCO that do not duplicate or contradict other recognized intergovernmental security requirements.” It further suggests that “verifiable compliance with security requirements and standards set by other intergovernmental organizations, such as IMO, UNECE, and ICAO, may constitute partial or complete compliance with applicable Customs-identified best security standards and best practices set forth below to the extent the requirements are identical or comparable.” This would suggest that with respect to ocean

carriers and port facilities, for instance, existing security and operational requirements established in the ISPS Code may be recognized for the purposes of the SAFE Framework. [5]

Conclusions: Ensuring the maritime security is a wide process extending beyond measures adopted by IMO. As a complement, ISO, WCO and the EU adopted their own regulatory measures affecting the maritime security in terms of supply chain. This international regulatory activity revealed the necessity of co-operation by incorporating the measures already adopted by other bodies in order to avoid identical or comparable requirements.

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## WRECK REMOVAL-LEGAL PROVISIONS

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**Abstract:** *The Convention will bridge a gap in the existing international legal framework, by providing the first set of uniform international rules meant to ensure the prompt and effective removal of wrecks located beyond the territorial sea. The new convention will provide the legal basis for States to remove, or to pay for the removal of shipwrecks or ships within their exclusive economic zone (EEZ) that may potentially endanger the safety of lives, goods and property at sea, as well as the marine environment. This article is aimed at analyzing the provisions of the Convention.*

**Key words:** *wreck, hazard, related interests, maritime casualty, removal.*

The Nairobi International Convention on the Removal of Wrecks, 2007, was adopted by a five-day Diplomatic Conference held in the United Nations Office at Nairobi (UNON) in May 2007 under the auspices of IMO, the UN specialized agency responsible for safety and security at sea and prevention of marine pollution from ships. The Convention will bridge a gap in the existing international legal framework, by providing the first set of uniform international rules meant to ensure the prompt and effective removal of wrecks located beyond the territorial sea. The new convention will provide the legal basis for States to remove, or to pay for the removal of shipwrecks or ships within their exclusive economic zone (EEZ) that may potentially endanger the safety of lives, goods and property at sea, as well as the marine environment. [1]

The adoption of this Convention is the result a 12-year-old preparatory work in the Legal Commission of IMO, but its origins go a long way back. [2]

The idea of a Convention on the subject of Wreck Removal had been for more than 36 years one of the top-priority items on the agenda of the Legal Committee of the International Maritime Organization (IMO). The subject already has a long history with

IMO, and the Legal Committee started considering the issue already at its 12th session. This was directly triggered by the 1967 incident with the oil tanker “Torrey Canyon” before the coasts of France and the United Kingdom. [1]

This topic was raised in 1974/75 in the Legal Commission of IMO when a review of the national legislation was performed by a number of Member States in order to develop an international instrument, but this was not accomplished at that time. [2,3] Moreover, in these early discussions in the beginning of the 1970s, it was decided that before a more general Convention on the Law of the Sea was established, it would be premature to even try to draw up a new convention. Since the United Nations Convention on the Law of the Sea was successfully concluded in 1982, the IMO Legal Committee decided further on that the subject should be dealt with when work on the HNS Convention and the LLMC Protocol had been concluded. Both the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea (HNS Convention) and a new Protocol to the Convention on Limitation of Liability for Maritime Claims (LLMC) were established in 1996 and furthermore complemented by the International Convention on Civil Liability for

Bunker Oil Pollution Damage, 2001 (Bunkers Convention). [1]

So the topic was first raised, in its current form, at a Legal Committee meeting in the autumn of 1993. At the 70th Session in the spring of 1994 Germany, the Netherlands and the United Kingdom submitted a further paper on the topic which argued that an international treaty on wreck removal was necessary in order to establish uniform rules for wreck removal operations in international waters. The co-sponsors suggested that this would be consistent with the powers of coastal states under Article 221 of the United Nations Convention on the Law of the Sea 1982 (UNCLOS) and would fill gaps in the existing international law. Attached to this joint submission was a first draft of a wreck removal convention. [3] The main goals of this draft-text were: to entitle a neighbouring state to remove wrecks located in its EEZ if they pose a risk for the navigation safety and for the marine environment; to hold the shipowner strictly liable for reporting, marking and removal costs if the neighbouring state needs to perform these procedures; to provide mandatory insurance and direct action against insurers within the limits established by LLMC shaped after the equivalent provisions of art.VII of the 1969 CLC Convention. [2] The current instrument has developed from that. [3]

Subsequent to thorough consideration of the draft WRC at its 74th session in 1996 the Legal Committee agreed to establish an IMO Correspondence Group on Wreck Removal for the purpose of identifying and, where appropriate, developing options for dealing with several problems identified by the correspondence group forwarded for the consideration of the Legal Committee. The analysis by the Legal Committee finally resulted in drawing up a text for a Convention on the Removal of Wrecks to be adopted at the Diplomatic Conference in Nairobi. [1]

During the 92nd session of the Legal Committee in Paris in October 2006 a general agreement was reached on the text of the draft Convention but no final solution was found for the possible application of the Convention within the territory including the territorial sea

of a State Party. Germany, which was holding the presidency of the Council of the European Union at the beginning of 2007, was requested to work out a compromise-proposal under high time-pressure before the Diplomatic Conference in Nairobi and despite a further meeting in London in the spring of 2007, no final agreement was reached with respect to the possible application to the territory before the start of the Conference in Kenya. In response to the joint efforts of Germany and many other countries and by using a counter-proposal at the Conference of Turkey and the United States for territorial application by national law only based on a Conference Resolution as a big stick, it was possible to narrow the gaps and to reach a broad-based agreement based on the opt-in proposals by Germany and other proponents. [1]

### **A Bird's Eye View Over the Convention**

Article 1 "Definitions" contains the usual structure of key-phrases that are precisely defined, but several of them in this Convention are important in terms of defining the limits of the application of the Convention. [2]

Article 1 Paragraph 1 "Convention area" means the EEZ of a State or the equivalent zone from the text of previous conventions, such as the Convention on Civil Liability for Bunker Oil Pollution Damage, (the 2001 Bunkers Convention). The words "established in accordance with international law" are an indirect hint at articles 55-75 of UNCLOS where the EEZ is defined. Subsequently, article 3 paragraph 3 extends the significance of the term "Convention Area" to the territory, including the territorial sea, to which the State Party exercised its option to extend the application field of the Convention to these waters. [2]

Article 1 Paragraph 2 offers an extensively large definition of the term "ship" which also includes floating platforms (subject to the exception adopted for the first time in the 1989 Convention on Salvage), except for platforms "on location" (a widely used term in the offshore industry) and engaged in the exploration, exploitation and production of mineral resources on the bottom of the sea. [2]

Article 1 Paragraph 3 defines the term “maritime casualty” identically to the definition in the 1969 International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties. It is worth pointing out that the term “wreck” is defined under paragraph 4 as a consequence of a maritime casualty, although it is highly unlikely that a ship may turn into a wreck but as a result of maritime casualty. [2]

In Article 1 Paragraph 4, the definition of the term “wreck” is extensive enough to include: a sunken or stranded ship; any part of a sunken or stranded ship, including any object that is or has been on board such a ship; any object that is lost at sea from a ship and that is stranded, sunken or adrift at sea; or a ship that is about, or may reasonably be expected, to sink or to strand, where effective measures to assist the ship or any property in danger have not already been taken. [2] Warships and state owned non-merchant vessels are not dealt with under the terms of the Convention. [3] The term “effective” was added upon request from the International Maritime Committee (IMC) and the International Salvage Union to ensure that a neighbouring state is not entitled to intervene when an incident is being dealt with by a competent salvor. Under these circumstances, the legal regulations applicable to a salvor in possession shall apply, and an intervening state may be exposed to legal liability to the salvor. [2]

Article 1 Paragraph 5 the definition of the term “hazard” explicitly points out that his term does not apply only on risks for the marine environment, but also to threats that may result in harmful consequences to the marine environment. In its great majority, the Legal Committee had already favoured the covering of all risks for the safety, the marine environment and the coast line. On the other hand, the view was also expressed to cover only safety risks, based on the fact that pollution damage is already adequately covered under the existing conventions (1992 CLC, the 1969 Intervention Convention and 1973 Protocol thereto and the HNS Convention). However, possible overlapping and conflicts with the existing conventions such as the 1969 CLC, the 1969 Intervention

Convention and the HNS Convention shall be avoided by means of exclusion clauses. [2] The Convention will also tackle the existing strong support for fishing activities. Aircraft wrecks can also represent maritime hazards. However, given the relation between IMO and ICAO it was decided not to cover such wrecks as well. [1]

Article 1 Paragraph 6 “related interests” means the interests of a coastal State directly affected or threatened by a wreck such as: maritime coastal, port and estuarine activities, including fisheries activities, constituting an essential means of livelihood of the persons concerned; tourist attractions and other economic interests of the area concerned; the health of the coastal population and the well-being of the area concerned, including conservation of marine living resources and of wildlife; offshore and underwater infrastructure. [2]

The phrase “related interests” is taken over from Article II(4) of the 1969 International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties and the definition follows the text of this article and adds “offshore and underwater infrastructure”, thus reflecting the increase in the 1969 offshore activity and the study of this activity in EEZ in article 56 of UNCLOS. [2]

The extended obligation created by the Convention on the Removal of Wrecks is to be found under article 2 (1) providing that “there should be a wreck which poses a hazard in the Convention area”. The six definitions under article 1 imply that all six should be applied in an incident where the Convention is to be invoked. [2]

Article 1 Paragraph 9 gives a very broad definition the term “ship operator” and also includes the bareboat charterer, thus reflecting the increase in the use of such agreements. The reference to the ISM Code is unusual since it is not customary for an international instrument to make reference to a different one, to which the States Party of the former may not be parties. Nevertheless, as the ISM Code is part of the SOLAS Convention which is almost universally applied, this fact is highly unlikely to cause any difficulties. [2]

The other significant definition is stipulated under Article 1 Paragraph 10, which defines the term “affected state” in terms of geography as being the state in whose Convention area the wreck is located. It is not difficult to foresee the circumstances under which a drifting ship represents more than a hazard in the vicinity of the coast line of a state, but the convention confers the intervention right only to one state, mainly the one in whose EEZ the ship is located at that moment. The identity of the affected state may change of course, if the ship drifts from the EEZ of one state into the EEZ of another state. [2]

The broad definitions of the Convention can mean that practice may vary from one state to another, which in the opinion of some authors might contribute to a potential lack of uniform implementation of the convention by the coastal states. [4]

Article 2 “Objectives and general principles” contains the essence of the convention and also establishes limits regarding the intervention right of affected states. The origin of these rights in the 1969 international convention relating to intervention on the high seas in cases of oil pollution casualties can be noticed here, especially in the manner the term “proportionality” is used under paragraph 2 and in the interdiction of more than is reasonably required and of the useless interference with the rights of other states, including the flag state of the ship. [2]

Article 3 “Scope of application”, a big part of which was developed during the Nairobi Diplomatic Conference, stipulates provisions aimed at giving efficiency to “opt-in” prerogatives for the coastal state. The somehow difficultly to comprise drafting shows the problems encountered in reaching an acceptable compromise. Particularly the last sentence of paragraph 2 was added on the advice of the International Group of P&I Clubs for the purpose of providing securities and of making sure that claims for expenses shall not be covered by such a security except for those made according to articles 7 (locating), 8 (marking), 9 (removal). The wording also covers the entry into force of any

notification to opt-in as well as its withdrawal. [2]

This article does not address the legal relation between a state which gave such a notification and one which did not give such a notification. Such is for instance the case of a wrecked ship in the territorial sea of a state which truly extended the Convention, but not in the case when the ship is registered in a state which has not done this. [2]

It is highly unlikely that the wreck removal prerogatives offered by the Convention may be broader than those of national laws applicable within the territorial sea of states, but, in order to benefit from the financial security advantage offered by the Convention, it would be wise that the affected state should notify the state of the ship’s registry in conformity with article 9(1), even if the replacing of this article by article 4 (4) II does not request this. [2]

Article 9 was developed a few months before article 3, but it is reasonable to suppose that the consent of the flag state based on article 9 (10) for measures taken by the affected state (provided they are in conformity with limits imposed by under article 2 and paragraphs 4 and 8 of article 9) shall extend to measures to be taken in the territorial sea, if affected state gave a notification on the basis of article 3. [2]

Again, article 4 paragraph 4 ii, appears to state that paragraphs 7 and 8 of article 9 (inter alia) do not apply to wrecks located in territorial and inner waters but according to article 3 paragraph 2 it appears that conformity with these paragraphs will not remain a prerequisite for liability of Clubs grounded on any letter of guarantee”. [2]

We should mention that the “opt-in” clause also contributes to a potential lack of uniform implementation of the Convention by coastal states which is a cause for concern on the part of CMI, ICS and the IG. However, the fact that during the Legal Committee discussions, some States indicated that they would not be prepared to change their national laws, resulted in a compromise whereby when ratifying the Convention, states can choose to apply certain provisions in their territorial waters. It is assumed that the attractions of the compulsory insurance and direct action

provisions will provide a sufficient incentive for states to make use of this option, but the position is not ideal from the perspective of encouraging a uniform global liability regime for the removal of wrecks. [4]

Article 4 “Exclusions” represents a curious collection of paragraphs, somehow without a connection to one another. Disregarding the similitude in wordings, paragraph 1, provides that this Convention shall not apply on measures taken on the basis of the 1969 International Convention relating to intervention on the high seas in cases of oil pollution casualties. It should be reminded that the said convention of 1969 applies to measures taken on the high seas. This was developed in a period when the limit of the territorial was of the majority of states 3 miles and the EEZ did not exist. [2]

Article 86 of UNCLOS provides that articles pertaining to high seas shall apply to “all parts of the sea that are not included in the EEZ, in the territorial sea or in the internal waters of a state”. When the Convention on Wreck Removal enters into force, the interconnection between this and the International Convention relating to intervention on the high seas in cases of oil pollution casualties will most certainly be beyond relevant limits of the EEZ. Nevertheless, until then, the situation is not quite clear. A state threatened by a ship in distress in its own EEZ might probably invoke the International Convention relating to intervention on the high seas in cases of oil pollution casualties and the usual international legislation in order to justify appropriate measures. [2]

The exclusions mentioned under paragraph 4(4) were a part of the compromise package allowing the “opt-in” provisions under article 3 to be adopted. Nevertheless, it is curious enough that this paragraph was not included in article 3, which it appeared logically to belong to. Also, regretfully enough, the application and non-application of certain provisions to any set of given circumstances involving a wreck within territorial or internal waters, is uncertain. [2]

Articles 5, 6, 7 and 8 are essentially of administrative nature and are designed to

ensure that reasonable precautions are taken to identify a ship, in order to assess the risk degree according to a set of objective criteria and to identify the wreck, to mark it and to make its location public by appropriate notifications to the owners. Their contents is also relevant for the application of those articles dealing with financial problems, as any claim for expenses from an affected state shall be accompanied by a proof of the fact that the procedures and criteria established under these articles have been met. [2]

The obligation stipulated under article 8, according to which an affected state should mark the wreck even if his is beyond its territorial waters is an obvious extension of the rights and obligations of the coastal state beyond those provided under article 56 UNCLOS pertaining to the rights of a coastal state in its own EEZ. [2]

Article 9 “Measures to facilitate the removal of wrecks” is one of the most important articles of the Nairobi Convention but it contains a sort of paragraphs that apparently have no connection whatsoever to one another. [2] It was suggested that a title such as “Wreck removal” would have been more appropriate. [3] The simple statement in paragraph 2, i.e. “the registered owner shall remove a wreck determined to constitute a hazard”, represents the core of the obligations created by this Convention, while the provisions of paragraphs 1 and 3, of information and consultation of the flag state and of providing proofs of insurance are rather administrative. [2]

Paragraph 4 is the most interesting and innovating of this article, largely because of only one word, i.e. “any”. Many states have a legislation that reserve salvage operations in their waters to their own salvage contractors. Of course such laws do not apply in the EEZ and paragraph 4 maintains the independence of the owner and of the P&I Club to select the most appropriate contractor for this activity. The second thesis and paragraph 5 limits the prerogative of the affected state to intervene if the wreck removal operations proceed safely and effectively. This also reflects the situation in which a salvor is in possession. [2]

Paragraphs 6 and 7 allow the affected state to intervene if the wreck removal operations have not been initiated within a reasonable deadline. The manner of drawing up the paragraphs is not controversial but there are potential problems in reserve here. A major operation of wreck removal will usually request thorough preparations and planning, sorting a substantial amount of heavy equipment on site, mostly imported from abroad and prudent use of tide and window weather. The government officials who rarely have detailed knowledge about such operations may become restless if they see that nothing happens. A wise contractor requests goods diplomatic skills and shall institute procedures to keep the affected state informed and hopefully the drawing up of paragraphs 6, 7 and 8 will encourage and support this fact. [2]

Paragraph 8 of this article allows the state to intervene and take over the operation if “an immediate action is necessary”. In practice, most governments are reticent to taking over a major wreck removal operation for which they lack experience and necessary equipment. Officials of an affected state should be well advised to stop and consider thoroughly the matter before invoking the prerogatives offered by this paragraph. By doing so they have to bear in mind the general limitations for measures of the affected state established under paragraphs 2 and 3 of article 2. The States interested in keeping their action freedom within their territory including the territorial sea were loud in the debates resulting in the Nairobi Conference, arguing that article 9 should not apply to salvage situations within their territory. [2]

The result was a compromise whereby article 4, paragraph 4(ii) excludes paragraphs 1, 5, 7, 8, 9 and 10 from the application of these operations. Nevertheless, it would be wise for an affected state to bear in mind that in order to obtain the reimbursement of wreck removal expenses according to article 12, it should prove that it has observed all the provisions of articles 7, 8 and 9. [2]

Article 10 “Liability of the owner” contains in paragraph 1 a statement according to which the registered owner shall be liable for the

costs of locating, marking and removing the wreck under articles 7, 8 and 9, except for the strict exclusions from liability under CLC, HNS and the Bunker Convention. It is worth mentioning the fact the term terrorism is not included. As this is a risk excluded from the usual cover offered by P&I Clubs, it remains to be seen if the P&I Clubs will be able to issue the certificates provided for under article 12. Considerable difficulties were encountered with the equivalent provisions of the Athens Protocol of 2000 relating to the Carriage of Passengers in this respect. Paragraph 2 maintains the owner’s prerogative to limit its liability based on the applicable scheme but it should be reminded that many states, including the UK have exercised the reserve under the 1976 CLCC Convention in order to exclude the wreck removal claims from the domain of limited liability. [2]

Practically, this is the issue raised by the International Chamber of Shipping. The Convention itself does not establish a right to limitation. The owners’ problem is that some states might not be parties to international limitation conventions or might have expressed reserves under these conventions with respect to wreck removal claims. Some states may have limited liability for wreck removal claims in their national legislation. ICS deems it inequitable that owners should be subject to strict liability for wreck removal without a corresponding right to limit that liability which is guaranteed by the law. [4]

Article 11 “Exceptions from liability”, excludes from the liability provided under the Wreck Removal Convention the costs covered by other well-established liability provisions. As for CLC, HNS and the nuclear liability, they pose no problems as they have their own “stand alone” funds. Nevertheless, in the case of the liability based on the 2001 International Convention on Civil Liability for Bunker Oil Pollution Damage (Bunkers Convention), the liability is restricted to the liability fund provided by the LLMC Convention and it goes the same for those under the Wreck Removal Convention. In case of an incident involving claims for bunker oil pollution damage and wreck removal, if the owner invokes the right to limit his liability, these claims shall compete



with one another for the limited available funds if the applicable legislation allows the limitation of liability for wreck removal claims. [2]

Article 12 “Compulsory insurance or other financial security”. This long article is very similar to the comparable provisions from the CLC, HNS Conventions and the Bunkers Convention. Particularly interesting is the relatively low threshold of 300 gt for certificate requested under paragraph 1. This will certainly enhance the administrative burden of owners and flag administrations, which will be requested to provide the appropriate certificate for small ships such as coasters and trawlers. [2]

Instead of separate state certificates according each liability regime, the Nairobi Convention chose to adopt a Resolution, “Resolution on compulsory insurance certificates under existing maritime liability conventions”, relating to the development of a single certificate to be issued in conformity with various regimes of liability and compensations. [2, 5]. The said resolution invites states to ensure the entry into force of other conventions regarding liabilities and compensations, especially the International Convention on Liability and Compensation for Damage in connection with the Carriage of Hazardous and Noxious Substances by Sea, 1996, the International Convention on Civil Liability for Bunker Oil Pollution Damage, 2001 and the Protocol to the Athens Convention Relating to the Carriage of Passengers and their Luggage by Sea, 2002. [5]

As mentioned before, the ISM Code implementation threshold is 500 tones and problems may be encountered in applying the provisions of article 1 paragraph 9, referring to the ISM Code, in defining the ship operator in case that the ship’s tonnage is lower than 500 gt, hence the ISM Code does not apply. To be kept in mind that the security value should comply with the liability limit of the ship, calculated according to art. 6 paragraph 1 letter b of the 1976 LLMC Convention, as modified by the 1996 Protocol thereto. [2]

The term “calculated” was added on the suggestion of IMC, in its attempt to make sure

that the insurer’s security and liability shall not exceed this limit even if the ship is wrecked in a state which has not ratified the LLMC Convention or which, such as UK, has excluded the wreck removal claims from liability limitation. [2]

Paragraph 13 contains a new drawing up which is not to be encountered in the other conventions relating to liability and which allows flag states to keep relevant financial securities electronically and to communicate that to IMO and to other states. Nevertheless, this paragraph shall not apply unless the coastal state or the port state has notified IMO they will recognize the security in this format. This is certainly the way to follow and hopefully this option will be adopted by governments and eventually applied in the case of financial securities requested by the CLC, HNS Conventions and the Bunkers Convention. [2]

Article 13 “Time limits”. Time limits of three years from the date when the hazard has been determined and six years from the date of the maritime casualty that resulted in the wreck follow the pattern of previous conventions relating to liability. The IOPC Fund believes that as the equivalent provisions of the International Convention on the establishment of an International Fund for compensation of oil pollution damage 1992, cancel the right to compensation, it is not possible to extend the time limit based on an agreement. [2]

That means that in significant cases parties are obliged to institute legal procedures against the Fund for the purpose of protecting time limits while solution-finding discussions are in progress and this fact may sometimes exacerbate the behaviour of the parties. It appears that the same thing will apply to claims made on the grounds of the Wreck Removal Convention.

Article 15 “Settlement of disputes”. This article was added in a late stage of the debates at the meeting of the IMO Legal Committee of October 2006, as a result of the proposals made by the governments of Italy and Germany, supported by an intervention of the representative of the Tribunal for the Law of the Sea. The Tribunal mainly deals with

disputes between states, but recently it has encouraged parties to forward their disputes for examination. Actions of governments and of natural persons against P&I Clubs, on the basis of their financial securities conferred in accordance with article 12 can be brought forward to this Tribunal, but in most of the cases the Club Regulation shall be governed by the English law or by the law of the country where the Club is located and actions shall be subject to arbitration, as provided by the Regulation. [2]

Article 16 “Relationship to other conventions and international agreements” This article expresses a general reserve to the rights and obligations of a state in conformity with UNCLOS or with the customary law of the sea. [2]

Final clauses follow the pattern of the latest IMO Conventions. Particularly interesting is the request for ratification by 10 states stipulated under article 18 for the entry into force of the Nairobi Convention. The relatively small number of states that shall ratify the convention shows that the end text reached a wide international recognition. [2]

The long gestation period of this convention permitted a full review of all problems. However, it is worth noting that the end text contains no provision allowing the ship owner or government removing the wreck to dispose of the wreck remainders (e.g. for further sale or scrap) in order to retrieve their expenses, as it does not allow the ship owner or the P&I Club to raise a claim for the net gain resulted from such sale. A provision in this sense is part of the law of the sea of many countries, but it appears that such provision did not interest the delegates in the IMO Legal Commission. Moreover, based on a broader background, the existence of a financial liability certificate provided for under the Nairobi Convention may rather have an impact on the issue of refuge locations. The state and the port authorities shall be justifiably concerned about the risk that a ship in distress might sink and hinder the navigation on their waterways. If the government has exercised the option under article 3 paragraph 2 to

extend the scope of application of the Convention to internal and territorial waters, this fact should appease their concern about the fact that they might end up with a worthless wreck without the possibility to recover their expenses from its owners. Under these circumstances, it would be wiser to recognize the connection between the Nairobi Convention with the Convention on places of refuge, currently under study. [2]

Conclusions: The entry into force of the Nairobi Convention shall emphasize more clearly the positive as well as the negative aspects. Until then, as a positive outcome, it has to be kept in mind the fact that the convention complements the framework of IMO conventions relating to liability and compensations. What may particularly raise practical problems is related to the lack of uniformity in its implementation by the States.

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## ACTION RESEARCH: A BRIEF HISTORY

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**Abstract:** *This article presents a brief history of the action research, starting with Kurt Lewin's contribution (1946). Right from the start, the action research was conceived as a methodological alternative to the mainstream science, but it is still little used, including in Romania.*

**Key words:** *action research, methodology, positivism*

### 1. KURT LEWIN'S CONTRIBUTION

The action research began to assert a distinct type of research in the social and human sciences after 1946, following Kurt Lewin's publication of his article: *Action research and minority problems*. The American (of German origin) psycho-sociologist Kurt Lewin is considered the "father" of the action research (especially since he is considered to have created the term, although John Collier used it in the same way a year before Lewin) and the delimitation of the specificity of this type of research is one of his major contributions to the development of psycho-sociology. Also, Jacob Levi Moreno's contribution to structure this type of research is noticed in most works devoted to the history of the action research.

A number of authors (Kock et.al., 1997; Baskerville, 1999 etc.) show that in parallel with Kurt Lewin's work at the University of Michigan, Research Center for Group Dynamics, similar research was developed (independently) at the *Tavistock Institute of Human Relations* in London on disorders being suffering from by the soldiers who fought in the Second World War. Also, James McKernan (1991, 8-9) identifies a number of similar research (Collier, 1945, Lippitt and Radke, 1946) immediately after the period when research was carried out by Lewin or by the Group from Tavistock and links the emergence of the new type of research to the

"Science in education" movement, active in the United States during the period between the XIX and XX centuries, as well as to a series of reconceptualization of education within the same cultural space, especially those of John Dewey (e.g. description of problem solving). Kurt Lewin's contribution is regarded as fundamental as he is the first author who conducted a systematic methodological reflection on the specificity and way of realization of the action research.

The idea of action research was based in the 40's by Kurt Lewin, in an attempt to connect social theory and practice. Lewin considered at the time that there was neither a relationship between social theory and social action, nor collaboration between scientists and practitioners, who should use the scientific results in their work. While scientists developed the theory without taking into consideration its applicability, practitioners in the social field engaged mostly in actions without being informed, so no one could talk about consistent results in any of the two "worlds": the abstract, the scientists' one, and the real one, of those who build the intervention strategies and work towards the social change. Bringing together these two worlds and the combination of the research with the action would result, in Lewin's conception, in the production of information and solutions that would result in informed actions, improved behaviors, and strategies of encouraging social change.

Lewin (1951) brought the cycle of action research approach, designed as a series of activities: identification of an initial "idea", fact-finding, planning, action, evaluation, developing a better plan and implementing it, then followed by the resumption of these activities to further understanding of the situation and formulating a theory as close as possible to the actual situation (Precupețu, 2007, 105).

Besides the article from 1946, Kurt Lewin developed the concept of "action research" in two other articles, which appeared in 1947. Although he developed the first theoretical approach and described for the first time the cycle of action research, Kurt Lewin has failed (due to his premature death, he was only 57 years old) to further articulate his ideas on this type of empirical research.

At sixty years after the publication of the article *Action research and minority problems*, David Bargal (2006, 378-383) and has assumed the task of formulating the principles of the action research, by extracting them from Kurt Lewin's three articles:

1) Action research combines the systematic study - often experimental – of some social problems with the solving efforts. In contrast to the traditional scientific model, where the researcher's main task was that of understanding the problem, in the action research one studies the problem and offers opportunities to intervene to solve it. The implementation of this principle requires a very good knowledge of the theories on the studied social problem, starting from the dictum "There isn't a more practical thing than a good theory" (Lewin, 1943/1951, 169).

2) The action research includes a data collection spiral setting the purpose for action to achieve results and assessment of intervention. Lewin designs the action research as a process of problem solving that takes place in a constantly changing environment. Therefore, in principle, there isn't an end of the intervention as problems to be solved arise permanently. For each process of solving a problem, the following stages are taken: data collection to determine the purpose of the intervention; the achievement of

the goals (through the intervention of the individual groups, organizations or communities) and the evaluation of the completed intervention.

3) The action research requires feedback from all parties involved in achieving it. The feedback can show deviations from the aim of the intervention (alterations in the original plan) and may exhibit discontinuities in the process of the intervention that are thus corrected in real time. This principle emphasizes the active role of all parties involved in the research project, including the customers (who are usually excluded, not having access to the information available to those carrying out the research).

4) The action research implies continuous cooperation between researchers and practitioners. If within the framework of the conventional scientific research model the investigator has exclusive control (being the only one familiar with the research hypothesis, the selection of participants, etc.), within the action-research framework the scientist and the other people who carry out the research are equal partners in making decisions. This cooperation is based on the recognition that the participants should be responsible for making decisions affecting their existence and they need to understand the reasons for the intervention. Because they are the researcher's equal partners in the project of intervention and know the reasons and decisions that were taken up, the participants can maintain their motivation at a high level.

5) The small group plays a central role in making decisions and changing individuals. For Kurt Lewin the small group is the most important vehicle for making decisions democratically, and the change of individuals through it goes through three phases: a) defrosting (reduction of forces that are keeping pressure on the current situation, by presenting a problem or a challenging event, with the aim to determine the organization's members to recognize the need for change and seek new solutions), b) the change itself (changing group members' behavior by developing new behaviors, values and attitudes), c) freezing

(through the establishment of new procedures and systems to support and maintain the change made).

6) The action research takes into account the values, goals and aspirations for the power of the parties involved. Since each person involved in the action research has its own set of priorities and values, the only way to ensure the success of the research is to approach the occurring conflicts in an open way. Again, one can notice the contrast with the classical manner of approaching the research, where only the person carrying out the research has the power to make decisions and resolve conflicts unilaterally.

7) The action research serves to create knowledge, to formulate the principles of intervention and evaluation. Regarding knowledge, it generates both data collected and processed in the same way as other types of research and "actionable knowledge" (important both for the intervention and for improving, in time, the group's, organization's or community's functioning). Also, the group can use the measuring instruments/tools used in the action research long after the intervention, as assessment tools.

8) In the action-research one focuses on recruitment, training, development and support of the change agents – the trainers. Since action research aims to social change, these investments in trainers (the change agents) may be considered essential, since they are the principal means of achieving the wanted social change: "In Lewin's definition, the action research is portrayed as a triangle: the training is the first leg and the other two are research and intervention. In contrast to the usual research, the trainer's role is beyond data collection and management of the evaluation process. The action research trainer needs a thorough understanding of the participants who take part in the intervention and should have the appropriate means to achieve the goals of the research. For this reason, the appropriate trainers' selection is essential, as well as providing them guidance and support during the intervention" (Bargal, 2006, 383).

Another way of interpretation of Kurt Lewin's contribution to the substantiation of the action research is the identification of the essential aspects of the paradigm of this type of research. For W.J. Allen (2001) Lewin's fundamental presumption is that effective social change depends on the engagement and understanding of those involved in the process of change. Richard Baskerville (1999, 6) identified two such assumptions: a) that reductionism is not effective in addressing complex social systems, b) that action brings their understanding. For Bob Dick (1997, 7) the essence of the action research is given by the simultaneous presence of the following characteristics: it serves both research and action, knowledge is produced in a cyclical manner, and the presence of a critical reflexivity component within each cycle of research.

## **2. CURRENT TRENDS IN ACTION RESEARCH**

In relation to the effervescence recorded in the mid-twentieth century, during which several authors can be credited with remarkable contributions to defining the action research, further development of this distinct type of research has been slow (Baskerville, 1999, 3). Bob Dick (1999) characterizes this trend as being caused by a "strange neglect" of this type of research, especially when this approach succeeds in drawing near the results of the research to the action desired by the practitioners from different social fields. As for us, we systematized the factors that have slowed down the affirmation of the new paradigm (described disparately in the literature) in the form of the following categories:

a) The existence of the ongoing controversy on the interpretation of Kurt Lewin's contribution to the delineation of the action research as a distinct type of research. As the "father" of this paradigm did not finish his work, the detailed interpretations of his contribution (the extraction of principles and basic assumptions) are relatively diverse and numerous. As a result, even the theoretical basis

of the new methodological approach seems a shaky one, despite the fact that the American psycho- sociologist was its firm supporter: "His energy devoted to the action research during the last years of his life and his efforts in establishing the Center for Group Dynamics shows a real passion for the new paradigm. In his memoirs about his father Miriam Lewin (1992) writes: "I think action research was a part of his response to the tragedy caused by the death of his mother [Lewin's mother and his aunt were killed by the Nazis - David Barge]. The memory of violent anti-Semitism and discrimination in Germany, delicately expressed in his letter to Köhler (1933/1987), was clearly the impetus for his efforts to ease tension and discrimination to which minorities were subject to in the United States" (Bargal, 2006, 384).

b) "Opposition" with positivism. Nereu F. Kock, Robert J. McQueen and John L. Scott (1997) note that, since its beginnings the action research was "evangelized" by its practitioners and intensely criticized by those who defended the positivist approach. Because the practitioners of the new type of research presented it as a methodological alternative designed to overcome the limitations of the positivism, the impression that action research and positivism are guidelines for research that were exclusive was created. The created opposition is unrealistic at present, since positivism is an epistemology that guides the dominant power in science (the mainstream science) and the action research, in relation to positivism, can not be more than one particular way of addressing the research (emerging as the need for intervention to solve a social problem, which is accompanied by a careful theoretical study and the analysis of results).

Starting from this observation, there are attempts to "reconcile", based on the description of the classic studies of action-research (including Kurt Lewin's) in positivist terms as a particular form of the field experiment, conducted with little control of the variables (Kock, McQueen and Scott, 1997, 5). Moreover, it should not be forgotten that the "father" of the action research remained in history as one of the

psycho-sociologist with the most remarkable experimental results and did not make a demarcation between it and positivism.

Several authors suggest that the declared opposition could become a genuine one, by developing an epistemology based on the paradigm of the action research, which show some real differences from the mainstream science.

c) The way of financing the social and human sciences during the postwar period, based mainly on public funds, encouraging mainly quantitative research, to the detriment of the quality. Action research, as a type of predominantly qualitative research, was one of the "victims" of this funding mechanism (Baskerville, 1999, 5). Perhaps this is the reason why a series of statements minimize the action research, classified as "fans' science" or "the poor's science" (Kemmis, 1993, 3).

d) Social Activism (sometimes of a radical type) adopted by some followers of the action research was appreciated neither by the positivists, nor by the governments (the principal donors of the research programs). Among the best-known examples in this respect there are the approaches made by Paulo Freire and Orlando Fals Borda in South America. Due to the social activism, the action research was seen as a less desirable type of research and was not financed very well.

e) Attempts to "corrupt" the action research (reinterpreting wrongly Kurt Lewin's essential concepts) derived both from those who practice it (giving up generating theories and testing them, trying only to ensure successful interventions) and from those who try to increase the rigor by experimental designs, bringing a deployment of theory to reality, producing research results largely irrelevant (Argyris, Putnam and Smith, 1985). Because of these attempts, a "distortion" of the action research over the way it was originally conceived took place (Kemmis, 1993, 4).

f) Strong assertion in a limited number of fields of study (such as school development or health care) and its discreet presence in the most areas. The possible causes of this trend are the

affirmation of the experiment as the main method in psycho-sociology and the fact that higher education has a certain tendency to conservatism in terms of teaching and learning the research methodology (Baskerville, 1999, 4).

The action research is less important among the academic concerns, but, in recent years, it has become more substantial precisely because of the need to create bridges between theory and practice, because of the need to apply research results in social intervention strategies, being adopted by international organizations as part of the social development programs.

Although in many studies one can identify elements of the action research, they do not always bear that name. Sometimes, the emphasis is placed on the idea of participation, sometimes on action, but the final concern is always the resolution of the social problems. Most applications of this approach are found in areas such as the organizational change, the social policies, the social assistance and the information systems (Precupețu, 2007, 110).

Due to these restraining factors, the action research has not had a spectacular evolution, except in some clearly defined sectors and scientific communities dedicated to practicing this type of research. Despite the fact that it has more than six decades of existence, the action research can still be considered a paradigm emerging globally (Bunning, 1994).

In an article which suggested reviewing the literature on the action research, Bob Dick (2004) listed a number of areas of psychosocial intervention for which there are the most publications: community development, health, education and applications in different types of organizations. The author identified a number of trends in the current literature: an increase in the volume of articles that use the action-research methodology, researchers' increased concern for the community and increased attention to practical details that can obtain the participants' participation and involvement.

### **3. ACTION RESEARCH IN ROMANIA**

As regards Romania, the action research was used very rarely, and in a review of the works appeared in 2004 (Lambriu and Mărginean) such an approach was noted as "among the first examples of the application of the action research in our country" (Chițu, 2006, 206). However, the action research is not a novelty in the Romanian literature: Pantelimon Golu (1974, 202-205) presented Kurt Lewin's contribution, and Henri H. Stahl (1975, 109) described the "centering on "action" as a common platform for all the particular social disciplines".

This timid practice cannot be explained by the absence of the latest local sources of information, because there are many authors who presented the action research in their work on the methodology of research, community development, or psychosocial intervention. In this regard, we will give three definitions of the action research extracted from volumes published in the last decade:

1) "An attempt to associate the social and human sciences to the action which a power can develop in different sectors of public life (political, educational, administrative, economic). It is a new kind of applied research, a new general methodology of the action issues, a praxeology of administration, difficult to dissociated from a pedagogical intervention" (Neculau, 2001, 9).

2) "A process of diagnosing problems, planning and implementing actions to reduce or eliminate the disruption, while monitoring the induced social changes (Chelcea, 2004/2007, 201);

3) "It is an iterative process, involving a series of activities, including the diagnosis of social problems, social intervention, the analysis of the results of the intervention, the adjustment of the strategy of the social intervention" (Precupețu, 2007, 105).

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## MARITIME ENGLISH LEARNING/TEACHING MATERIALS

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*Abstract: Within the broad range of ESP, Maritime English is gaining ground. Therefore, there is a great need for learning/teaching materials in this field. Our intention in this paper is to provide our fellow teachers with relevant Maritime English (ME) materials and resources; to share our expertise in teaching ME by illustrating how we use some of the suggested materials and resources. Finally, conclusions will be drawn hoping that a ME teaching/learning network will be developed.*

*Key words: ESP; Maritime English; materials; resources*

### 1. Introduction

How is **English for Specific Purposes (ESP)** different from **English as a Second Language (ESL)** or **English as a Foreign Language (EFL)** ?

The most important difference lies in the learners and their purposes for learning English. ESP learners are learning the language to perform particular job-related functions. An ESP programme is therefore built on an assessment of purposes and needs and the functions for which English is required.

### 2. The need for a common maritime language

Shipping industry has rapidly developed during the last twenty years both in point of tonnage (number of vessels) and traffic (cargo carried at sea). The great majority of vessels are manned with multinational crew members therefore, there has arisen the problem of imposing a common communication language at sea. In this respect, IMO and other maritime organizations and conventions decided that

English, in fact Maritime English is the language the seafarer should be proficient in. The decision to introduce and require SMCP (Standard marine Communication Phrases) was the result of numerous incidents at sea caused by lack of communication on board ship or misunderstandings in ship-to-ship, ship-to-shore communications.

### 2.1. Provisions of STCW 95 (Standards of Training , Certification & Watchkeeping)

The levels of attainment required for watchkeepers by this convention were specified and approved under IMO's auspices, and the implementations is carried out by each country's marine administration. The language describing competences, however, is not always helpful being often vague and imprecise, using words such as 'appropriate', 'adequate', 'acceptable'. This is no doubt an intended diplomacy, to provide as wide an interpretation as possible, but it is not helpful for teachers to understand the required attainment levels. Neither does

this 'wide-open' situation provide for standardization worldwide.

For Maritime English, the STCW 95 Code states at Table A-111/11:

**Competence:** "Use the Standard Navigational Vocabulary as replaced by the IMO Standard Marine Communication Phrases and use English in written and oral form.

**Knowledge, understanding and proficiency:**

**Adequate** knowledge of the English language to enable the officer to use charts and other nautical publications, to understand meteorological information and messages concerning ship's safety and operation, to communicate with other ships and coast stations and to perform the officer's duties also use and understand the Standard Marine Navigational Vocabulary as replaced by the IMO Standard marine Communication Phrases."

**Demonstrating and evaluating competence** in the officer's 'adequate' knowledge and **use of oral English** is to be by both Examination and assessment of evidence obtained from practical instruction; also that, 'English language navigational publications and messages relevant to the safety of the ship are correctly interpreted or drafted.'

The ESP teacher has a difficult job to design a course syllabus which should reflect the 'imprecise' standards contained in the convention. Another problem for ME teachers is the scarcity of ME teaching/learning materials and resources.

## 2.2. Classification of the existing Maritime English resources and materials

Boris Pritchard, Head of Foreign Languages Department, Faculty of Maritime Studies University of Rijeca, Croatia, suggests a classification of ME

resources and materials using a number of criteria:

- textbooks/coursebooks vs. supporting/supplementary materials
- written vs. aural or combined (multimedia)
- general vs. communicative competence-based
- spoken maritime English vs. non-spoken
- paper vs. electronic/CD & software/internet-based
- (maritime) topic-oriented vs. language/function-oriented
- register-based (nautical, marine engineering, maritime communications, maritime law) vs. genre-based (e.g. for vocational training ratings, familiarization courses for passenger ship crews, etc.)
- commercially published vs. in house vs. teacher generated/adapted vs. self-access materials
- comprehensive (General Maritime English) vs. tailored to suit specific purposes
- resources/materials for presentation vs. practicing vs. production
- grammar-oriented vs. content-based
- General maritime English vs. vocational training in the maritime sector
- dictionaries vs. resources
- electronic internet textual and lexical (conceptual or thematic) databases.

He further on claims that it is obvious that most maritime English materials are a combination of a number of the above resources. They normally range on a scale between the extreme items of the binary oppositions listed above.

In addition, the resources for Maritime English teaching also include:

- studies, reports and articles or papers and proceedings published as a result of various projects, conferences and workshops on or relating to maritime English (e.g. MARCOM, METHAR,

METNET; IMEC, WOME, IMLA, GAME, IAMU, AMETIAP, etc.)

-coursebooks, handbooks and manuals on maritime subjects

-maritime journals and periodicals

-publications by IMO and other maritime organizations (ICS, ITU, MAIB, Lloyds, classification societies)

-drawings, diagrams, tables, pictorial materials

-ship's papers, shipping documents, ship's technical specifications

-all operating and maintenance manuals on board and in ports and terminals

-library resources, internet resources.

Further on in his article Boris Pritchard proposes a more user-friendly classification of ME resources. Firstly, he divides the resources into ME materials and other ME resources. Furthermore, maritime materials are divided into comprehensive, register/genre-specific, visual/aural, electronic, CALL. Then considerations accompanied by examples are made on the four sub-classes of materials.

He states that most materials are a combination of at least two-subclasses. Thus, in addition to being a modern paper coursebook, Peter van Kluijven's IMLP is accompanied by a multi-medial course plus CD-ROM containing numerous practical exercises in spoken Maritime English, SMCP included. Van Kluijven's coursebook is both comprehensive (encompassing general maritime English topics) and register-based (i.e. texts and units in navigation, marine engineering, marine communications and ship's business). Typical representatives of materials on nautical, maritime communications or marine engineering are: Maritime Studies, Blakey (1987), Marlin's, Packs 1&2, Seaspeak, Weeks (1986 and 1988), Zhang & Shaolin (1993) etc.

Electronic PC-based materials, on CD-ROMs and multimedia, and CALL software, are of particular interest for both Maritime English teacher and learner, because they allow a high degree of interactivity and self-learning. Here is selected list of the materials retrievable from the ME database initiated by Pritchard:

- multimedia CD-ROMs (*Maritime English*. Maritime Education Sweden AB, -now available from Videotel London and seagull, Norway; *Maritime Communications*. Maritime Education, Sweden AB; multimedia CD-ROM versions of former videos: *Marlins, Study Pack 1&2*, Videotel & Seagull, London; ME software applications: *MarineSoft's SMCP and Marine Language Training*, MarineSoft GmbH, Rostock, Germany; *Marlin's Study Pack1, Progress Test*, Videotel, London, *Marlins Test of Spoken English (TOSE)*, Videotel, London

After enumerating the materials belonging to each subclass, Pritchard describes the pilot version of the Maritime English Databank which is restricted to materials' only for the time being. He states that there were two main issues preceding and during the process of compilation and creation of the databank:

- (a) which attributes should each material/resource item in the list contain (i.e. individual material), and
- (b) how to classify or categorize the materials/resources.

As far as the attributes are concerned, the decision was made on the following descriptors:

- title of the material
- name of author(s)
- year of publication
- where published
- publisher's name
- category of the material

- ISDN, if applicable
- medium of materials (paper coursebook, audio/video cassette, CD-ROM, software, internet, or a combination of any of these)
- link for visitors of the internet-based databank to add/insert their own materials into the databank
- link for visitors to edit a particular item (e.g. updating and correcting/expanding information)

The categorization (b) of the materials served as a basis for the categories adopted in the databank. For the moment, the databank is subdivided into five categories of ME materials:

- general and nautical textbooks
- maritime law and shipping
- marine engineers and engineer officers
- maritime communications
- media type (video, CD, multimedia, internet)

Example of databank item entry:

**Type:** Coursebook

**ID:** 88

**Title:** Nautical English

**Authors:** Wu D

**Publ Year:** 1994

**Notes:** Soft cover book with a teacher's manual

**City:** Dalian, China

**Publisher:** Dalian Maritime University Press

**Category:** general and nautical textbooks

**ISDN:** 7-5632-0765-1

**Media Type:** paperback

**URL:**

**Cover:** View

**Contents:** View

**Sample:** View

The databank allows for alphabetical searches in the appropriate columns for title of material, author, city of publication, category of material, and numerical ordering of years of publication.

We salute Pritchard's initiative which is beneficial for all ME teachers.

Our intention is to contribute our materials to the existing databank.

### 3. ME materials and resources within the Naval Academy in Constanta

The Foreign Languages Department at the Naval Academy is the beneficiary of both ME materials and resources. The presentation of our teaching/learning materials will be done according to Pritchard's classification.

We have paper coursebooks on the registers of nautical English, marine engineering, and port operations. The topics in these coursebooks are correlated with the students' specialist subject matter (e.g. terms related to the ship structure –for the first year nautical students) Some of the courses were printed at the Academy's printing press and they can be found at the naval Academy's Library as well as at the Foreign Languages Department. We also have English-Romanian dictionaries for marine engineering and Maritime English dictionaries.

As far as CALL materials are concerned we boast of quite a wide range of materials (part of them mentioned by Pritchard in his article: Marlins Progress Test, Seagull CD-ROMs, Maritime English CD-ROM), which can be accessed and worked on independently in the Academy Resource Center.

Nautical publications (magazines and journals as well as MARS reports) round off our maritime materials and resources which we are willing to share with our peer teachers.

### 4. Conclusions

As a conclusion to this paper, we go back again to Pritchard who urges all ME teachers to offer their own materials and resources for insertion in the databank hoping that this will be a useful source of

information for searching, evaluating and obtaining appropriate materials suitable for specific needs of both ME teachers and learners.

On the other hand, a ME teachers network should be developed so that peer teachers could share their expertise or debate problems they encounter in their teaching English for Special Purposes in the maritime field.

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## AD TERROR AS A MEANS OF EVOKING NEGATIVE EMOTIONS

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**Abstract:** Ad terror means spreading fear among a population through acts of violence that deliberately generate terror, fright, dread and are meant to make publicity for the terrorists' purposes. (Delcea, 2006; Law no.535/2004) Reality shows us that mass media has become a sine qua non condition for terrorist acts, as means of mastering and paralyzing with fear the masses through psychological coercion and criminal intimidation. More often than not, if publicity is missing terrorist acts are not as efficient and can not function. Using as a starting point the studies on ad terror conducted along the years by researchers (Wilkinson, 1977; Martha, Middletonwn, & Wesleyan, 1983; Wardlaw, 1989; Wiewiorka, 1993; Wilkinson, 1997; Ganor, Ehrlich, Garcin-Morrou, 2001; Shay, 2002; Silver, 2002; Chermak, 2003; Delcea, 2004; Toma, 2004; Odorogea, 2004; Angheluș and Vescan, 2005) we took a critical approach on statements and theories on ad terror. As a result of this analysis we made an experiment in order to capture the negative emotional effect on the public as a media consumer and the cognitive and behaviour dysfunctionalities as provoked by advertised terror in the media.

**Key-words:** *ad terror, behavior and cognitive aspects, advertising, terrorism.*

### 1. DEFINIREA AD-TERORISMULUI

În ceea ce privește conceptul de ad-terorismului s-au scris și publicat multe studii. Pentru a înțelege acest concept, destul de controversat (Cosnier, 2002), vom încerca să definim și să-l delimităm conceptual.

Cuvântul *ad*, provine din limba engleză de la termenul „advertising” (reclamă) care „este doar produsul efectiv și final (mesajul) al procesului și activității de publicitate care, în funcție de canalul mediatic căruia îi este destinat, poate fi macheta de presă, spotul TV sau radio etc.” (Petre & Nicola, 2004, pg. 23 ). „Reclama (ad) - sub orice formă s-ar prezenta – nu constituie altceva decât o situație ce apare în câmpul variat al fenomenelor exterioare, în fața cărora indivizii sunt chemați să se adapteze. Aceste situații (reclame) au câteva caracteristici specifice, dintre care cele mai de seamă sunt următoarele:

1. reclamele au un caracter de apel, avertizare, invitare, etc.
2. apelul, avertizarea, invitația, etc., au scopul de a determina o anumită reacție din partea acelorora cărora li se adresează.” (Tudoran, 2004, pg. 47).

Având o „funcție de comunicare, de transmitere de informații, *ad* facilitează relația dintre anunțator și consumator” (Petre și Nicola, 2004, p.44).

Așadar, „reclama (ad) nu este numai un discurs comercial, ci și discurs politic, social, moral, întotdeauna discurs ideologic,” (Cathelat, 2005, pg. 64) și „ceea ce ajunge la public nu este decât un slogan, un cuvânt sau o siglă mai mult sau mai puțin explicită (ex. IRA, Al Qaida etc.), un simbol sau un drapel, care sunt tot atâtea mărci de recunoaștere. Acolo se află miezul unui mesaj (ad), al unei ideologii,” (Marret, 2002, pg. 165) „întrucât teroarea este îndreptată spre media și nu spre victime, succesul ei este definit în termeni de acoperire mediatică” (Toma, 2004, pg. 74) pentru „a induce sentimentul de frică în rândul

populației sau a unei părți a populației ca efect psihologic a acestui mod de luptă” (Stănescu, 2001, pg.55). „În această interpretare, relația dintre mass-media și terorism se bazează, pe de o parte, pe principiul interesului reciproc, transgresiunea tabuului violenței, șocul evenimentului, teama, sentimentul de amenințare și iraționalul; pe de altă parte, vizibilitatea și, la limită, legitimitatea spectacolului, pe care le împrumută canalele de comunicare indispensabile funcționării societăților democratice.” (Garcia-Morrou, 2005, pg.82). De altfel, teroriștii ar acționa

vizând doar publicitatea mediatică chiar dacă este evident că acțiunile lor sunt alese astfel încât să fie cunoscute de un număr cât mai mare de oameni, în funcție de date și de locuri specifice sau cu conotație simbolică. Pare mai degrabă o simbioză (pe lângă alte tipuri de simbioză economică, politică, culturală ) decât o metodă obiectivă de transmitere a unei informații violente (Delcea, 2006; Tétu; 2000; Picard, 1991). În tabelul de mai jos sunt trecuți câțiva cercetători care au delimitat conceptual termenul de ad-terorism în urma studiilor efectuate asupra mass-media și terorismului.

**Tabel 1**

Temenul	Delcea (2006)	Dulea (2006)	Scalechti (2006)	Angheluși Vescan (2005)	Garcin-Marrou (2001, 2005)	Chermak (2003)	Wilkinson (1997)
<i>Ad-terorism</i>	+	+	+	+	+	+	+
<i>Publicitate</i>	+	+	+	+	+	+	+
<i>Reclamă</i>	+	+	+	+	+	+	+
<i>Mediatizarea terorismului, violenței, și a fricii</i>	+	+	+	+	+	+	+

(Delcea, 2006)

Cele mai influente definiții ale ad-terorismului provin din științele psihosociale. Din multitudinea de definiții au fost selectate câteva cu intenția de a surprinde multiplele aspecte ale acestui domeniu, privit fie ca un proces de comunicare-violentă cu „efect psihologic” (Buș, 2005) fie ca o activitate de comunicare între grupul ce emite mesajul ideologic și public; fără a se contrazice, ele aduc noi informații ce explică complexitatea acestui act comunicațional de tip terorist. Astfel:

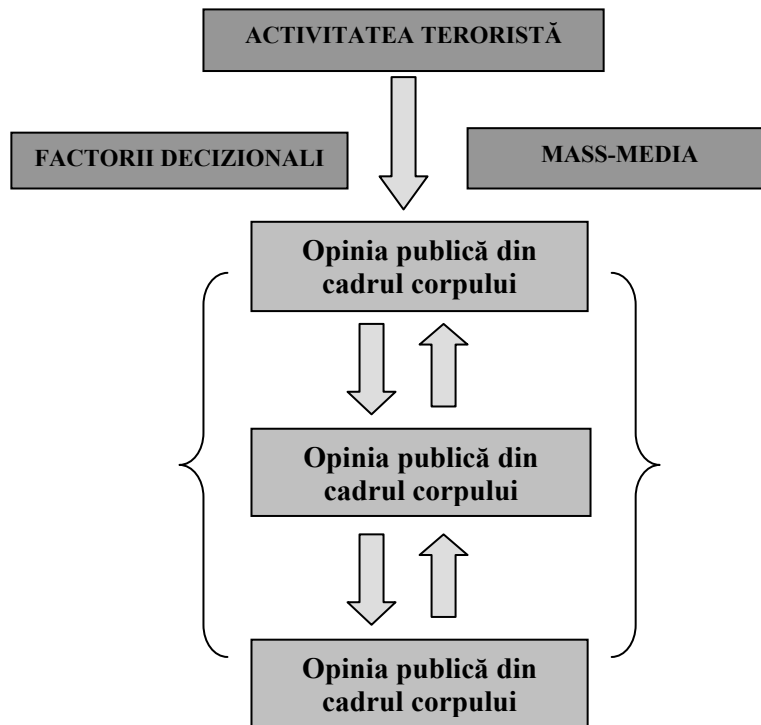
*Ad-terorismul, din perspectiva abordărilor științelor socio-cognitive, reprezintă o comunicare de tip persuasiv, emisă de către o grupare teroristă prin mass-media adresată unui public-țintă în scopul de a modifica favorabil atitudinea acestuia față de expectanțele lor (Delcea, 2005, p. 60).*

*Terorismul nu poate determina apariția unei stări de teamă decât printr-o campanie de utilizare sistematică a violenței (Buș, 2005, pg. 197).*

*Ad-terorismul este o formă de comunicare în masă care are o puternică influență asupra formării, consolidării și schimbării atitudinilor, gusturilor, părerilor și comportamentelor oamenilor, pentru a determina un guvern sau grup țintă să acționeze în vederea atingerii scopurilor lor propuse ( Angheluș și Vescan, 2005, pg. 87).*

*Ad-terorismul este reclama sau publicitatea teroristului, o formă de comunicare, făcută prin intermediul mass-media, de către teroriști, cu intenția de persuasiune și de producere de teroare. (Dulea, 2006, pg. 53 )*

*Ad-terorismul este o formă specială de terorism care se ocupă cu reclama sau publicitatea terorismului, fiind o armă eficientă de manipulare și intimidare, utilizată de liderii grupărilor teroriste, care folosesc această strategie de teroare, ajutați de mass-media, împotriva oamenilor nevinovați și împotriva autorităților care se opun mișcărilor lor (Scalechti, 2006, pg. 21).*



(Gabor, 2002)

Așadar, cele mai prestigioase abordări asupra ad-terorismului din perspectiva psihosocială abundă în cercetări legate de relația dintre mass-media și terorism (simbioză) ca o modalitate de intimidare și evocare a emoțiilor negative în rândul publicului-țintă (Wilkinson, 1977; Martha, Middletonwn, & Wesleyan, 1983; Wardlaw, 1989; Wieviorka, 1993; Wilkinson, 1997; Ventura, 1999; Ganor, Ehrlich, Shay, 2002; Silver, 2002; Chermak, 2003; Toma, 2004; Odorogea, 2004; Angheluș și Vescan, 2005; Delcea, 2006; Dulea, 2006; Scalehti, 2006). Atât pentru victimele care supraviețuiesc atacurilor teroriste, cât și pentru familiile și prietenii acestora, reacția devine una de stres post-traumatic care implică tulburări emoționale și de comportament; simptomele cele mai des întâlnite sunt stările de anxietate, insomniile și coșmaruri, înstrăinarea față de comunitate și probleme în relațiile sociale.

Din cauza impactului emoțional negativ provocat de terorism, mass-media utilizează termeni vagi și superficiali pentru a realiza o descriere a incidentelor. Mass-media este primul instrument de avertizare a populației. Aria de tratare a subiectelor legate de actele de terorism care s-au succedat la nivel mondial în perioada 1980-1990 a contribuit oarecum la

sentimentul de aprehensiune, dar suma și structura modurilor de abordare a incidentelor internaționale sunt total diferite în momentul în care se realizează o paralelă cu atacurile asupra teritoriului american. Evenimentele prezentate de mass-media, precum bombardarea asupra World Trade Center din 1993, atacul asupra clădirii federale a orașului Oklahoma din 1995 și amenințările permanente, au lăsat impresia că problema devine una majoră și scapă de sub control. Pentru ca impactul să fie cât mai puternic, grupările teroriste aleg cu grijă locația și momentul atacurilor. De exemplu, atacul asupra clădirii federale din Oklahoma nu a fost unul la întâmplare, deoarece autorul ei, Timothy McVeigh, membru al rețelei Al-Qaeda a ales o oră (09:02), un teritoriu (clădirea federală) și o locație specifică (o intrare) pentru ca șocul să fie unul de proporții. Mesajul său era acela de a garanta insecuritatea populației civile. În viziunea teroriștilor, o poziție primordială o ocupă crearea groazei și prezentarea unei atmosfere sumbre.

Ca mijloc psihologic de a instaura teamă în rândul civililor, teroristul utilizează mass-media pentru a transmite mesaje și pentru a-și populariza ideile și credințele, amenințându-i



pe cei care li se opun. Organizațiile teroriste urmăresc maximizarea impactului atacurilor plănuite prin selectarea unor ținte care vor spori în mod considerabil interesul mass-mediei. După evenimentele din 11 septembrie 2001, americanii erau efectiv traumatizați întrucât trăiau cu senzația că ei înșiși au fost victime ale dezastrului. Proximitatea morții era resimțită ca urmare a transmisiunilor în direct.

Conflictul din Kosovo se caracterizează ca fiind primul război pe Internet. Actorii guvernamentali și non-guvernamentali accesau Internet-ul în vederea diseminării informației, realizării unei propagande, demonizării oponentilor și solicitării sprijinului pentru pozițiile pe care le-au adoptat. Anthony Pratkanis, profesor de psihologie la Universitatea din California a remarcat faptul că situația la care se asistă în prezent este doar prima rundă a ceea ce va deveni un instrument important și extrem de sofisticat al tradiției unei propagande a războiului informațional sau mediatic.

Efortul de a elabora o definiție a conceptului de terorism va reprezenta baza operațională a mijloacelor de întărire a capacității comunității internaționale de a învinge în lupta ce se dă pentru combaterea terorismului. Mai mult decât atât, va permite actelor legislative și punitive să ia măsuri drastice în privința adeptilor și a celor implicați direct în rețelele teroriste și va încuraja întocmirea unui cod de legi și realizarea unei convenții internaționale împotriva terorismului, împotriva organizațiilor de acest gen, a statelor care oferă finanțare terorismului și, nu în ultimul rând, împotriva firmelor economice implicate.

Secolul XXI este marcat de conflicte majore între civilizații, conflicte care par să reprezinte un element vital al evoluției societății. Această concepție eronată în care se dă o luptă a omului împotriva omului a fost accentuată de răspândirea rețelelor de teroriști pe întregul glob. Relația de simbioză între teroriști și mijloacele prin care aceștia își transmit mesajul, se află în strânsă legătură cu efectul pe care îl are mass-media. Subiectele privind actele de terorism captează atenția foarte ușor, ceea ce înseamnă că mass-media nu concepe să adopte o atitudine de ignoranță. Galtung și

Ruge au identificat 12 factori ce contribuie la creșterea audienței, dintre care intensitatea, elementul-surpriză, claritatea, raritatea, legătura cu elitele, personalizarea, caracterul și emoțiile negative.

Paul Wilkinson oferă o soluție la atitudinea pe care mass-media, dar în primul rând societatea, trebuie să o adopte vizavi de terorism, cum ar fi poziția sceptică, autocontrolul și autogovernarea mentală. În prezent, teroriștii profită de faptul că mass-media le oferă o atenție deosebită pentru a satisface dorința publicului larg de a fi martori ai unor scene dramatice televizate. Paradoxal, din acest punct de vedere, gradul de satisfacție este crescut atât în rândul audienței, cât și al teroriștilor și, fără doar și poate, în cadrul mass-mediei care se dovedește a fi un liant între cele două.

Pentru atingerea unor obiective financiare și pentru șantaj, țintele teroriștilor sunt oameni de stat, membri ai corpului diplomatic și din mass-media. O altă tendință este aceea de maximizare a numărului de victime ale atentatelor pe care le pun la cale. În vederea distrugerilor masive, ei vor alege întotdeauna locuri supraaglomerate, așa cum au procedat la New York (11 septembrie 2001), Oklahoma (1995), Madrid (11 martie 2004) și Londra (7 iulie 2005). „Formarea și dezvoltarea noii generații de luptători sfinți” compusă din simpatizanți și adepți ai Jihadului constituie o nouă tendință de proliferare a crimelor teroriste. Bătălia ce se dă în vederea stăvilirii și dezrădăcinării terorismului ar trebui să se poarte la toate nivelurile: individual, de grup, de comunitate națională și globală.

În cea de-a doua jumătate a secolului XX, numeroase țări s-au folosit în mod excesiv de organizațiile teroriste pentru a-și promova interesele naționale pe scena internațională. Dacă inițial, terorismul era conceput ca fiind „arma celor slabi”, un instrument al grupurilor minoritare, al mișcărilor de eliberare sau a organizațiilor revoluționare, ulterior a îmbrățișat forma unui instrument la îndemâna statelor și a polilor mondiali de putere.

Sprijinul statelor pentru desfășurarea atacurilor teroriste a generat cooperare între grupările teroriste la scară mondială. Un exemplu elocvent în acest sens este cel cu

privire la fosta Uniune Sovietică, prima dintre statele care au finanțat diverse organizații, fie în mod direct, fie prin prisma statelor-satelit. O dată cu declinul Uniunii Sovietice, Iranul și-a asumat controlul asupra sprijinului direct sau indirect acordat terorismului.

În „Accomplice or Witness? The Media’s Role in Terrorism” (2000), Brigitte L. Nacos atrage atenția asupra formelor prin care terorismul profită de sectorul mass-media pentru a manipula, amenința și intimida publicul larg, anumite grupuri, indivizi sau oficiali guvernamentali. Atenția nu constituie singurul element pe care teroriștii doresc să îl dobândească; ei urmăresc, printre altele, recunoașterea cauzei și a nedreptăților la care sunt supuși. De altfel, multe grupări pretind respect, un grad de legitimitate atât în interiorul propriei societăți, cât și pe plan internațional.

Cuvintele nu se transformă în simple simboluri întrucât influențează gândirea și limitează ideile și conceptele care pot fi transmise de la un individ la altul. Mass-media joacă un rol central în evidențierea faptului că societatea va judeca și critica cuvintele oricărui discurs.

## 2. TIPURI DE AD-TERORISM

Tipurile de ad-terorism se stabilesc în funcție de diferitele caracteristici ale mesajului transmis de către teroriști grupului țintă. Există mai multe criterii după care se pot distinge diferitele tipuri de ad-terorism. Preluăm informația mediatizată cu unele conotații de persuasiune, revendicare, negociere, propagandă și amenințare. Așadar, după canalul mediatic, după conținutul mesajului transmis, tipul mesajului și efectul sau reacția consumatorului de media întâlnim șase tipuri

de ad-terorism: de intimidare și amenințare, de haos, șoc și teroare, de negociere, de propagandă religioasă, propagandă politică și anunțul victorios.

Acestea sunt cele care au fost utilizate până în prezent de către teroriști pentru a-și atinge scopurile criminale. Aceste tipuri nu au fost studiate până acum și nici nu se regăsesc în teoriile cercetătorilor din cadrul Departamentului de Stat din America sau din serviciile secrete din Israel și UK.

De aceea, pentru foarte mulți cercetători militari și din serviciile secrete aceste tipuri au reprezentat un concept de tipul: „elementul psihologic” (Stanescu, 2001), „influențarea unui public” (Departamentul de Stat, 1988) sau „inducerea sentimentului de frică în rândul populației sau a unei părți a acesteia” (Schmid and Jongman, 1988) fără însă a fi delimitat conceptual în vederea stopării acestor forme de violență și reducerii numărului de informații cu caracter violent transmise prin intermediul mass-media.

Dobrescu și Bargaoanu (2003) susțin teoriile lui Lasswell care explicitează mecanismul comunicării (emitentul-mesajul-receptorul-efectul) care de altfel stă și la baza ad-terorismului ca modalitate a comunicării. După modelul lor, în procesul de comunicare, teroriștii au în vedere cele cinci întrebări care trebuie puse pentru a transmite prin mass-media un mesaj al terorii. Acestea sunt: Cine emite?, Ce mesaj transmit ?, Prin ce canal media?, Care este grupul țintă? și Ce efect ating? Plecând de la aceste teorii, vom prezenta în tabelul de mai jos clasificarea tipurilor de ad-terorism, a grupurilor țintă cărora li se transmite mesajul și canalele media utilizate pentru atingerea celor mai mari efecte negative din punct de vedere emoțional.

Tabel 4

Nr.	Tipul de Ad-terorism	Grupul țintă	Sursa de Mediatizare
1	Intimidare și amenințare	Statele care se împotrivesc	Mass-media
2	Haos, șoc și teroare	Populația necombatantă și grupuri asemănătoare	Mass-media
3	Negociere	Statele care nu recunosc	Mass-media, scrisori,

		statutul formelor teroriste	telefon, fax și internet
4	Propagandă religioasă	Grupul care se împotrivește	Mass-media și liderii religioși
5	Propagandă politică	Statele care se împotrivesc expansiunilor teritoriale și politice	Mass-media
6	Anunțul victorios	Statele și grupurile care au suferit atentate sinucigașe, deturnări de avioane, asasinat etc.	Mass-media scrisori, telefon, fax și internet

(Delcea, 2006)

Vom delimita conceptual aceste tipuri și vom face cunoscut unele criterii prin care se poate caracteriza conceptul definit în vederea unei clarificări a acestor manifestări ale terorii.

## 2.1. AD-TERORISM CA INTIMIDARE ȘI AMENINȚARE

Intimidarea și amenințarea sunt forme de manifestare ale violenței la adresa societății civile săvârșite în mod deliberat de teroriști prin mass-media, pentru a genera un sentiment de insecuritate, teamă irațională și neliniște (Stănescu, 2005). Emițătorul (teroristul) mediatizează un mesaj al temerii către grupul țintă (societatea civilă) pentru a slăbi procesele psihofiziologice de adaptare și funcționare la parametrii normali ai consumatorilor de media.

Buş Ioan (2005), definește ad-terorismul ca amenințare și intimidare: „Violența este orientată către crearea unei stări de teroare colectivă și intimidarea adversarilor. Violența este un mijloc și nu un scop; asasinarea liderilor politici ori spirituali vizează influențarea deciziilor politice, ca efect al răspândirii terorii. Ceea ce contează este efectul psihologic, de aceea amenințarea cu violența reprezintă o caracteristică majoră a terorismului”.

Garcin-Marrou Isabelle (2005), consideră ad-terorismul ca un instrument de amenințare și intimidare: „O formă extremă a violenței”. Autoarea face diferența între ceea ce este un război combatant și un război psihologic sub forma amenințării și șantajului condiționând astfel societatea civilă să fie în acord cu scopurile infracționale ale teroriștilor. Spre exemplu răpirea celor trei jurnaliști din 29 martie 2005 a scos la iveală unele din

caracteristicile ad-terorismului: amenințarea și intimidarea societății civile din România. După răpirea acestora s-a trecut la publicitatea/reclama grupării teroriste, Tawhid wal Jihad, condusă de iordanianul Abu Musab Al-Zarqawi cu un număr de 1500 de membri în Irak. Teroriștii au amenințat statul român cerându-i să-și retragă trupele din Irak. Din sursele serviciilor secrete (Stănescu, 2005) se cunoaște că această grupare teroristă a făcut reclamă cu teroarea, fiind în concurență chiar cu compania Coca-Cola din America. Toate sursele media din Statele Unite ale Americii și Europa au făcut reclamă gratis grupării teroriste până acolo că într-un studiu recent realizat de BBC London s-a remarcat faptul că există niște cogniții inoculate de mass-media, în rândul consumatorilor de media din mai multe state, cu privire la trupele americane din Irak. Cercetările făcute de jurnalistii de la BBC au dovedit teoria mesajului inoculat în mod repetitiv: „Retrageți-vă trupele din Irak”. Ca efect al acestui mesaj s-a ajuns la un răspuns din partea societății civile, amenințate și intimidare prin intermediul mass-media, sub forma unui acord cu teroriștii din gruparea teroristă „Tawhid wal Jihad”.

Ariel M., în volumul său „Terrorism as a Strategy of Insurgence” (1993), delimitează conceptual ad-terorismul considerându-l intimidare și amenințare: „Un element psihologic de bază al strategiei terorismului a fost, după cum putem deduce și din termen, intenția de îngrozire a inamicului”. Tot el mai subliniază efectul pe care îl are această manifestare a terorii asupra non-combatanților pentru a sensibiliza guvernarea în vederea unor revendicări sociale sau legi.

Așadar, ad-terorismul ca amenințare și intimidare este o metodă folosită des de către teroriști pentru a-și atinge scopurile propuse în numele ideologiei sau a mărcii grupării teroriste, săvârșind astfel asasinat, tortură sau răpire.

## **2.2. AD-TERORISMUL CA GENERATOR DE HAOS, ȘOC ȘI TEROARE**

Această formă de manifestare reprezintă o strategie a comunicării cu societatea civilă prin mass-media pentru a crea un climat traumatic generând astfel angoasa și teama în rândul consumatorului de media. Prin crearea unor expectanțe ale terorii după fiecare emisie a unei casete video sau audio cu înregistrarea lui Bin Laden, al grupării Al Qaida s-a construit un pattern, conform științei behavioriste, de stimul și răspuns.

Publicul este condiționat să creadă că aceste avertismente vor fi urmate de un atentat terorist în viitorul apropiat. Se stabilește astfel un reflex condiționat între teroriști și public prin instaurarea stării de anxietate privitoare la atentatele viitoare. Fără să-și dea seama, publicul ajunge să joace un rol activ în strategia terorismului. Este important să înțelegem că teroriștii nu sunt interesați să ucidă doar de dragul crimei. Pentru ei nu contează dacă ucid o singură persoană sau o sută sau mai multe atâta timp cât mesajul este transmis marelui public, care va exercita ulterior presiuni asupra guvernelor să accepte cererile lor. Imaginația victimelor potențiale ale terorismului devin unelte inconștiente în mâna organizațiilor de acest tip. Orice cetățean al unei națiuni vizate nu poate să nu se vadă pe sine sau pe cineva apropiat ca victimă potențială a atentatului următor.

Din teoriile susținute de Rentner (1985) cu privire la ad-terorism ca generator de haos, șoc și teroare, reiese că acest tip de manifestare pare să fie cel mai des săvârșit de teroriști în vederea unei sensibilizări la nivel social pentru a contracara cerințele guvernamentale. Autorul face referire la „strategie a haosului” ca încercare a teroriștilor de a crea o atmosferă de haos care să demonstreze vulnerabilitatea statului sau a guvernanților de a menține ordinea potrivit legii. Prin instaurarea unei

dezordini și instabilități guvernamentale ei își pot atinge scopurile criminale apelând la presa scrisă și televiziune, manipulând astfel publicul, mai susține autorul.

Mass-media este mult prea ușor manipulabilă și încadrată între uneltele declanșatoare ale conflictelor psihice. La urma urmei, rolul mass-mediei este de a anunța publicului informațiile de care acesta are nevoie și la care are dreptul. Dar prin transmiterea anunțurilor, amenințărilor și declarațiilor organizațiilor teroriste, mass-media servește mai degrabă interesele teroriștilor decât pe cele ale publicului. Acest fapt este ilustrat de avertismentele recente ale mișcărilor islamice privitoare la atentatele ce urmează a fi îndeplinite în Statele Unite și în țările aliaților prezenți în Irak. Unul dintre scopurile acestor anunțuri a fost să creeze o reacție de confuzie despre acțiunile lor și să dea naștere unui răspuns în mințile cetățenilor vestici. Legătura dintre atacul asupra Irakului și terorism a fundamentat credința că orice atentat terorist îndeplinit nu s-ar fi întâmplat dacă Statele Unite n-ar fi atacat Irakul. Viceversa, dacă Irakul nu este atacat, atentatul terorist anticipat nu se va îndeplini. Se stipulează că dacă, Statele Unite acceptă cererile Al Qaida, totul va fi bine și nu va mai avea loc nici un atentat terorist împotriva intereselor Statelor. Toate acestea sunt, bineînțeles, folosite pentru manipularea opiniei publice mondiale ca să se opună atacului asupra Irakului. Fisura raționamentului e evidentă: chiar dacă va fi anulată campania militară împotriva Irakului, oare acest fapt va preveni într-adevăr atentatele viitoare împotriva Statelor? Răspunsul la această întrebare este că cele două lucruri nu au nimic de a face unul cu altul.

În concluzie, prin manipularea eficientă a mass-mediei în crearea expectanței unui atentat, teroriștii obțin nivelul de anxietate scontat chiar fără a fi nevoie să-l mai îndepluiască, generând astfel în rândul societății civile haos, șoc și teroare.

## **2.3. AD-TERORISMUL CA NEGOCIERE**

Ad-terorismul ca negociere este o formă de manifestare a dialogului deschis cu autoritățile

statului pentru revendicarea unor drepturi sau privilegii sociale înainte de a recurge la atentate sau sabotaj în numele cauzei. De fel, teroriștii recurg la o serie de acțiuni inumane fără să țină cont de factorii psihofiziologici ai ostaticilor folosindu-i astfel ca scuturi și garanții în vederea revendicărilor (Buș, 2005; Jenkins, 1990).

Marret Jean-Luc (2000), unul dintre cei mai mari cercetători în domeniul terorismului a lansat o lucrare cu titlul: „Techniques du terrorisme” descriind modalitățile de manifestare ostilă la adresa securității și drepturilor omului, modalitatea în care teroriștii vor „să determine autoritățile publice” prin luarea de ostatici, vrând să negocieze cu acestea prin intermediul televizorului și a presei scrise, cerând drepturile care, după părerea lor, li se cuvin. Marret, descrie un caz istoric din 1996 când gruparea teroristă Tupac Amaru din Japonia la o ambasadă din Lima (Peru), a luat ostatici 400 de oameni. Teroriștii au profitat de „privirile mediilor de informare” și au operat o „extravagantă manevră de discuții discrete și de declarații marțiale” pentru a sensibiliza autoritățile statului revendicându-și astfel drepturile sociale.

Hoffman (1998), aduce noi teorii cu privire la manifestarea ad-terorismului ca negociere. El susține că această formă de manifestare care a luat amploare după anii '90, în rândul teroriștilor, reprezintă o disonanță cognitivă inoculată consumatorilor de media pentru a-i determina să le accepte scuzele pentru comportamentul lor antisocial, deoarece contrazice unele principii sau credințe existente.

#### **2.4. AD-TERORISMUL CA PROPAGANDĂ RELIGIOASĂ ȘI POLITICĂ**

Ad-terorismul ca propagandă religioasă și politică presupune o activitate sistematică de transmitere, răspândire și impunere a unor credințe derivate din perspectiva unor ideologii sau interese ale unei grupări teroriste prin mass-media. De fapt, acest tip urmărește în mod explicit formularea la nivelul consumatorului de media a unor atitudini,

convingeri, concepții sau comportamente convenabile grupărilor teroriste de influență care inițiază și coordonează această formă de manifestare. Ad-terorismul ca propagandă religioasă și politică mai este cunoscut sub termenul de „comunicare politică și religioasă” (Delcea, 2006) pentru a influența mase de oameni în vederea schimbărilor de atitudine. Acest tip de reclamă a terorii are următoarele funcții (Delcea, 2006):

- Ad-terorismul ca propagandă religioasă și politică urmărește interesul grupării teroriste în a determina efecte predeterminate care să corespundă concepțiilor și intereselor sale.
- Ad-terorismul ca propagandă religioasă și politică transmite interpretările unui lider către consumatorul de media fiind de fapt perspectiva unor scopuri care sunt formulate și prezentate în mod explicit grupului-țintă.
- Ad-terorismul ca propagandă religioasă și politică poate fi văzut ca o relație dintre sursă și țintă ce este unilateral, nepunându-se în nici un fel problema că și ținta ar putea influența opiniile sau atitudinile sursei de influență.
- Ad-terorismul ca propagandă religioasă și politică mai este considerat ca o formă de manipulare a conștiințelor în interesul unor factori de putere sau de influență.

Propaganda religioasă apelează la suportul emoțional ce se caracterizează prin provocarea deliberată a unor trăiri și adeviziuni afective puternice la nivelul țintei care să favorizeze adoptarea conținutului mesajului propagandistic.

Propaganda politică îndeplinește unele trăsături tipice ale terorismului prin orchestrare, simplificare, prevalență și inocularea doctrinei grupului-țintă prin care teroriștii își justifică demersurile criminale. Așadar, ad-terorismul ca propagandă religioasă și politică poate fi clasificat după natura obiectivelor sale (politice, economice, religioase, etnice, etc.) sau după durata estimată a atingerii acestora (Cristea, 2000).

## 2.5. AD-TERORISMUL CA ANUNȚ VICTORIOS

Acest tip de reclamă a terorii reprezintă anunțul victorios în urma actelor deliberate de crimă împotriva umanității și securității internaționale pentru a dovedi potențialul fizic și psihologic pe care teroriștii îl au asupra societății civile.

În foarte multe atacuri sinucigașe au fost mediatizate victoria și răzbunarea pentru a atrage privirile multora în vederea intimidării și influențării Comunității Internaționale în a-și schimba atitudinea. Mai mult, ei, se folosesc de orice mijloc pentru a șoca și intimida consumatorul de media în vederea slăbirii dușmanului sau pe cei care le stau în cale.

Paul L. Williams (2003) definește acest tip al manifestărilor ostile împotriva umanității ca un punct forte de sensibilizare, șoc, groază și frică vrând să dovedească vulnerabilitatea securității internaționale și lipsa de eficientizare sau de prevenire a acestora. Tot el amintește și faptul că sursele de informare (în special internetul) sunt foarte utile după atentate pentru a arăta sau mediatiza atribuirea acestor crime.

Robert G. Picard (1991) aduce mari contribuții în conceptualizarea acestui tip de manifestare a terorii în publicația sa cu titlul: „The Journalist's role in coverage of terrorist events” amintind că manifestările violenței teroriste ca forme de victorie nu sunt datorate întâmplării, ele sunt de fapt destinate consumatorilor de media punându-i într-o poziție vulnerabilă.

Garcin-Marrou Isabelle (2005) aduce și ea o contribuție definitorie în conceptualizarea acestui tip de manifestare a terorii afirmând că dimensiunea simbolică a anunțului victorios, folosindu-se de un eveniment marcant, se bazează pe toți factorii ce pot influența cogniția și comportamentul în vederea schimbărilor de atitudine.

În concluzie, orice eveniment al terorii este ridicat la rang de victorie subliniindu-se astfel puterea pe care o au teroriștii asupra non-combatanților, provocând panică și haos. De ce este teroristul preocupat de mass-media și de impactul ei social? Datorită faptului că mass-media poate influența consumatorul

modelându-i cognițiile, comportamentul și emoțiile în favoarea lor.

## CONCLUZII

Studiile (Wilkinson, 1977; Martha, Middletonwn, & Wesleyan, 1983; Wardlaw, 1989; Wieviorka, 1993; Wilkinson, 1997; Ventura, 1999; Ganor, Ehrlich, Shay, 2002; Silver, 2002; Chermak, 2003;; Toma, 2004; Odorogea, 2004; Angheluș și Vescan, 2005 Delcea, 2006, Dulea, 2006, Scalechti, 2006) mai sus abordate ne fac să ne gândim serios la problematica ad-terorismului. Sunt multe cercetări în fază de finalizare în domeniul ad-terorismului pentru a contura asumțiile de bază cu privire la mediatizarea terorismului pentru a surprinde efectul negativ asupra consumatorului de media. Am încercat să subliniez unele teorii ale comunicării în masă și teorii ale științelor cognitive care pot explica mecanismele activatoare și defensive ale consumatorului de media. Mai mult, toate studiile până în prezent cu relevanță ad-terorismului au fost analizate critic pentru a delimita conceptual teoria ad-terorismului.

Am abordat un număr de mijloace sau metode ce pot fi folosite pentru a pregăti publicul în a face față ramificațiilor psihologice ale terorismului. Prima metodă implică educație și propagandă, bazată pe analiză rațională adică o dată ce consumatorul de media învață ce înseamnă terorismul, caracteristicile și metodele acestuia, și o dată ce aceștia știu cum gândesc teroriștii și de ce fac ceea ce fac, ei vor ști mai bine să învingă teama și anxietatea în fața terorismului, și nu vor fi ei înșiși un instrument în mâinile teroriștilor ci vor gestiona orice stimul al terorii mediatizate.

Alte două mijloace prezentate implică schimbarea modului în care media difuzează terorismul și sistemul de alertare a fenomenului terorist (Danciu, 2003). Soluția este ca jurnaliștii să dea dovadă de profesionalism și chiar să se specializeze în domeniul psihologiei pentru a înțelege mai bine modul de influențare a comportamentelor prin mass-media. În ceea ce privește alertele de terorism, este important ca acestea să fie mai specifice și să nu contribuie la anxietatea

în rândul consumatorilor de media, mai degrabă să ajute la diminuarea ei. Campaniile de informare a publicului sunt o altă metodă de creștere a avertismentelor.

Ultima categorie a prevenirii ad-terorismului implică desfășurarea de exerciții și simulări a tuturor factorilor responsabili pentru siguranța consumatorului de media. Aceste exerciții au o importanță în diminuarea efectului și neutralizarea temerii și anxietății create de ad-terorism. Un stat care a avut parte de atacuri teroriste ar trebui să nu oprească antrenarea ofițerilor din cadrul departamentelor antitero, dar să fie și responsabili în pregătirea consumatorilor de media în fața terorismului și ramificațiilor sale psihologice. În acest fel, nu se câștigă numai bătălia în fața terorii, ci și războiul împotriva terorismului (David, 2004; Delcea, 2006; Chelcea, 2000; Crișan și Danciu, 2000).

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## KEY ISSUES AND PRESENT REFLECTIONS REGARDING THE NEW INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) IN EDUCATION AND TRAINING

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**Abstract:** Nowadays the new informational technologies have changed the "face" of the present society, which is in a going on reforming process. The paper wants to underline the essential aspects of the importance of ICT to the teaching staff's training, the situation of the infrastructure of ICT in Romania, as well as several aspects regarding the proper politics and strategies of ICT to the educational objectives on long-term. In the end, we will underline the key issues specific to ICT in the educational and training process.

**Key words:** information and communication technologies (ITC), teacher training, tutor, e-learning

### 1. THE IMPORTANCE OF ICT IN THE TEACHING STAFF'S TRAINING

The Romanian system of teacher-training is restructuring. With arguments for both continuity and renewal, the models proposed for the initial and continuing training are results of a constructive balance among tradition, social demand and the need for harmonization at the European level.

A recent report, written following a broader process of research, conducted between 2004-2006 on the basis of some questionnaires (applied both to teacher-training institutions and practitioners of educational systems in 11 countries such as Albania, Austria, Bulgaria, Croatia, Kosovo, Macedonia, Moldova, Montenegro, Romania, Serbia and Slovenia) has highlighted that *the use of information and communication technology in teacher training is still in the top in a large part of South Eastern Europe*. The research was funded by the Open Society Institute through the RE:FINE program, Resourcing Education: Fund for Innovation and Networking. So, in less than a fifth of institutions, ICT are used systematically in the initial (19.3%) and continuous (17.6%)

training, while the majority (42.0%) began to use ICT in some subjects only and intends to extend these activities in future. This is largely marked by the lack of both financial and human resources.

In parallel with the questionnaires sent to teacher-training institutions, the teaching staff were consulted about the initial and continuing training systems and the directions for improvement of the programs of study for teacher-training and the educational system in general.

Most of the teachers in the investigation (55.9%) believe that their educational background is adequate for starting the teaching profession, but at least initially, a lot of practical teaching experience is needed and continuous training is required. Just over one third (34.9%) considers that the initial training is appropriate and meets the requirements of the profession, i.e. teachers do not need too much training.

In general, there were not many critical responses: only 8.1% of the responders considered their initial training inadequate, emphasizing that formal education does not meet the requirements of their profession and the fact that their work in schools is mainly

based on personal teaching experience and continuous training.

In Romania, the most significant themes or content of the continuous training activities are considered the methodology of teaching-learning-assessment.

The following topics are held in the hierarchy by the activities aimed at developing the competencies needed for using the new technologies (39%) and the development of the communication skills (36%). A third of the teachers consider that the most important themes are the school/educational management issues (32%) and those relating to the school-family-community cooperation, etc. (30%). Almost one quarter (23% and 22% respectively) places on the first place, in terms of importance, the contents which aim at the social and cultural aspects of education or learning a foreign language. The less significant are considered to be the topics from the field of training children with special needs.

Taking into consideration the above-presented facts, we can say that providing adequate education, initial and continuous training for teachers, is an important objective of ICT within various educational policies.

The teachers' age is also important because many of them still do not know even the basics of using a computer. Pupils and students often outshine their teachers in using computers. There is, therefore, the specific need for some teachers to acquire basic technical skills as they did not have the opportunity of using a computer during their initial training period.

The pedagogical use of ICT is important for teachers. They must cope with important changes in their work and fulfill other roles such as experts in content, tutor, resource, author and evaluator. Most teachers were trained in the traditional manner of transmission of knowledge "from teacher to student" and adopted standards for assessing knowledge and skills through the storage and reproduction of content. These teaching methods have to be changed over time. Among teachers learning and collaboration activities begin to develop, communities of education in the initial and continuous training being set up.

## **2. TUTORS – A NEW GENERATION OF TEACHERS**

'Tutors' is a new generation of teachers who work with the online learners. Thus, the roles and responsibilities of the teaching staff and trainers move from the level of motivation and theoretical support to the management of social relations in the online learning environment, by creating an effective virtual team.

To assess correctly the potential of virtual learning platforms, teachers are forced to assume new roles, assimilated to a modern statute, slightly different from the one held in the traditional education. Thus, not only are a number of new skills and experience in computer use necessary, but also knowledge of the online working environment and its valences for training activities.

A good tutor can come from various professional fields and have a varied experience of learning and teaching. Observing the opportunity criterion, the one who fits best with the actual situation of instruction should be chosen.

As a member and a "pivot" of the community of education, a tutor should be a good leader, which does not necessarily mean highly skilled, many years of experience, or that he should be an expert in terms of theoretical content. The diversity of the tutor's roles in e-Learning, however, requires an appropriate level of training, different from the traditional one. In this respect, the following aspects will be taken into consideration:

- **Pedagogical training** is used in particular in relation to online students. Interaction with the teacher continues to be the central component of education and training, regardless of medium. In the students' case, we can notice that they have different levels of autonomy: some are more confident, others less, and they need a leader to motivate them and support them during their training. Beside the motivational aspect, tutors should use strategies to optimize learning, taking all the opportunities of the online working environment. Tutorial support always includes summaries and feedback. Feedback on

students' progress in learning must be accompanied by calls for further discussion, which should target new dimensions of content, new possible approaches.

• In the **academic field** of study, tutors aim to:

- guide pupils/ students in content;
- encourage the sharing of experience and knowledge;
- determine which results are expected in relation to the opportunities of the online working environment;
- provoke discussion with students/learners;
- launch debate themes related to the proposed content.

The role of the tutor is:

a) to involve the learners so that the knowledge they build and develop to be useful in new, different situations;

b) to facilitate understanding and application, enabling meaning making more than content transmission.

• **Social Plan** aims to integrate the learner within the learning community. Starting from the premise that learning is primarily a social activity and not just an intellectual activity, it is easy to reveal the importance of contact, cooperation. Absence or reduction of contact between students and tutors has an impact on students' motivation and satisfaction regarding their own learning.

The main role of the tutor on the social plan is as follows:

a) to encourage online learners' communication, interaction and involvement;

b) to use combined different methods of communication and to foster the development of the learners' "sense of community".

Regarding **technical aspects**, the tutor's support focuses both on computer use and the use of the e-Learning platform. The tutor must know the potential of the online learning, to know how to use the facilities of the application to fully exploit it. Tools such as instant messenger, chat, forums and e-mail communication make possible both synchronous and asynchronous communication among members of the learning community and monitoring their participation.

With the implementation of new information technologies and communications, the new generation of teachers (tutors) acquires another dimension. A successful tutor is becoming more and more flexible, encouraging participants' interaction and engagement, acting as an equal, as a partner. In the XXIst century, the teacher no longer transmits, but facilitates the access to information, creates the communication and positive relationship framework favorable to the learner's active involvement in the learning process. The professional profile of the teaching staff is getting new dimensions, is supplemented by a series of new academic, educational, social and technical skills.

### **3. INFRASTRUCTURE OF ICT IN ROMANIA**

Information and communication technologies (ICT) are the main spread of knowledge and their role is multiple i.e. they aim to educate and train the individual. At the basis of these technologies the computer has an essential role. Only in Romania, the degree of computer penetration is of 3.2 computers per 100 inhabitants and the Internet has approximately 860.00 users. In early 2000, Romania had the lowest level of IT spending per capita. Also, in the same period, the rate of growth of the Internet in Romania was of 10% compared to the average of 86% in the EU countries. The number of Internet users per 1000 inhabitants was, at the end of 2001, of 33% compared to an average of 84% in the EU. All these highlight the fact that the ICT infrastructure in Romania at that time was very poor, with a strong negative effect on the forms of production based on knowledge. After 2005, the situation improved substantially in the sense that efforts were made in terms of investment in this field of new information and communication technologies.

At present, major changes took place with great impact on education in most educational institutes. We could say that Romania has become a model for the other countries. As an example, we take the **European Conference**

of e-Learning which was held in Lisbon this year.

Between 15 - 16 October 2007, Portugal hosted the European Conference of e-Learning – Lisbon 2007, organized under the high patronage of the European Commission and the Government of Portugal. The event had part of the most current topics in the field of e-learning at the European level, being addressed particularly the decision makers from the political arena, HR managers, authorities and managers from the educational field, teachers and e-Learning experts. With the general theme of "Delivering on the Lisbon Agenda", the event brought together brand names from the world of European e-learning. The major themes analyzed during the sessions included: e-Inclusion, Knowledge Sharing, Informal Learning, Communities, Skills, Quality and Valuation.

In Romania, the need for educated workforce, able to use new technologies and to adapt quickly to a constantly changing climate brought a very positive climate to develop solutions for e-Learning. (for example: the AeL platform for e-Learning created by SIVECO Romania wants to transform the classical teaching process into an interactive and attractive activity, which leads to the learners' greater involvement and a more rapid and long-term knowledge assimilation).

In the future, using the e-Learning solutions will be, at the European level, a mandatory component of development in society. With the SEI (IT-based Educational System) program, SIVECO Romania intends to contribute to the training of the future creative generations, familiar with technology and change. Prof. Radu Jugureanu, AeL eContent Department Manager within SIVECO Romania, states that: *"Technological developments will rebuild the school, on a global level, and e-learning will allow, ultimately, free and equal access to education and culture for all children from each and every country"*.

Another example regarding the new changes occurring in the field of information and communication technologies was completed by providing the **e-Learning Awards 2007**, which aimed to promote the use

of information technology in schools and encourage collaboration among schools. In this respect, Romanian teachers were invited to take part in competition projects that demonstrate the importance of using information technologies in education.

Since 2001, European Schoolnet has been running the eLearning Awards to recognise the people and schools that provide some of the finest examples of ICT innovation and impact on children's learning. The objective of this competition is to identify and highlight best practice examples in schools that make good pedagogical use of ICT. Many teachers use their technical and creative skills to find new and innovative ways of teaching and learning based on the use of new technologies, but often their work is not known outside a small circle. The eLearning Awards provide a platform to share successes and learn from each other. There teachers can show to a wider audience how ICT helps improve their methodology, makes their daily life in teaching easier and also enriches their work in the classroom. The eLearning Awards 2008 were organised by European Schoolnet, with the support of major industry players in the area of new technologies in teaching and learning. Because of its constant interest to support and promote Romanian education, SIVECO Romania decided to get involved in this competition, becoming the official partner of this prestigious event.

In the last seven years, the winners were invited to prize-giving ceremonies at the EMINENT conference in Lisbon, Stockholm, Geneva, Prague, Paris, Bruges and Brussels. In 2008 the event took place in the ancient city of Rome on 4 December. The EMINENT conference was the major European event which brought together senior ICT policy makers from Agencies and Ministries of Education members of the EUN Consortium, invited experts, participants from national school portals and networks, leading researchers, innovative teachers and leading eLearning suppliers from the commercial sector.

#### 4. ICT POLICIES AND STRATEGIES READY TO MEET THE LONG-TERM EDUCATIONAL OBJECTIVES

To meet the fundamental changes facing the education community today, especially those related to ICT integration, there is a real need for policies and strategies with educational perspectives in the long term.

To lead the changes and innovations taking place at present, ICT policies and strategies must focus on various pedagogical uses of ICT to facilitate the achievement of the educational objectives. Among the overall aims of the processes of education and training, established by the Board of Education, we will underline those related to the development of the individual, society and economy by providing skills for the workforce.

"*The possibility of having a job*" must be seen from a long-term perspective, aimed at linking educational strategies to both long term professional development and the possibilities of short-term employment.

ICT is not only an instrument of presenting the existing content through other means; they also introduce new models of learning, changing thus the relationship with information and communication within the institutions of education. For example, in areas such as the use of ICT for science education, the policies should address the following needs:

a) train pupils/students to choose careers in science;

b) to educate them to act as citizens in a society in which scientific progress gives rise to major challenges.

We should not forget that the perspective of permanent/ continuous learning is at the basis of the policies of the long term development and will lead to the integration of the educational system with other learning environments.

#### 5. CONCLUSIONS

The present paper wanted to highlight some significant aspects related to the impact of the new information and communication technologies on Romanian education. There will always be gaps in implementing these information technologies in all educational

institutions. Romania has continually tried to improve the reform process and the implementation of these technologies aimed at improving the efficiency of education. For this, it is good that the Romania educational institutions take into account the following:

- designing a unitary curriculum for the initial and continuous training, adequated to the teaching staff's required skills;

- focusing the courses on skills and practical abilities; a more pragmatic approach of the departments training teaching staff;

- rethinking and appropriately balancing the mandatory and optional disciplines/ themes, disciplines of specialty, didactic and theoretical disciplines;

- establishing different wage levels, according to the number of the completed training programs and the progress in work as a result of the skills acquired through continuous training; professional promotion, based on competence in education/ pedagogy, at least in the key positions of the educational system.

In order to best use the ICT in schools as a teaching tool and as a resource for continuing training, we will mention some viable solutions to be implemented:

- Diversification of the training offers for the teaching staff, including more topics concerning the use of the new technologies, computer-assisted instruction;

- Organization of training programs available in the e- Learning system;

- Providing material resources and IT equipment in schools;

- Distribution of (modern) teaching materials to teachers (videos, multimedia encyclopedias, educational software, tapes, etc.); implementing ICT support (electronic lessons) for each discipline and for each year of study;

- Internet publication of updated information and resources for teachers; providing access to online information sources; creating an efficient system of informing teachers; publication of updated information about specific legislation and training opportunities.

The Romanian training institutions are open to change, considering that the

difficulties in upgrading the continuous training system derive from the inadequate legislative and methodological framework, existing at national level, and the lack of material resources (including financial, insufficient training and low motivation of the teaching staff from teacher training institutions.

We must remember that, despite the existing legislative flaws, education in Romania has developed enormously. This idea is reinforced by the statement of Ștefan Morcov, Line of Business Senior Director within SIVECO Romanian: „*At present the Romanian educational system can be considered a successful case at the European level, regarding the implementation of the interactive resources*”.

We believe that the way the Romanians are on is a long and difficult one, but there is no going back. ICT are part of our life, with or without our will, and, in order to have properly instructed future generations, the today's tutors must understand, implement and use the ICT.

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## ROMANIAN ORTHODOX CHURCH FACTOR IN CHANGING LOCAL COMMUNITIES' ATTITUDE TOWARDS DOMESTIC VIOLENCE

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**Abstract:** *The present study expound the main results of the research “Knowledge, attitudes, practices and behaviors of the general population regarding family violence”, developed within the framework of the project “Strengthening the community initiatives for preventing family violence”, implemented in Romania by the International Organization for Christian-Orthodox Charity in April 2005 – March 2008. Using a religious approach, the aim of the project was to promote a responsible social behavior, by strengthening parochial community’s initiatives regarding prevention and rebuttal of family violence. More specifically, the project aimed to develop a positive attitude for church personal (priests, religion teachers, social and cultural services, parishioners) through education, so that they become social changing and pro-active factors at parochial community level concerning prevention of imminent social problems and dealing with the existing ones, especially family violence.*

**Key words:** *family violence, community, church, preventing and combating actions*

Family violence is an ancient phenomenon, having its roots in traditional cultural mentalities and being tolerate in most societies. Anthropological studies reveal the fact that there were societies considered “primitive” which aren’t familiar with domestic violence, or if it appears, individual who causes it, is immediately punished through relegation from the community and woman’s protection by the community members. In most developed countries though family violence wasn’t taken into account until two decades ago. The development of social sciences and of egalitarian trends determined attention upon this domain. The costs for treating violence aggressions have determined the governments to reassess the prevention programs. In ex-communist countries, accustomed to think in a restricted paradigm which considers the individual second to the mass ideology, the real ampleness of the phenomenon remains

unknown, but it is estimated as being severe. Ex-communist countries report a smaller number of family violence than other European states. And this, not because of less violence, but because of lack of adequate reporting and acknowledging systems and because of high tolerance towards the phenomenon, considered as being “normal” in many families and communities. In Romanian society, family violence is an issue still not enough understood and a relatively hidden problem. First research upon family violence and work violence was made through a European program by the Equality Partnership Center, in august 2003 (Gallup). The research results corroborated with public institutions statistics revealed that 800.000 women have bared frequent family violence in a variety of forms. Most abused women prefer to turn to a parent, a friend or a closed relative, but they don’t ask medical, legally or spiritually help because of fear or the



shame of being blamable by the family, or because they have no trust that someone could do something about it. Many Romanians don't consider that physical or verbal abuses are a serious problem.

Having a robust hierarchical structure and a vertical reporting system infiltrated into society and educational institutions, The Romanian Orthodox Church may play an important role in offering moral and material help both to suffering people and to those who commit violent acts. These facts permit to The Romanian Orthodox Church to be an important factor in changing adults', families' or children's attitudes, ways of thinking regarding social problems. Under its ethical guiding local communities could dare to become pro-active in their fight against discrimination and social inequity.

Using a religious approach, the aim of the project was to promote a responsible social behavior, by strengthening parochial community's initiatives regarding prevention and rebuttal of family violence. More specifically, the project aimed to develop a positive attitude for church personal (priests, religion teachers, social and cultural services, parishioners) through education, so that they become social changing and pro-active factors at parochial community level concerning prevention of imminent social problems and dealing with the existing ones, especially family violence.

The projects was developed between April 2005 and March 2008 and strived to sustain and to develop a positive attitude along priests, religion teachers, social and cultural services, parishioners, through training activities, so that they become social changing agents in developing a community integrated answer for preventing family violence a supporting social integration of family violence victims.

The project activities covered a number of 13 counties, all around the Romania: Alba, Bacău, Braşov, Bucureşti, Constanţa, Dolj, Ialomiţa, Iaşi, Galaţi, Mehedinţi, Neamţ, Timiş şi Vaslui.

Through the project a number of 52 educational and community coordinators were trained as trainers in family violence and community development field. At their turn, they trained and offered technical assistance to a number of 1284 priests and 906 teachers from the 13 counties involved. The assessment stage of the project consists in evaluation of project implementation, periodic assessment of the progress and results evaluation. Beside this there is a summative assessment of the project's impact over the target people. In order to measure the impact of the intervention at a base level a study KAPB (knowledge, attitudes, practices and behaviors) was implemented, using the pre and post intervention technique. This research report presents the main results of the study "Knowledge, attitudes, practices and behaviors of the general population regarding family violence", developed within the framework of the project "Strengthening the community initiatives for preventing family violence", implemented in Romania by the International Organization for Christian-Orthodox Charity. The study was carried out in two stages:

First stage (pre-intervention) realized in February 2006, consisted of collecting field data for describing the existent situation concerning family violence, before starting the project's activities. Data analyze was made upon 650 participants. The investigated population was represented by people from the general population, with age over 18 years, from 64 rural and urban villages, belonging to 8 counties.

The second stage (post-intervention) realized in February 2008 consisted of collecting data after the implementation of project's activities and of comparing the obtained results with those from the first stage of the study. The sample used in this second stage contained a number of 646 persons from the same villages used in the first stage. A number of 333 individuals (52%) participated in the first phase too.

For both phases of the study were used the same methodologies of sampling and the

same questionnaires. Sampling technique was simple randomized and it was developed for the population involved in the project's activities, for 19 months, in communities near churches. The questionnaire was structured in 3 chapters, aiming to intercept people's knowledge, attitudes, practices and behaviors regarding family violence and the church role in community's life. The same questionnaire was utilized in both pre and post intervention stage.

## RESULTS:

### People's perception upon family violence

Most people involved consider that they have enough, good and very good knowledge about family violence phenomenon. In comparison with initial situation, the percent grows easily, until 78, 5%. Inside this category we observed an important increasing for the subjects considering they have sufficient knowledge about family violence, from 27,4% in the pre-intervention phase to 35,6% in the post-intervention one, and a decreasing for the persons declaring having good knowledge about family violence (from 30,6% in 2006 to 28,4% in 2007) and very good knowledge (from 19,5% in 2006 to 14,5% in 2007).

*Apparently this situation could be interpreted as a decrease in the number of persons having good and very good knowledge about the discussed phenomenon, in reality they made a better and a more correct evaluation of the held knowledge, as a result of understanding the fact that they gathered new information and accepting that they still don't know very well the phenomenon.*

Concerning the other forms of family violence, there is a high percent of people who consider that this forms don't represent in fact family violence: pushing a family member (29,6%), using a humiliating language for threatening or scaring a family member (26%), neglecting children (29,1%), neglecting parents (31,3%) and refusing giving money to a family member for important needs (52,8%).

*We can observe an increasing in recognizing most forms of family violence, but there are some forms that are less known:*

*refusing giving money to a family member for important needs, neglecting children and parents, pushing a family member and using a humiliating language.*

### Frequency of family violence forms

The most frequent family violence forms met in the studied villages both in pre and post intervention phases are: beating a family member, curses addressed to a family member, hurting a family member and using a humiliating language (with the intention to threat or to scare).

*The frequency of main family violence forms is maintained at high cotes, over 75% of the investigated population considering that beating a family member, curses addressed to a family member, hurting a family member and using a humiliating language (with the intention to threat or to scare) are frequent in their communities.*

### People's attitude and behavior toward family violence

More than a half of investigated population declares that they do not approve or approve little and very little the family violence forms presented in the study: "Family violence is accepted in certain situations", "Were mother kicks, grows", "Family violence should always be kept secret", "A man that doesn't beat his wife, doesn't love her", "The woman must be beat once and wile because she knows why", "Beating comes from heaven".

*In comparison with 2006, in 2007 we observed an increasing in the number of persons declaring that they do not approve or approve little this family violence manifestation forms.*

In the next situations: woman doesn't cook, doesn't clean up, doesn't take care of her children, or she dresses to short and décolletages, most people declare that "it has to resolve through a discussion".

For the situation in which the woman cheats her husband or the husband cheats his wife, most people consider that: "they would

better divorce each other”, “a good beat is necessary”, “a clout is enough”.

There are still high percents of people (20%) considering that there is a reason for fight in the next situations: woman doesn't shout her mouth, man comes drunk home, doesn't give all the money or does nothing around the house. Almost 5% of investigated individuals consider that if the woman doesn't shout her mouth, a clout is enough. We observe that at a declarative level, aggressive attitudes of the population are maintained, even for those situations which could be resolved through a simple discussion.

### **Population's perception upon community's role in resolving family violence situations**

Community's role in resolving family violence situations is seen by the most people as helping individual's relatives for resolving the couple's conflict.

*The situation in which beating intervenes between partners is still considered o problem, which could be resolved by the intervention of police, beside relatives. We can see a diminishing perceived role of friends, neighbors, godfathers, or church in resolving the conflict.*

It can be seen though an increasing of family doctor's role in resolving the issue (but the percent is very small, only 6,2%).

A significant fact is that *more than a quart of people preferred not to answer* regarding to the resort that should intervene in the violent situation; this percent increased with 5 points compared with the initial situation.

*We discovered that although at a declarative level most people are against family violence forms, after being aware of the gravity of this rod in community and after being aware of the correct opinions toward this, individuals hesitate to be honest and to admit an attitude according to which they actually don't agree that someone to intervene in couple's issues, even if we are talking about family violence.* To support this conclusion we bring the fact that, in general the role of other persons in resolving couple's difficulties has decreased.

### **Information sources regarding family violence and people's availability to inform them selves**

The perceived sources to get more information about family violence are: school (80,8%), doctors (79,1%) and priests (75,5%). In 2006 the first three positions were: doctors (83,6%), priests (60,5%) and family (46%).

*We can observe an increasing of church, school, family and friends' role in offering information about family violence.*

Regarding the availability for getting more information about family violence, compared with the starting situation, we discovered a decreasing of the number of respondents who show themselves available to get new information about family violence, the percent being maintained at over 80% of the population.

### **Perception toward priest's involvement in combating and preventing family violence**

*The study showed a maintaining of the percent of people who consider that the priest should involve in preventing and combating family violence.*

In comparison with 2006, in 2007 we discovered an increasing of individuals who believe that the priest should not involve in this issue and a decreasing of individuals who think that the priest should involve in combating and preventing family violence (from 12,6% in 2006 to 22,1% in 2007).

The most mentioned ways for the priest to involve in combating and preventing family violence were: to require the help of competent institutions, to shelter the victim, to speak to the aggressor, to talk to the victim, to directly intervene between the persons to stop the violent acts.

Comparing these results with the first phase of the study, we discovered an increasing for individuals who mentioned the next ways for priest to involve: to pray for those involved in the violent situation, to speak about family violence at the service, to initiate public meetings about family violence, to express in public their disapproval of violent acts, to

directly intervene between the persons to stop the violent acts, to speak to the aggressor and to shelter the victim.

### **The availability of involving in prevention activities beside along with the priest**

The percent of persons who declare that they want to involve in preventing activities decreased comparing to initial phase, but it is still a high one (68,3% in 2007 and 86,3% in 2006).

One explanation for this results could be the fact that in the first phase of the study the questionnaire operators were in most part the priests who could influence people's opinion toward the availability to support church's actions. In the second phase of the study, data was collected by neutral persons, the answers being more closed to the reality.

*The most important fact is that the majority of investigated population is available to take part in the preventing activities along with the priests.*

## **CONCLUSIONS**

### **Increasing of knowledge level referring to family violence for the people from the 13 counties were the project's activities took part:**

- Increasing the knowledge about the majority of family violence manifestations, including the ones less known before the development of the project: sexual relationships with children, the neglect of children, the neglect of parents, the refuse to offer money to a family member for important needs, pushing a family member, and using a humiliating language with a family member.
- Increasing people's awareness toward the gravity of family violence issue in their community.

### **Strengthening the attitudes and disapproval opinions of the people involved, toward family violence, through:**

- Over 50% of the population doesn't agree at all, or in small and very small way with the violent forms presented in the study: "Family violence is accepted in certain situations", "Were mother kicks, there grows", "Family violence should always be kept secret", "A man that doesn't beat his wife, doesn't love her", "The woman must be beat once and wile because she knows why", "Beating comes from heaven".
- People's attitude is less tolerant toward aggressive forms of dealing with the couple's conflict situations; the number of people who think that the problems should be resolved through a discussion, increased.
- The percent of people, who think that for resolving the conflict situation inside the family a sound beat or a divorce is needed, decreased less than 1%.

### **Increasing the perceived role of educational institutions in informing about family violence**

- Generally it was observed an increasing in knowing the main forms of family violence, but there are still some forms unknown, as: the refuse to offer money to a family member for important needs, the neglect of children or the neglect of parents.

Generally the degree of knowing the family violence forms has increased after the project implementation, although there were some forms less known.

- The frequency of the main forms of family violence is maintained at high cotes, over 75% of the population considering that beating a family member, curses addressed to a family member, hurting a family member and using a humiliating language (with the intention to threat or to scare) are frequent in their communities.

- The situation in which the beat between the partners intervenes is considered to be a problem that could be resolved by the interference of relatives or police, the role of friends, neighbors, godfathers or church being diminished.
- Although at declarative level the attitude of the majority of population is against family violence forms, individuals hesitate to be honest and acknowledge the fact that, in reality they don't agree that someone else to be involved in couple's conflict's.

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## COMMUNICATION BARRIERS

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**Abstract:** *The process of communication always unfolds within a system. During information transmission, various factors may interfere and distort it. Under sensitive circumstances, we can identify these blockages, or observe certain codes and taboos.*

**Key words:**  *censorship, persuasion, feedback, stereotypes, ethnocentrism.*

### 1. Introduction

The word “communication” is one of the generous concepts that have numerous connotations. Communication process necessarily involves two entities and a relationship between them. Generally speaking, life cannot exist without the exchanges taking place between living bodies. Communication can refer either to the act itself, or to its result. The object of communication can be material (documents, data) or immaterial (ideas, feelings). This transmission unfolds by signs (sight) and sounds (hearing), and requires a sender, a message, and a receiver. The persuasion capacity and credibility (or information acceptance) depend on the quality of the supporting materials. These should be simple, relevant, and accessible. Logics are absolutely critical in communication. Besides, communications techniques influence perception. Individuals must develop or improve communication skills, particularly if they function in PR (public relations). This implies his/her preliminary willingness to make an effort in terms of self-awareness, analysis, and understanding of communication processes.

### 2. Communication pre-requisites

Communication consists of transmitting ideas orally or in writing, and its goal is to inform. As a result, information is conveyed by communication channels, from sender to receiver. The sender can be an individual, a group, or an institution. It can gain various degrees of information influence or manipulation. Also, it has the possibility to reward the receiver, which is a positive aspect. At the same time, the receiver can also be an individual, a group, or an institution. In many cases, it can influence the message; for instance, it can perceive the message accurately and critically, according to its own criteria. Messages can be transmitted without being received, or can be misunderstood. The perception capacity can vary, according to the receiver’s understanding and tolerance. One may identify three levels of human thinking that govern the conveyed message: “the first level – allocation of thoughts and feelings; the second – adjustment of important parts of the message, and the third – partial or total assimilation” [1]. The response may go back, and so the information is certain to be perceived and implemented. This process is called *feedback*. It can be positive or negative.

Some information is not heard, or reaches areas where it cannot be heard. Communication is an essential need of the human being (that is, message exchange), whereas “communication barriers result from refusing to communicate” [2].

### **3. Communication barriers**

Most frequently, information flow is hampered by what is generically called communication barriers. They can be psychological or situational. Next, we shall tackle each category.

#### **a. Barriers related to the nature of information**

In some cases, the message does not reach the receiver in its initial form. Blockages of communication channels can occur, which leads to the impossibility to communicate. There should be three information transmission channels in order to avoid such blockages. They should be carefully checked along the way from the sender to receiver.

Another cause would be that of initial omissions related to the message, whether intentional or unintentional. They are linked to the sender’s intentions, who may choose to transmit only a piece of information, wait for the response, and then send the rest of information. We speak, therefore, about the sender’s communication strategy. Also, there can be intentional or contingency omissions, which influence both the sender and the receiver.

Another situation may occur when the receiver misinterprets the message.

In PR, communication barriers are subjected to certain strategies. In order to protect a state’s political interests or the interests of several states involved in a military conflict, communication processes are strictly controlled. Also, the state’s perception abroad is considered. In case of military conflicts, for instance, secret services control the combat information, and only safe information is released in order to protect diplomatic or military

actions. In the last three decades, we have witnessed unconventional conflict, in which mass-media plays a critical role.

Breaking news is something common nowadays. In conflicts such as the ones in Iraq and Yugoslavia, media has been a central element. It is a form of manipulation, control, and influence of the public opinion in terms of the forces taking part in the conflict. Therefore, one may say this as a media conflict as much as it is a military one.

Propaganda and censorship are also two blockage factors. Censorship refers to the information disseminated to the public, which is determined by a controlling group. Censorship can be easily mistaken by PR, but it is underpinned by an ideology serving an idea, which requires blocking other ideas. The constraints of the past are no longer valid today.

Propaganda can be political (e.g. totalitarian regimes – fascist, communist, etc.) or economic (monopolies of companies trying to maintain their market control, even at the expense of loyal competition).

Censorship frequently accompanies propaganda, and manifests by blocking information dissemination by controlling media. In many countries, means of mass communication are strictly controlled by an elite group that has power.

Persuasion and manipulation also play a significant role in the political and economic environment. Persuasion implies three categories: ethos (expression morality), logos (expression correctness), and pathos (personal touch of expression). By persuasion, an individual or a group is convinced to think and act in a certain way. Nowadays, persuasion is an omnipresent phenomenon. People react to commercials, ideologies, and politicians’ discourses. Persuasion is a relation based on the parties’ free will. The freedom of choice is a characteristic of persuasion, according to experts. It should not be examined from the sender’s point of view, but from the receiver’s point of view – the reader, the TV watcher, the radio listener, etc. The social impact of persuasion has stirred the

interest of specialists in many fields: psychology, sociology, political sciences, law, journalism, anthropology, etc. naturally, persuasion is not a recent fad, which is the reason why our forerunners should have been aware of its existence and role. To conclude, all these elements lead to intentional communication barriers.

#### **b. Psycho-emotional barriers**

The personality characteristics of the parties involved in communication are another blockage factor. People have more or less communication skills. A shy, introvert individual is less prone to communication, and is sometimes reluctant to engage in social relations. At the other end of the scale, extrovert people can also block communication due to their very characteristics. Personality clashes are common. However, we are not always able to influence other people's personality, but we can be open, patient, and receptive to those whom we meet.

Lack of knowledge in a certain field, as well as the lack of personal interest result in barriers that are sometimes hard to overcome. Another aspect to mention is the perception differences caused by emotions. Consequently, self-control and openness are traits one should develop, for they help us to communicate in various situations.

Blockages can also occur for environmental reasons: noise, lack of concentration, hearing problems, and physical factors (particularly when communicating over the telephone).

#### **c. Cultural and mentality barriers**

Such phenomena emerge, more and more often, in the field of international relations and of multinational organizations or corporations. In such cases, communication takes place in another language and a different environment than the usual ones. In terms of political relations, the conduct codes and etiquette concerning official meetings are known by the officials

working with the ministry of foreign affairs participating in political activities and summits. Also, they must be familiar with other countries' languages, cultures, and civilizations.

Under these circumstances, behavior and dress codes must be observed. For official meetings and soirees people should wear elegant and appropriate clothes. There are also special rules related to titles and addressing to the guests, and a pre-established code to allocate participants to their seats. The meal ends right after serving the fruits. From this viewpoint, the Europeans and the Asians are stricter, whereas the Americans are more relaxed.

The addressing mode is also very important: one should never use one's first name or another familiar formula when approaching a political personality. There have been cases when breaking these rules resulted in conflicts or diplomatic tensions. Therefore, attention should be paid to subtle elements and customs of other cultures. In Arab cultures, for example, there are certain rules and traditions regarding women, which is why such topics should be avoided.

The main communication obstacles when dealing with other cultures are the language ones and the subsequent potential misinterpretations or misunderstandings. Translation or interpretation errors, vocabulary, punctuation, pronunciation – all contribute to deepening communication gaps and differences.

Social-human blockages refer to the impossibility to accept and understand people with other standards, life-styles and sets of values, which can be labeled as lack of consideration towards others.

#### **d. Stereotypes**

These are defined as recurring attitudes, certain mentalities that do not alter due to any external influences. One may say there are numerous such stereotypes which hamper or hinder communication processes, as follows:



- ethnocentrism – one’s belief that one’s culture and language is better than others’;
- egoism – appreciation for one’s own ideas and actions;
- lack of interest – one’s idea that there is nothing one can learn or gain from others.

Prejudices and opinions formulated before meeting somebody else are examples of stereotypes. A prejudiced idea accompanied by a critical attitude are enough to slow down or even stop communication and information flow. Lack of openness and honesty are characteristics of formal circumstances, when people feel they cannot express their ideas and feelings. Such communication situations foster lack of trust, and people may have the feeling that information is kept from them for various reasons.

#### **4. Means and methods to overcome barriers**

Openness and willingness to communicate are essential. Jumping to conclusions before

collecting and considering all the available information is not a good idea. Communication is a dialog, therefore it requires at least two parties. The information sender should observe some principles concerning feedback, that is:

- mutual trust between sender and receiver;
- feedback is specific, not general;
- a prompt answer or response should be provided to the receiver.

Information value should prevail at all times. Egoism and prejudices will be replaced with kindness and information analysis.

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## THE IMPORTANCE OF PUBLIC RELATIONS IN COMMUNICATION

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**Abstract:** *Communication entails an individual that sends the information, and one that receives it. Public relations involve an entire network established between the individual and the community, between various institutions and the community, or between different departments within an organization. This field of activity came into existence at the beginning of the 20<sup>th</sup> century, and nowadays is based on team-work, which is a sine-qua-non of any organization.*

**Key words:** *publicity, PR, communication, marketing.*

### 1. Introduction

Communication has been in human nature ever since mankind has existed. Communication methods and procedures have become more and more numerous. The first forms of communication were shouts and sounds that imitated animals. Then, words appeared and become known to a certain group of people. In the Paleolithic, cave paintings were an artistic form of communication. In the 1<sup>st</sup> millennium AD, the alphabet appeared, and enabled information mobility mainly resulted from commercial exchanges and circulation. In the 16<sup>th</sup> century the printing machine was invented, which was one more important step towards cultural development and people's access to education. The educational system of all levels facilitated communication amongst people.

Starting from these initial forms of communication until today, communication methods and procedures have also evolved. Nowadays, we speak about electronic books, on-line library access, etc. The

Internet and mass-media (both written and TV) significantly enable communication and information circulation. However, the direct effect is human alienation, for the rapid access to information makes inter-human relations superfluous. Virtual communication has replaced direct, face-to-face contact between people in the last years.

### 2. Communication specificity

In fact, communication is defined as „acknowledgment, news, report, relation, link; specialized presentation of a scientific topic in a personal manner” [1].

Communication is a process comprising four fundamental components:

- sender
- channel
- information
- receiver.

“The essence of communication is the transfer of information”[2]. Communication ends when information is received; afterwards, the effect of communication gains importance.

Public relations (PR) have also developed starting since the '50s, when they appeared in the USA due to the need to establish contacts between institutions as well as institutions and communities. Following the American model, this activity has evolved in Europe after the '70s – '80s. communication classes were taught in colleges, first targeting leaders, then all young people. During the process, PR penetrate the administrative field, industry, tourism, etc. In the '90s, they form corporations serving organizations and institutions, but also mass-media and culture.

As a result, the following question emerges: what is the impact of communication, and what criteria does it meet? One can identify three levels of communication interaction and manifestation:

- a. Communication has a social impact in mass-media. It shapes and offers certain types of models (not necessarily positive). By means of persuasion, media can offer violence, aggressiveness, and pornography, which are current and serious events nowadays.
- b. Media plays a positive role in communication. By means of commercials, information reaches audience. Specific channels are used to reach the target. Information will be synthetic, articles will consist of both text and pictures, images and sounds will be combined to attract audience and sell information.
- c. Communication addresses social needs. By better knowing the targeted public, the message is conveyed by means of repetition, sometimes 10 times. Commercials offers people alternatives and solutions for daily problems. People's willingness to listen and communicate is a survival condition. Nobody can survive in isolation. To fulfill spiritual needs, people need to communicate.

### **3. PR definition**

Specialized literature as well as practice provide several definitions in this respect, as follows:

- "PR stand for communication management between an organization and its various types of customers" [3].
- "PR are a leadership function that assesses public attitudes, identifies the policies and procedures which an individual or an organization can use in terms of stirring public interest, planning and executing an action plan in order to gain public understanding and support" [4].
- "The conscientious and legitimate effort to enhance comprehension, to build and sustain public trust based on systematic research" (The German Association of PR).
- "PR are group activities aiming to build and sustain trust-based relations among people, as well as between people and various public categories that are directly or indirectly interested in that group's economic or social undertakings" (The PR Office of Denmark).

The most comprehensive definition is provided by the Oxford Business Dictionary: "PR activity focuses upon the following: ensuring the subject's holistic image, maintaining its positive image, maintaining its good relations with different internal or international organizations, institutions, audience, etc.; performing favorable lobby actions and assuring internal and external communication".

PR can be found in every social field. No organization survives in the market without good PR. Also, international PR aim to create the positive image of a state, of its leader, or of its institutions. This is probably the most difficult way to create and sustain image within the communication process.

#### **4. PR activities**

In most institutions and organizations, organizing and coordinating roles are performed by managers and administration boards. They will make strategic decisions and profit, or the organization will die out. In management, organizational communication is an essential pre-requisite. Information can flow top-down (from managers to employees), or horizontally (between various departments). Each organization chooses its communication methods. This can be done smoothly and based on the team-spirit, or defensively, with a negative impact upon organizational climate. Communication comprises several activities, which lead to a common goal:

- marketing
- communication
- planning
- conceptual evolution
- goal-setting and contributing to an objective
- developing relations with customers and media.

Marketing constantly preserves the link with the market, its demands, and changes occurred in customers' expectations. By aggressive promotion of a product, buyers' preferences can be altered or educated. Ideally, loyal competition laws should be observed. These must be instilled and sustained inside the organization. When it does not have the necessary resources, it can hire a PR consultancy company, on the grounds of an outsourcing agreement.

Lobby is a systematic promotion activity by means of mail, direct telephoning, data bases, etc. It is a permanent activity in every institution, whether commercial or public.

PR expand over several sectors of public life:

- a. Business – PR are meant to increase profit;
- b. Politics – the most sensitive field, for here we talk about political structures (president, government,

parliament, state, etc.). In this case, one should also mention less transparent activities such as secret services, intelligence, etc.

- c. Strict field of PR and publicity.

The need for communication and social knowledge, competition, conquering European and global markets, the ever-growing mobility of workforce determine companies to focus on culture. It can ensure their identity on the market as well as credibility and stability of their relations with community. Until now, several prejudices and stereotypes concerning culture and the artist's social role have prevented the business world from bonding with culture. Culture depends on state funding, which is why efficient communication strategies are necessary in order to attract private capital to culture.

Between the two world wars, in Romania there was a philanthropic tradition sustained by the royal family (by the Hohenzollern royal family's foundation) and the great corporations of that time. After 1945, the communist regime interrupted this activity, and culture eventually became one of the many tools that contributed to creating Nicolae Ceausescu's cult of personality.

After 1990, in Romania there have been attempts to revive the old traditions. Great companies support cultural individual projects. Significant cultural events are carried out on sponsorship basis. Let us list but a few: the Golden Stag, "George Enescu" Festival, "Sibiu – capital of Europe" event, etc. This sponsoring activity is well sustained in the western world by fiscal laws of tax reduction for companies investing in education, culture, and health. If we had similar laws, we could certainly speak about the real involvement of companies in cultural endeavors.

Communication, particularly the written one and TV, can offer us dubious products, which explains why manipulation and persuasion are elements of communication. Every day we are exposed to violent or pornographic news, social or false events (whose sole purpose is to sell the papers), or over-coverage of certain subjects. Media

orients public tastes in the desired directions. Shaping an individual's or an event's false perception makes the contents of some news presented to us as communication means. Another form of manipulation is publicity. Commercials address the primary needs of modern people, who are too hasty or agitated to analyze. By repetition and persuasion, these are assimilated, sometimes without even noticing it. The information selection capacity is made in time, according to one's educational and cultural background.

Media censorship is impossible as it would break the right to free expression, but controlling it is necessary. Specialists in the field should better know the targeted public. However, this is their source of money, which results in breaking many fundamental rules. In case of television, there is the National Audio-Visual Council, which takes punitive measures against programs that violate common sense. In the written media, there are journalists' guilds in charge with their professional ethics. But in spite of all the aforementioned, one can notice frequent problems in this respect.

PR also manifest in the field of public services functioning in a community or a county. Concrete and timely data and information transmission are the main objectives of central and local authorities. In every country there are at least two types of interests: national (represented by political institutions – president, government, and parliament), and local (represented by local authorities such as city halls). Communication is performed directly, by PR offices, or on-line, e.g. in case of downloading documents. Ideally, communication should take little time, and information should be conveyed in due time. Unfortunately, the public servant's law now in force does not always guarantee a conduct model. Public usually reacts

promptly, but solving administrative problems does not always unfolds properly. Therefore, central and local authorities should involve more in such issues.

## 5. Conclusions

Communication is a complex process requiring several factors. Information flow takes place either from the sender to the receiver, or from the receiver backwards as a response to information perception and interpretation. PR are a relatively new field of interest, which emerged in the second part of the last century. Its development is significant, considering that the image of a person, institution, or product is more and more important and visible. PR activities are carried out by a specialized department of an organization, or by specialized companies that provide such services. In either case, the final result should be the same, that is, the rapid flow of information and the concern for its accurate perception.

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## THE WATER TRADE IN THE CAPITAL IN THE 19TH CENTURY

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**ABSTRACT:** *Water has always been perceived as a vital element of survival on earth, without which no living form would exist. It represented and it still represents the main source of survival for man together with food as well as a key element for hygiene, whether it be human, animal, domestic or industrial.*

*The citizens of Bucharest would make no exception from these unwritten rules; water was used for: drinking, washing up, food, domestic hygiene, gardening, or raising animals. We can see that the entire domestic universe was moving round water, which unfortunately, was found only in Dambovita and in few deep sources.*

*The river crossing the city did not have the best water, the latter would be used by the citizens for bathing or for watering the animals, to which we can add throwing domestic wastes. All these impurities made it impossible to drink, a fact which did not stop citizens from using it since it was the only available source. Due to the long distances and to the lack of time, they bought it from the water traders. These were known as water bearers, because of the large tubs in which they carried water to sell in the capital.*

*From dusk till dawn they would announce their presence through specific shouts while the housewives would wait for them at the gates to buy water according to their needs and possibilities.*

*The poor would buy the cheapest one, which they had to beat with a stick and wait for the garbage to settle at the bottom of the jar; the boyars would buy water brought from outside the city, from very deep wells where there were not infiltrations with chemical elements.*

*Although they knew that it was full of germs they would use it because it was the only one they could buy or because they didn't believe Pasteur's theory that it could hurt them.*

*There were other sources as well: fountains and springs but there were few of them and the majority were within the gardens of common people. Only after 1864 when the river went out of its banks the first real measures were taken: several springs were built and pipes were linked to the central areas until 1899, while the suburbs were still at the mercy of the water bearers. The process of urbanism for providing citizens with water barely started in 1907.*

**Key words:** *water, trade, Bucharest, provisions.*

As a complex phenomenon, trade has always been present in every age, and has manifested itself under different forms according to the international and local contexts, including the Romanian space which makes no exception to the rule. The economical life represents the social drive, in times of peace and war alike, the same way the capital city is the axis of trade within a state.

Bucharest was part of this world being a political centre for all Romanians and the main commercial knot from where different laws would come as well as reference prices and of

course the latest "fashion" concerning provisioning and trading goods; both perceived as a necessity or as a luxury according to the social category or the event we refer to.

Within the space delimited by the Dambovita river, there was a hundred years ago a rural-urban economy, which had taken over many characteristics of the capitalist society.

There is, however, a different situation concerning the water supplies for the capital's citizens, during the modern and the contemporary ages; water used to be

inaccessible to the largest part of the population.

Water has represented and still represents the vital element for all people or communities no matter the latter's sizes. Life is impossible without it, since it is vital for survival as well as for personal hygiene. Bucharest is no exception to the rule; everybody uses water for all intended purposes.

Unfortunately, for the former citizens of Bucharest, water was hard to obtain; few could afford to build wells, fountains or springs in their yards or close to them.

Some of the rich people owned a spring with a pomp, with which they extracted «crystal cold» water directly from the springs underneath. The main source was the Dambovită river, which still crosses the city. Thus, we should not be surprised to see that water was the object of trade, out of necessity, being often bought from water carriers. The water trade disappears after the 1900's, and no longer makes sense after 1906, due to Dambovită being sewed and to the building of edges. «Then, after the water intake developments were concluded and sand filters were installed in Arcuda, the capital city was provisioned with filtered water delivered through special pipes.»<sup>1</sup>

Water was dirty back then since everybody could freely bathe or wash animals in it, and even dump wastes. It seems, though, that initially, at the beginning of the modern age, before the city started expanding during 1800-1820, Dîmbovița was a crystal clear water which eased the thirst of those who appreciated the qualities of «ferruginous (challybeate)» water. It also represented the water supply for those who had no wells in their yards<sup>2</sup>. Paradoxically, we could say that a dirty river had cleansing qualities as well.

«Dambovită, sweet water/ Those who drink you, don't leave you»... says an old song dedicated to the river crossing the capital. A

<sup>1</sup> Constantin Bacalbașa, *Bucureștii de altădată*, vol. III, Eminescu Publishing, București, p. 149.

<sup>2</sup> <http://www.summitbucharest.ro/ro/66.html>, articol de Luminița Ciobanu, *Povestea "Gârlei" din mijlocul Bucureștilor*.

walk along the river's gorge can be pleasant nowadays, although the »setting« (wastes thrown in the river) leave us with a bitter taste, even now when our water comes from the Argeș river and is well filtered; at least that is what the authorities tell us. There are however city areas whose water supplies come from Dambovită; thus the river's image should not be neglected!

Dambovită is also an important objective, especially, since Bucharest has been referred to as the «Citadel on Dambovită». Clean water, at least at the beginning, «running along a tight canal, 7 km long, looking like a fortress' ditch on whose bottom runs a yellowish, dirty and full of mud water»<sup>3</sup>.

A long time ago the citizens of Bucharest also used water coming from the wells in the yards or the fountains on the streets and markets. Some of the wells are still well-known: the Well with poplars, the well with cold water, Zamfir's Well or the fountain of Filaret's Archbishop or Marcuța and Cismigiu fountains<sup>4</sup>.

Every family or businessman had to buy the water for the daily chores, or for the holidays<sup>5</sup>. There is little information; most of it comes from the newspapers published in those days or from writers' notes, especially those who have grown up in Bucharest in the first half of the 19th century. These sources prove us that the citizens of Bucharest who had no water sources, bought it from water carriers and stored it in large barrels.

The luckiest people were those living on the river's banks because they could drink clean water; at least until the floods came and destroyed their houses partially or even totally. There were a few places with crystal clear water where water carriers would come to refill their barrels and then set out to sell it

<sup>3</sup> Frédéric Damé, *Bucureștiul în 1906*, Editura paralela 45, Pitești, 2007, p. 209.

<sup>4</sup> <http://www.summitbucharest.ro/ro/66.html>, articol de Luminița Ciobanu, *Povestea "Gârlei" din mijlocul Bucureștilor*.

<sup>5</sup> Lelia Zamani, *Oameni și locuri din vechiul București*, Editura Vreamea, București, 2008, p. 78.

in the city<sup>6</sup>. Every morning, before sunrise, they would start walking across the city together with other traders; thus one of the oldest trades of Bucharest, flourished: the water trade<sup>7</sup>. The water carriers were also useful in case fire should burst; they would help people and firemen alike.

The water carriers were poor people; they had only one or two barrels for which they paid taxes at the Town Hall; besides, they were obliged to help put out the fires. In 1827, Iancu Sacala, a former captain in Dorobanti, bought around 30 barrels, carriages and horses in order to sell water on the city's streets; thus, water was sold using barrels. The latter were made of wood and could hold the quantity of around 20 water buckets<sup>8</sup>.

They had meager horses which carried the barrels while the water carriers would shout effectively: Wateeer! Aaaaater! The citizens would buy water since they were always thirsty. Sometimes there would be one who would give away water freely, from a barrel on top of which a candle burnt; it was a tribute to the dead;<sup>9</sup>

„ the water carriers crowded the city with their barrels carried on wheels; they would shout to let people know what they were selling; by its colour, the merchandise looked more like millet beer than water”.

Constantin Bacalbaşa, vividly presents this almost idyllic image in his volume entitled "Yesterday's Bucharest": he describes the image of the river crossing the city in 1871. " Dambovită had no sewers. It was not too deep running along a canal built at the same level the street had been built; it had no banks and the wooden bridges were in poor shape; the river had several fords (places) from where the water carriers collected the water they would either deliver to their customers or sell on the

streets taking 50 coins per barrel”<sup>10</sup>. Those that brought water were considered indispensable by society; thus, they would not pay taxes”<sup>11</sup>.

Society was structured in such a manner that men were supposed to work for their families while women had to take care of the house and the daily chores. This is the reason why women (wives, mothers, daughters or maids) were those who would wait in front of the gates with their pails and, using the sums of money they disposed of, would buy plain water « paying 50 coins per a barrel containing water from the river and 1 banknote (leu) for the royal water brought from the Filaret fountain or from Marcuța »<sup>12</sup>. The citizens' provisions came from a place symbolically called The Water Carriers' Stream, while the boyards' came from the locations previously mentioned<sup>13</sup>.

All types of water were used for washing but when it came to cooking and drinking the situation changed radically; the housewife had a difficult task in choosing water; if money was not enough to buy quality water, then she would more likely buy water that was not of quality which they would clear using a rural procedure:

« Each housewife, after buying water, used to put a handful of sour grind and used to beat it with a whisk or stick and then would put it in the basement where it was cooler. The family drank it without fear of bacteria. » Water was then put in the basement where it was cooler, being sipped without fear of bacteria, before the breakthrough..... »<sup>14</sup>.

There were also rich people who placed silver at the bottom of the barrels, because the metal purified the water. Nowadays, in several areas of the country, people put an egg, a cabbage leaf and a silver coin in the water, from dusk till dawn, at Easter time. People wash their faces with that water in the morning to have

<sup>6</sup> <http://www.summitbucharest.ro/ro/66.html>, articol.de

Luminița Ciobanu, *Povestea*

“Gârlei” din mijlocul Bucureștilor.

<sup>7</sup> Alexandrescu Predescu, *Dâmbovița apă dulce*, Editura Albatros, București, 1970, p.92.

<sup>8</sup> <http://www.summitbucharest.ro/ro/66.html>, articol.de Luminița Ciobanu, *Povestea “Gârlei” din mijlocul Bucureștilor*.

<sup>9</sup> Lelia Zamani, *op.cit*, p.100.

<sup>10</sup> <http://www.summitbucharest.ro/ro/66.html>, articol.de

Luminița Ciobanu, *Povestea “Gârlei” din mijlocul Bucureștilor*.

<sup>11</sup> Alexandrescu Predescu, *Dâmbovița, op.cit*, p.93.

<sup>12</sup> Alexandrescu Predescu, *Dâmbovița, op.cit*, p.93.

<sup>13</sup> Lelia Zamani, *op.cit*, p.100.

<sup>14</sup> Alexandrescu Predescu, *op.cit*, p.93.



red cheeks, to look young like the green leaf and healthy like silver, all year round.

Doctor Felix, the manager of the sanitary service, fought for years on end to prevent citizens from drinking “sweet water”, motivating that the former” was hardly drinkable”.

His motivation was based on the fact that water gathered wastes, dirt, sewage, animal corpses or organic wastes from factories or butcher’s shops, along its course through the city. Cases of diseases were often signaled, but the uneducated citizens took these events lightly and did not believe that impure water could be the cause.

» In order to cool water during summer, people used ice cubes that had been saved since winter and had been gathered from the waters around the city. Sometimes water was passed through cones made of porous stone, which were sold in wooden cupboards »<sup>15</sup>.

We can say that both people and animals were forced by the circumstances to use Dambovita’s muddy waters.

The authorities have tried to work out the citizens’ problems regarding the water supplies. The measures taken have often been scarce due to the lack of funds or to the slow development of the ample workings that needed to be done in order to systematize Dambovita as well as the adduction from several rivers.” “The citizens of Bucharest were pleased to drink water, beaten with sour grind, from The Dambovita river, in the 18<sup>th</sup> century. Still the century brought something new since the landlords have started to build springs with clear, clean water directly from natural brookes”<sup>16</sup>.

Mr. Del Chiaro, Alexandru Ipsilanti’s secretary tells us how the latter has built the first 2 fountains of the city , one in Boiangilor Street and the second in front of the Sarindaru church in 1779. Other fountains: the red fountain on the Mogosoia bridge and the Ox’s fountain near Schitu-Măgureanu<sup>17</sup>.

<sup>15</sup> Frédéric Damé, *op.cit*, p.212.

<sup>16</sup> George Costescu, *Bucureștii Vechiului Regat*, Editura Capitel, 2005, p.131.

<sup>17</sup> Alexandrescu Predescu, *Dâmbovița apă dulce*, Editura Albatros, 1970, p.91.

In the second half of the 19th century the situation changed. Dambovita’s clean water has become more and more polluted. Ion Ghica mentions this fact in his writings : » Bucharest’s water has become a drastic purge instead of a digestive, that is why the citizen prefers Opler’s beer and the rotgut. If the one who drinks water from the Dambovita does not depart anymore, it means that he goes to Belu’s garden as a young man. »<sup>18</sup>.

An important step is taken by Mihail Sutu, who builds « alimentary springs » at Cretulești and Crevedia-Giulesti ; they bore this name due to the fact that they could be used freely by everybody ; there was still one problem since people could only walk or use carriages for transportation. The majority preferred walking for financial reasons. That is why water carriers were vital since they would bring water to people’s gates.

This step is taken further by Gheorghe Bibescu who in 1846 founded new springs on the Mogosoia bridge which were alimented from the river but with water filtered through » wool filters »<sup>19</sup> ; soon the latter deteriorated and turned inefficient. In the second half of the 19th century, people tried alimenting the city with drinkable water brought through shingles made of burnt clay, which brought water from around the capital (Cretulești and Crevedia). But these services were restricted for the use of the Royal Court, of some monasteries and of a few boyards’ houses. When they had pipes installed, the fords were sealed, the water waggons (barrels) were filled from pumps installed near several crossroads<sup>20</sup>.

« Only in 1848, did Gheorghe Bibescu decide to start a project by the French engineer Marsillon in order to bring filtered water through pipes and to build around 50 springs (fountains) all over the city »<sup>21</sup> ; the number was dropped to 20 due to the lack of funds.

<sup>18</sup> <http://www.summitbucharest.ro/ro/66.html>, articol.de Luminița Ciobanu , *Povestea*

“Gârlei” din mijlocul Bucureștilor.

<sup>19</sup> Frédéric Damé, *op.cit*, p.211.

<sup>20</sup> <http://www.summitbucharest.ro/ro/66.html>, articol.de Luminița Ciobanu , *Povestea*

“Gârlei” din mijlocul Bucureștilor.

<sup>21</sup> George Costescu, *op.cit*, p.127.

Meanwhile, efforts were taken to provision the citizens with drinkable water. In 1847, a pipe which united Dambovită with the grand avenue, passing through Mogosoia, was inaugurated. Its purpose was to aliment some public fountains and a few private residences<sup>22</sup>. In 1861, the Town Hall allowed people to drag pipes in their yards in order to provision themselves with water from the capital's fountains<sup>23</sup>.

The first project for canalizing Dambovită was done during Alexandru Ioan Cuza's reign, after the 1864 flood, which scared the citizens. In 1879, the engineers Culman and Bürkly-Ziegler from Zürich and Lalanne from Paris were brought to examine the projects regarding the alimentering and the canalizing of the streets. Lalanne issued a report which showed that in 1879 there were 10,5 km of pipes, 41 public fountains, 188 private installations and 200 water outfalls; the daily water consumption raised to 1200 metre cubes for a population of 190.000-200.000 citizens<sup>24</sup>.

In 1880, using Grigore Cerchez's plans the basis for canalizing and rectification of Dambovită's course is finally settled; as well as for the building of modern installations for alimentering the city with water. The works were finally ended in 1883. The project was presented by the engineer Cucu and later concluded by the engineer Ilie Radu. The developments started in May 1899 and ended on September 17<sup>th</sup>, 1900 when water was given to the citizens, for consumption<sup>25</sup>.

The pumps in Bragadiru were activated by the electric plant in Cotroceni. The water extracted from the Bragadiru well, was of much better quality and became largely used for the city's provisioning<sup>26</sup>.

The development for alimentering the city with water is finally ended in 1901; unfortunately, it did not meet with the citizens' needs (270.000 citizens who would use 2170 liters per person). The water amount was insufficient for a large city like Bucharest, which lay on a large surface and had lots of private gardens as well as a few that were maintained by the local administration; such as the well-known Cismigiu. The gardens' city, as it was named by foreign visitors, did not suffer from thirst but from the lack of drinkable water for its people. There were 360 streets alimentered and 6.227 subscribers (prospects) in 1906.

In 1909, the city already had a network for water provisioning which exceeded 180 km; more and more houses, from the city centre, are linked to the new installations; the citizens in the suburbs still had to use water taken from the water carriers and collected from the wells<sup>27</sup>.

In conclusion, the most alarming aspect is the fact that people had to use water, for drinking and cooking, which was taken from the same places where animals and additions were washed, even at the beginning of the Contemporary Age. The water trade was a reality generated by the development of a city without any urban rules or financial resources for systematizing the streets and building an efficient canalizing network, necessary in order to serve the population.

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## LAS MENINAS - A POSTMODERN SYMBOL?

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**Abstract:** *Las Meninas*, a 1656 painting by Diego Velázquez, is a complex and enigmatic composition that raises questions about reality and illusion (Téophile Gautier, while in front of it, "wondered where the picture was"), and creates an uncertain relationship between the viewer and the figures depicted, affecting him in salutary ways.

This paper attempts at pointing out the rich collection of metaphors epitomizing several features of postmodernism hidden behind this famous painting. *Las Meninas* lends itself to a heterogeneous constellation of interpretations, without committing itself to any single interpretation.

**Key words:** postmodernism, illusion, reality, simulacra, mirror, collage, representation

The tremendous success attributed to M. Foucault's *Les mots et les choses* (*The Order of Things*) is due to two "plastic" moments which signpost the beginning and the end of his book. Our study will focus on one of them: the analysis of Velasquez's painting *Las Meninas* (*The Maids of Honor*).

During one of his voyages to Spain, at Prado Museum, a thought struck Foucault in front of Velasquez's *Las Meninas*, and the text brought about by this revelation took the shape of a monolog, a natural result of the debate initiated there, a sort of a preview of the uncorked topic, a "*mise en abîme*" (mirroring).

By analysing the terms in a classical **representation**, Foucault discovers, within it, the very essence of the *representation* which is the simultaneous absence of both the subject and the object.

The first chapter introduces Velasquez's painting as an excuse to dramatize the relationships between language and the visible, emphasizing the incompatibility between what is *seen* ("visible") and what is

The painter's hand seems to pause in the air for a moment or so, holding his paint brush which, a moment ago, reached the color palette. Foucault takes notice of the fact that the only source towards the visible in the

*told* ("dicible"). *Las Meninas* specifically pinpoints the empty place destined to the sovereign which is to be taken by man in the episteme of modernity.

Thus, Foucault seems to practice a sort of "nouvelle critique", envisaging the work of art as an abysmal and self referential one: *Las Meninas* is a painting about painting following the tradition of *illusiv space*. Here also the painter's set look perceiving beyond the frontiers of the space represented in the painting and touching the point reaching the lines formed by *menina*'s eyes, Dona Isabel de Velasco's, the nobleman's in the center (who is believed to be Don Diego Ruiz de Ascona) and Maribola's, the dwarf.

Foucault takes this point as the one in which the involved spectator remains, converging with the painter's point who watches and paints the represented scene as well as with the model's who is painted by the artist.

painting is the window opposite the painter's look through which light is let in. This light is indeed seen above the painting and seems to emanate from the interstice of the framework [1]

It is almost invisible, and the piercing light underlines it, even dissolves the contour of the characters, infant's hair and the vertical side of the represented canvas, as well as the model's place.

On the wall in the background there is the **mirror** which brings into focus but is ignored in the same time. It uncurtains the object the painter looks at and also fascinates the other admirers, including Don Nieto who, placed in front of the open door, seems to substitute himself for all spectators but also blocks out the reflection in the mirror by his dynamic corpulence.

The image in the mirror portrays the royal couple, King Ferdinand IV and Queen Mariana, both leaving the impression of posing for a double portrait (which has never been commissioned to Velasquez), and also watching their portraits being drawn (actually unrepresented by the painter) with the same amount of interest as the other participants. In an invisible, hidden reality, they function as the focus of attention and reference, and their reflection in the mirror is a compromised and ephemeral aspect of the represented scene.

Had the menina in the left corner - Dona Maria Augustine de Sarmiento - stood up (she knelt down), the ghostly sovereigns would have instantly been eclipsed, and the mirror would only reflect her carefully trimmed wig and the butterflies attached to it.

The mirror superposes the viewer and the viewed, the inside and the outside, and the whole gives the impression of instability, as if it happened accidentally, transiently.

In the bottom left-hand corners the inverted canvas is to be noticed; it will not reveal its contents, whereas in the right-hand corner the dog just gazes in the distance.

While the reflection in the mirror functions as the actual center of the painting, the visual focus is centered upon the young infant's head at the meeting point of the main compositional axes, bathed in the light flux and standing out because of the other surrounding meninas down on their knee. The intersection lines of her look and the royal couple converge in a point represented by the model-spectator, forming the acute angle of the painting.

This superposition is, however, annihilated within the represented scene by the three components: the painter, the model (in reflection) and the spectator (in the person of Don Nieto).

Within the "propeller - like volute" cycle of the representation which Foucault draws from the window to the careful look and the painter tools, the reflection in the mirror, the paintings hanging above the mirror, the spectator's look and finally back to the light which dissolves just about everything: the author's place and his substitute is defined by a void, an absence.

With Foucault, this absence is essentially human as the chasm in the cycle of representation reveals the impossibility of developing man's science within the classical episteme. In his own interpretation, Foucault builds up a triangular relationship between the painter, the image in the mirror and the man in the obscure background. These three elements are related as they are all representations of a reality within the painting.

Almost ten years later, John Snyder thoroughly scrutinizes Foucault's interpretation and his outcome is most surprising: the image contained by the mirror is not a direct reflection of the real faces of the royal couple (the model) as the perspective that had been created would cause the mirror reflect whatever was on the canvas lying on the easel. [2]

The image in the mirror is made up of small dots; it is not a clear image, being exactly the reverse of a reflection. Thus, one more element is added to the initial triangle, an element as important as the previous ones, in Snyder's opinion: the canvas.

It builds up a second triangle within Foucault's triangle, by making the latter more complicated to interpret and emphasizing the notion of paradox in Velasquez's representation.

The second triangle confuses the viewer even more through its multiple focus points, which are actually not real ones. *Las Meninas* becomes a genuine *hall of mirrors* under the control of Velasquez-the artist.

The new relationship between the real model and the mirror is facilitated by the canvas. The original model is reflected on the

canvas – painting within painting, picture in picture – its representation is reflected in the mirror. The small triangle modifies the original triangle. The canvas absorbs the most significant part of the painting, covering practically the whole vertical left margin of it and ingeniously hiding the room corners.

Unlike the other characters, the canvas does not “look” at anything/anyone and refuses to reveal its content. The representation of the model in *Las Meninas* becomes more and more complex. The canvas is a modified copy of the model (the king and the queen). The representation of the model in the mirror can be seen only from our perspective (the spectator’s perspective), not from the model’s perspective. In fact, the model looks at the mirror and sees nothing, while we can see the reflection of the painted model in the mirror. Nevertheless, none of these perspectives reveals the whole truth. We watch a scene in which the characters seem to watch us although they can not see us. Actually they watch the models – the king and the queen. They only appear to be watching us as we have the same position as the models. Outside the painting, the spectator meets both the painter and the model, but it is only a mere illusion. The three of them do not become one, they just superpose. The king and the queen in the mirror also watch, they watch themselves, their unrepresented images, just as everybody else watches them. The upsetting dimension (which forces the painter to step back in order to contemplate his models) and the position of the canvas prevent the models from seeing themselves. Ironically, it is only the mirror that proves the presence of the models.

However, the mirror is just an illusion as it does not reflect the reality. Moreover, it reflects an altered copy of the truth in the painting: the canvas. The presence of the models is certified by the mirror, though the canvas deflected from our eyes puts a stop to the direct relationship between the model and the mirror.

The only slice of real life reflected in the painting does not appear valid. The center of the painting seems to oscillate due to the multiple levels of form and meaning contained within the painting.

Both illusion and real life merge, becoming one more convincing than the other, up to the point where there is no perception of the truth whatsoever; it is only part of the illusion, the outcome of it.

So, we are dealing now with a **simulacrum** of reality. The analysis undertaken by Snyder and Cohen (the mirror does not reflect the hypothetical model, but rather a portion of it represented on canvas) is corroborated by Jonathan Brown who is convinced that the image in the mirror reflects the greater canvas on which the artist is working.[3]

The image in the painted mirror is strangely ambiguous. Its frame makes it easily mistaken for the other paintings clinging to the wall, nevertheless the shining line surrounding its margins and its bright surface indicate its purely optical status.

The image is intended to be “read” backwards: the red curtains seems inappropriately placed in the top right-hand corner when it should have been put in the top left-hand corner just as in the case of other paintings by Velasquez, such as *Portrait of Balthazar Carlos* or *Las Hinderas*, and finally the place of the king and the queen (in the right and respectively left side, in the reflection) when it was a customary painting technique to “read” from left to right, according to the hierarchy.

All these details suggest a reversed artistic composition, typical of optical representation devices such as the mirror. Foucault chose this painting to illustrate the episteme of representation in terms of order, simultaneity, clarity, taxonomy: the episteme of representation is essentially spatial, a geometric representation.

To Foucault, this artistic creation is the only one where the *signifier* (“signifiant”) is the *signified* (“signifié”).

*Las Meninas* functions as a sign about signs, a meta-sign which operates by describing itself. It launches the exterior viewer the invitation to take the painter’s place, it addresses the meta-subject. The subject is seen as the author, it produces significance.

A series of 58 interpretations of this painting, and figures from it, have been painted by Pablo Picasso in 1957, and in 1973

Richard Hamilton made a **collage** called *Picasso's Meninas* drawn on both Velázquez and Picasso.

When Picasso was getting ready to start his Velázquez variations in the late 1950s, Velázquez's masterpiece *Las Meninas* was nearing its three hundredth birthday. It is an enormous oil canvas painting measured 76 3/8" by 102 1/4", horizontally oriented on the canvas (unlike the Velázquez's original) and painted in a grisaille (gray) palette that projects a dark and haunting image. Picasso retains the striking visual effect of the infanta tended to by her numerous maids of honor. He retains Velázquez's depiction of the infanta with the white dress that forces the child to be the eye of the storm in this whirlwind of people and events. One can also see the King and Queen in the mirror behind the painter albeit in an almost comical expression not seen in the original. Yet, the visual space of the palace room has been compressed into a cacophony of cubist shapes. Some of the maids and especially the dog below the infanta are completely devoid of any detail save a black outline. Picasso has also shifted some of the figures in the paintings in an almost deliberate attempt to further distance himself from the Velázquez's original. The painter (presumably Picasso's depiction of himself a la Velázquez) depicted on the left side of the painting is the most chaotic figure in the painting, while in the original Velázquez painting, the painter is the most ordinary figure. In the variation, all of the lines used to draw the painter lead towards a central point in the middle of the figure. The exterior image of the painter bleeds into the surrounding area. It is as if the painter does not really exist there at that moment and is only a blurry figment of imagination. Picasso also alters one other major figure in his variation - a figure that many art scholars have suggested holds the key to Velázquez's intention with *Las Meninas*.

A striking difference in Picasso's variation is the increased visibility of José Nieto, the Queen's chamberlain. Picasso, looking on *Las Meninas*, once said, "The door José Nieto holds open suggests the entrance of fascist soldiers into the studio of Velázquez

with a warrant for his arrest." Nieto, who is almost an afterthought to the unobservant viewer in the original (but definitely not placed there as an afterthought by Velázquez), has been altered by Picasso into a menacing figure contrasted by his dark figure and the light background behind him. Nieto's position in this variation has also been altered slightly to be directly above the child. It is now impossible for any viewer to ignore Nieto. The eyes are immediately drawn to him. His shadow casts a direct light over a substantial part of the painting. Picasso forces us to ponder questions about this mysterious dark figure. Is he a friend or foe? Is he coming or going? Why does he have no detail at all? But, we do not have enough information to make even a futile attempt at answering these questions.

All of these distinctions from the original Velázquez painting are relatively minor when we consider that the most important quality of the Velázquez original is lost - the aspect of being right there at that moment in that room. By use of the Cubist motif, Picasso severs that tie with the audience. Velázquez's highly realistic painting makes you feel as if you were right there, but with the chaos portrayed by the cubist figures, this feeling is lost. The viewer now feels distant from the events portrayed in the picture. We can no longer relate to the infanta with all of the maids of honor surrounding her.

However, back to Velázquez's painting some features can be grasped: Perspective. Multiple perspectives. Meta. About painting. About the act of painting. Velasquez paints Velasquez. But *This is not a pipe*. This is not Velasquez. Are we, the audience, looking at the painter painting us? Or, does our vanity blind us and prevent us from seeing that it is the king and queen of Spain in that mirror, not you? Mirrors. Pictures within pictures, plays within plays within plays. All is vanity as the Infanta Margarita tires of being painted. So tired that they have to bring in her court dwarves to keep her in the picture. Is Velasquez mocking the royal family, mocking their pride? He may have wanted us to talk about this mystery for centuries, just like Joyce wanted us to talk about *Ulysses*. Finding

something new each time we gaze at it. The structure. The composition. The light. Dig up all of the gossip on the royal family. Entertainment Tonight. So can we talk about the dawn of the Enlightenment and the precursor of the postmodern? All in all, it is perhaps first **post-modernist** painting, well before the period assigned to that name.

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## PERSONALITY CORRELATES PROMOTED BY MILITARY SERVICE AND CAREER

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**Abstract:** *The present study was carried out in 2005-2006 on 140 soldiers in military service -at the beginning and at the end of their training stage- and 126 commissioned officers in the army who belonged to two categories: contract officers and career officers. The objectives of the study aimed to grasp -through specifically psychological instruments (tests of intelligence, self-esteem, personal efficacy, sex-role, anxiety, together with a multidimensional questionnaire of personality) - the effect of military instruction on soldiers during their military service, the differences between them as trainees and their trainers, as well as the differences between the category of career officers and the category of contract officers. The drawn up hypotheses stipulated both positive and negative effects on soldiers' training during their military service and also a close level of aptitude and personality characteristics for the two categories of military professionals, with a plus for the career officers.*

**Key word:** *soldiers during their military service, commissioned officers , organizational socializing, personality correlates.*

### 1. Introduction

The present study was carried out in 2005-2006 on a number of 264 subjects, out of which 140 were soldiers during their military service and 124 commissioned officers. The main idea of the study is to compare, taking into account several criteria, the two categories in order to grasp the proximal gender and their specific difference.

Although army is a special type of organization, defined by specific values and behaviours, the process of organizational socialization must have characteristics which are common to other types of organizations. Thus, the phenomenon through which the specifically military values, attitudes and behaviours are passed on to the soldiers in their military service must comply with the rules of “organizational enculturation”, due to which a professional Ego, different from the intimate Ego, is developed. This phenomenon of “structural duplicity” (Luca, 2003) may be favoured in army by the active organizational resistance which the young soldiers put up to the process of enculturation during their military service, especially during the first

stage. This phenomenon appears as a consequence of the pronounced disparity between the sets of values and behaviours which civil society and military-type organization promote. One of the major sources of inadaptability to military background comes from the fact that in army complying with norm must be unconditioned, some traits of personality (independence, autonomy, assertiveness, Ego self-promotion) being severely censored in favour of developing stress resiliency, capacity of unconditionally executing orders, efficacy in individual action and especially in group action, while in civil life adaptation is conditioned by differentiating and individualizing the Ego (Jung), developing all personal resources in order to cope successfully with the current life necessities. In this case success is decisively conditioned by developing a collective personality that builds skills of action and fight in accordance with the proposed standards which are practiced during the period of instruction. Facing these pressures, the intimate Ego can remain an “inner redoubt” destined to counterbalance the pressures perceived as

leveling agents which erase individual differences, which give little room to free manifestations and personal creativity, which leave aside the person that is seen just as a statistical individual or as the perfect performer of some missions with which the soldier identifies himself more or less.

However, the benefits gained in the course of the soldier life seem to be unquestionable which is a proof of the great social prestige the institution of the Romanian army has always rejoiced of and which has been materialized in current perception. According with that, he who has done his military service has passed an important maturity test because military service has made him prepared for the rigour of adult life, for fully participation at social life, for setting up a family. Our research is an attempt destined to clarifying the changes produced by military service for soldiers who are put to a double comparison: in order to grasp the meaning of the changes that appeared during the months of military service, we compare, using the same instruments, the group of soldiers in the first stage of training with the group of soldiers in the third stage. On the other hand, we compare the soldiers in military service with the commissioned officers, who are agentive elements that have to bring about the change from common soldier to commissioned officer. A third analysis is possible, within the third category mentioned above, through comparing, the military people who are career officers with the contract officers during a certain period of time.

## 2. Hypotheses of survey

1. In the comparison career officers – soldiers in military service, there are expected significant differences in favour of the former category, both on aptitude level (intelligence) and on the level of some personality features (ascendance, self-discipline, conscientiousness, perseverance, self-esteem etc.). This superiority of being an officer comes from two conjugate sources: on one hand, from the plus of maturity due to age and experience (confused variables which can hardly be separated in our survey) and, on the other hand, from the direct formative effects of

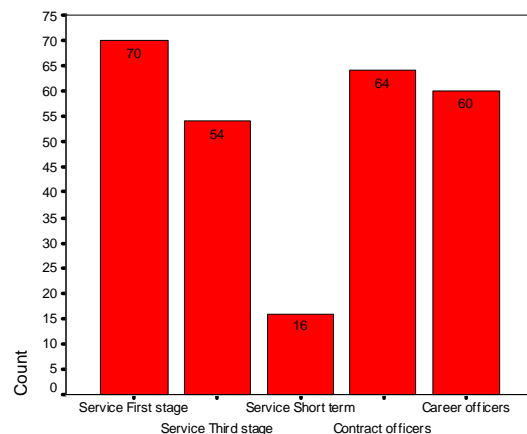
military-type institution and education. The importance of this ascendant is extremely big because career officer represents the value and competence pole towards which both the soldier during his military service and the contract officer aim.

2. The process of organizational socialization will be better outlined for the career officer and contract officer than for the soldier during his military service, by virtue of more extended time of organizational socializing and the former category representatives' deeper adherence towards the military organization values and behaviours.

3. The effects of military service for the soldiers will be contradictory because their adapting to the military background will reduce a part of the initial stress and anxiety, as a consequence of rising their feeling of competence and personal efficacy through taking possession of practiced skills and capacities. In the same time there can also appear phenomena showing resistance and structural duplicity, namely a lower level of self-esteem, a stronger feeling of suspicion and accentuation of the masculinity exigencies of sex-role.

## 3. Sample

The structure of our sample is presented below.



**Figure 1.** Subjects distribution on the five categories that were regrouped in soldiers during their military service and military professionals, each group having two subcategories.

The smallest and in the same time the least representative number of subjects is the one of

the soldiers during their short time military service (16), who were included in the survey because they belonged to the respective military establishment at the moment the survey was carried out. They will be included in the category of soldiers during their military service in order to make the comparison with the military professionals as a group. Each of these two groups will allow us to make two intra-categorical comparisons. The former is between the soldiers in the first stage who, being at the beginning of their military service, are still preserving the values of the civil society they come from and the soldiers who are towards the end of their military service (the third stage) and for whom the new organizational values and behaviours have already started to be outlined. The latter comparison is made between the career officers, who have a complete route of military training, behind their back, which started early at the adolescence age, and the contract officers whose adherence to the values, behaviours and capacities of military organization will be strong enough but not of the same intensity like the one of the career officers. They are the ones who could represent the necessary buffer between the military austerity and the values of the civil society they come from.

#### **4. Instruments that were used**

We used a lot of psychological instruments in our research.

1. **Bonnardel 53 Intelligence test (B 53)**, consisting of 65 items, with an applying time of 15 minutes. It requires abstract inductive-type reasoning to a great extent, necessitating a good analytical capacity, clear thinking, ability of detecting dynamic relations in the matrices of elements arranged in line. It is a test that is strongly saturated in g factor and a good measure of nonverbal intelligence which is in fact the reason it was included in the battery for.

2. **Cattell's C Anxiety test**, consisting of 40 items which give a suggestive expression to the measured construct. Cattell introduced the difference between anxiety as a feature and anxiety as a state; the former is found in the test as veiled anxiety while the

latter is found as manifest anxiety. To each of these forms, which combined offer a good indicator of a person's general level of anxiety, there contribute five factors of personality which are the Ego Force (factor C), Paranoid Suspicion (factor L), Worried Suspicion, Culpability (factor O), Self-discipline (characterful self-control and stability, factor Q3) and Straining, contracting (highly ergic tension, factor Q4).

3. **16 PF Cattell test**, which contributes to outline a comprehensive profile of personality composed of 16 independent dimensions that are included in an indicator or Universal Index (UI).

4. **Cliniciu Questionnaire of Self-perception (PS)**, consisting of 30 bipolar items which give expression to a negative component and also a positive one of self-esteem, out of whose game the general level of this indicator is outlined. The questionnaire has a good inner consistency (alpha Cronbach is 0.94), in spite of the fact that the factorial analysis made evident the existence of three factors that composed global self-esteem, namely attitude towards risk, decision facility and personal self-assessment. In this research we used only the negative, positive and total components of self-esteem.

5. **MEE, namely Mehrabian-Epstein Questionnaire of Empathy**, consisting of 30 assertions that have to be scored on a scale from -4 to +4 and which is defining for the level of a person's empathy.

6. **Sherer Questionnaire of Self-efficacy**, consisting of 23 items that are positively scored on a Likert scale from 1 to 4 and give expression to the feeling of personal efficacy. As a rule, the high self-esteem and empathy function conjugately, being strongly inter-correlated, and we therefore chose to include these two instruments in the battery.

7. **BSRI, namely Bem Sex-Role Inventory**, which is an instrument through which there are picked up information for a masculinity scale, for a feminineness scale and a social desirability scale having a distractor role. According to Bem's theory, in the contemporary western society androgyny is desirable because it assures a more flexible fulfillment of social roles. In military

institution – which is highly masculine through its essence – it is supposed that it is not androgyny but exacerbation of masculine dimension which assures a better adaptation to an organization requirements in which activism, confrontation, aggressiveness and harshness are the essential attributes.

8. Mini-questionnaire of **factual data**, including the demographical data which are necessary to statistical processing.

**5. Results**

*a. Comparison: beginning and end of*

*stage of the soldiers during their military service*

Being a quasi-experimental (the compared categories are naturally made up and not through a random selection) study, we have to make clear that the independent variables are the beginning and the end of the training stage for the soldiers during military service, while the dependent variable represents its effects on some indicators of personality and attitude, as they are summarized in the table below.

	Group <sub>1</sub>	N <sub>1</sub>	Mean	St. Dev.	Difference	Student	Signif.
	Group <sub>2</sub>	N <sub>2</sub>	x	σ	Δ = x <sub>2</sub> -x <sub>1</sub>	t	p
	Stage 1	70	16.17	4.86			
	Stage 3	54	14.78	4.10			
	Stage 1	70	13.96	6.26			
	Stage 3	75	12.52	5.61			
	Stage 1	70	30.17	8.97			
	Stage 3	54	27.30	8.50			
	Stage 1	70	4.50	2.60			
	Stage 3	54	3.44	2.04			
	Stage 1	70	8.91	3.61			
	Stage 3	54	7.15	3.35			
	Stage 1	70	-11.90	8.62			
	Stage 3	54	-16.70	9.79			
	Stage 1	70	38.66	16.56			
	Stage 3	54	38.33	14.28			
	Stage 1	70	27.07	23.15			
	Stage 3	54	21.33	22.35			
	Stage 1	70	8.51	16.39			
	Stage 3	54	20.59	22.58			
	Stage 1	70	81.93	11.20			
	Stage 3	54	87.33	10.60			
	Stage 1	70	2.50	1.83			
	Stage 3	54	3.52	2.08			
	Stage 1	70	6.03	1.53			
	Stage 3	54	6.59	1.76			
	Stage 1	70	4.89	1.88			
	Stage 3	54	6.00	1.72			
	Stage 1	70	5.27	2.34			
	Stage 3	54	6.15	2.47			
	Stage 1	70	4.79	2.47			
	Stage 3	54	3.96	1.91			
	Stage 1	70	6.00	1.59			
	Stage 3	54	5.27	1.72			
	Stage 1	70	26.94	9.65			
	Stage 3	54	31.48	10.99			

Figure 2. T test for independent samples to variables in the tests we used.

As anticipated, some variables of our study indicate alterations with adaptive value as a consequence of attending the military service. Thus, the level of anxiety expressed by Cattell's test C has a decline which, although it does not reach the statistical significance threshold, shows a decrease of the general level of anxious tension as a result of a better adaptation to the needs of the military institution. The main contributors to this phenomenon are factors C (Ego force) and factor O – Culpability and insecurity, whose decreasing must be parallel with acquiring the necessary skills in order to perform desirable behaviours. Important adaptive alterations are also the ones in connection with the rise of the general level of empathy:  $t(70.54) = 3.45$ ,  $p < .01$ , indicating a better capacity of cognitive and affective transposition of the soldier during his military service to his superiors' necessities and expectations, but also the effect of the collectivism that is supposed by achieving his orders. In accordance with these alterations, the general level of personal self-efficacy (Sherer) is much higher at the soldiers in the third stage:  $t(70.54) = 2.73$ ,  $p < .01$ , and also their general resolute capacity (factor B from 16PF):  $t(70.54) = 2.39$ ,  $p < .01$ ; the score at the test B 53:  $t(70.54) = 2.44$ ,  $p = .01$ , or at courage (factor H from 16PF):  $t(70.54) = 1.95$ ,  $p < .05$ . Yet these broad adaptive alterations are not positive on all personality dimensions of the soldier during his military service. The soldiers in the third stage have a significantly bigger level of emotional dependence as compared to the ones in the first stage (factor I):  $t(70.54) = 3.40$ ,  $p < .01$ ; a higher level of nervousness and paranoiac suspicion (factor L):  $t(70.54) = 2.02$ ,  $p < .05$  and a lower control of general emotiveness:  $t(70.54) = 2.44$ ,  $p = .01$ . Therefore we can identify two distinctive categories of phenomena, some of them

representing, when we speak about behaviour, the answer to the beneficent effects of the military instruction, where the acquisition of specific skills and knowledge makes easier the task of managing to successfully deal with solicitations and of coping with the stress caused by solicitations. Another tendency, that might explain many paradoxical effects which end in severe incidents that occur towards the end of the military service, is the result of frustrations storage, strengthening the emotional dependence and the general control of emotiveness, phenomena that should be taken into account especially by the strategies of preventing stress or human accidents with baneful results.

**b. ANOVA for soldiers in military service, contract officers and career officers**

It is expected that variance analysis should make evident extremely significant differences between soldiers during military service, contract officers and career officers, because these categories have different statuses, different ages and very different levels of education and training. If the soldiers in military service were not chosen after specific criteria, the military service being compulsory at that moment, the military professionals who trained them were thoroughly selected when admitted into the system; they attend long training stages and accomplish the solicited activities due to rather their vocation than to obligation and their activities are paid adequately. They represent the value vectors of the military institution, their basic mission being the professional enculturation of the young people that are recruited in accordance with this set of values. We briefly set forth only a cutting out of the multitude comprising these differences between them and those who train them.

<b>Variable</b>	<b>F</b>	<b>P</b>
B 53 Intelligence	37.46	< .001
C Global anxiety	36.52	< .001
PS Self-esteem	28.79	< .001
Sherer Self-efficacy	40.78	< .001

BSRI Social desirability	38.36	< .001
BSRI Masculinity Feminineness	15.90	< .001
16PF Anxiety-Adaptation	29.26	< .001
16PF Introversion-Extraversion	8.75	< .001
16PF Emotiveness control	12.51	< .001
16PF Independence	20.38	< .001
Age	141.05	< .001
Background	22.16	< .001
Studies	173.47	< .001

Figura 3. ANOVA test for soldiers in military service, contract officers and career officers.

The differences pointed out between the first category and the other two categories are significant at extremely high statistical level and on a large front, namely at nearly the most study variables. An important contribution to these differences is also brought by some significant demographic variables because the military professionals (the contract and career ones) have significantly older ages and therefore more mature experience levels; in a much greater extent they come from urban areas and have an incomparably higher level of studies. That is why it is not surprising that the significant differences are so huge. The highest values of F are the ones that come from holding the instrumentation necessary to adapt and impose the values of military organization, which confers the military professionals a very strong feeling of personal efficacy ( $F = 40.78$ ), a bigger respect of social desirability ( $F = 38.36$ ), a higher lever of general intelligence ( $F = 37.46$ ), as well as decreasing the global level of global anxiety ( $F = 36.52$ ), which is a sign of full integration into the military-type organization. For almost all the investigated variables that give significant differences, these are marked only for the first category – soldiers in military service –, compared to the other two categories, contract officers and career officers. Between these two categories there are differences, usually in favour of the soldiers during their military service, but they rarely reach the level of statistical significance. This means that, despite their different training routes, the contract officers represent an extremely useful professional category because, although coming rather from civil

society, the process of organizational socialization is complete and ended, and they can be relied on in the same extent the career officers can.

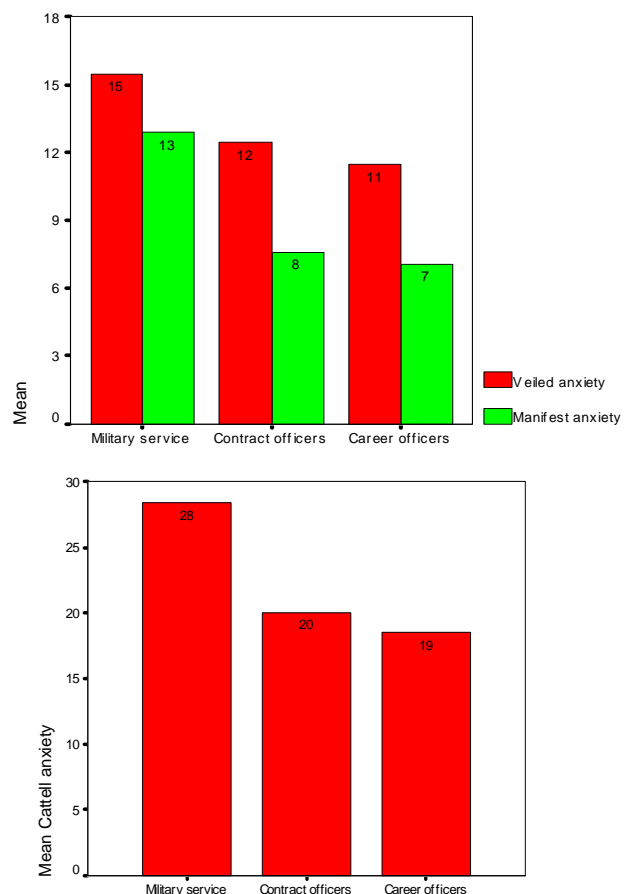


Figure 4. Graphics with levels of anxiety for the three categories

The above graphics points out the fact that the levels of global, veiled and manifest anxiety are much higher at the patients of training action than at the agents of this activity but they are extremely close between the contract officers and the career ones.

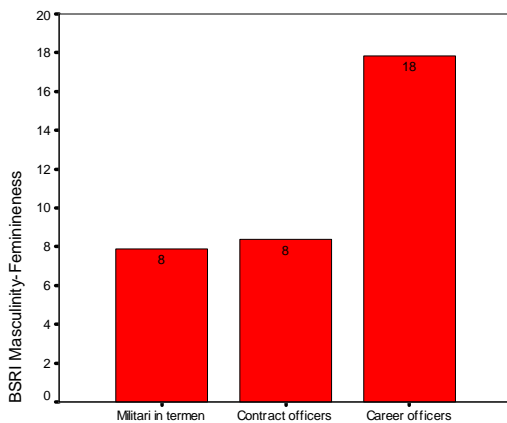
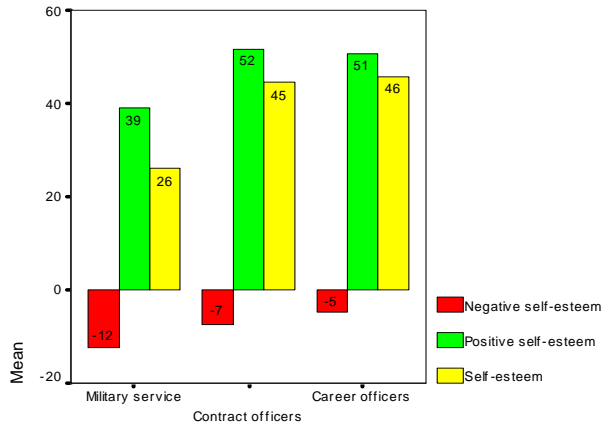


Figure 5. Graphics regarding self-esteem and difference Masculinity-Feminineness from BSRI

The value of mean regarding self-esteem corresponds to the medium value found in the basic population which the PS test was developed and standardized on but it reaches very high values for the military professionals where, as a matter of fact, there are not differences between the contract ones and the career ones. In conclusion, the status of a military professional is extremely high, conferring the feeling of a very high personal and social value to those involved. On the other hand, the fact that military organization exacerbates the values of the masculine status is proved especially by the career officers, while the contract officers preserve a ratio masculinity-feminineness that corresponds to the soldiers in military service or the masculine representatives of civil society. Maybe this is one of the elements that make this category be ideal mediators between the values of military organization and civil society, whose representatives are formed through the institution of army.

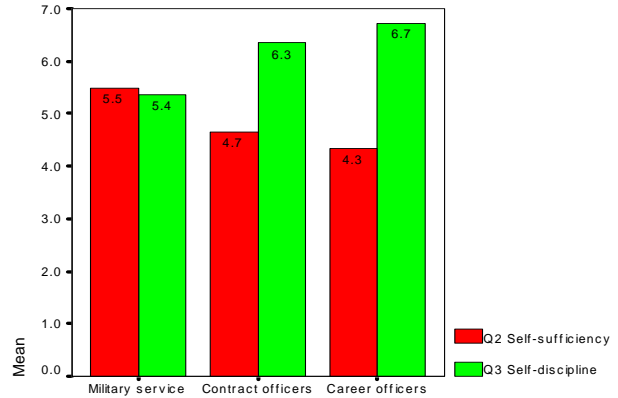


Figure 6. Graphic with the evolution of factors Q2 and Q3 from 16PF Cattell.

The above graphic also presents differentiated effects for all the three categories we analysed, the feeling of self-discipline (auto-discipline, constancy and characterial stability, defining for factor Q3) being progressively higher from one category to another, while group dependency in making decisions (factor Q2) is stronger for the category of soldiers in military service.

## 6. Conclusions and discussions

Reorganizing the military institution and renouncing at the compulsory military service represent basic changes in organizing the Romanian army. Giving up the communist doctrine of the entire people's war moves the centre of weight from the large and indistinct training of a big number of soldiers in military service to a number of people who of assume adhesion to the values of military-type organization with their own accord, through a contract and for long. Being selected after criteria of compatibility with the requests and values of the organization they adhere to by their own accord, their development must be carried out in accordance with rules adequate to the new conditions, thus being more efficient and focused on specific objectives. Under these circumstances the balance between the positive effects and the negative ones that are signaled – through the present study – to have appeared between the beginning and the end of the training stage is probably more strongly inclined in favour of the positive effects. The process of organizational enculturation is expected to be

more pronounced and the distance between the professional Ego and the intimate one will probably be smaller.

Studying these suppositions requires a new survey achieved according to a similar design. To sum up, our study makes evident a multitude of positive effects of the nature of developed competences, cognition and of instrumental order, counterbalanced by less desirable effects when we speak about

controlling general emotiveness and self-esteem. The solution of appealing to hiring officers through contract seems economical and viable because, although these employees do not meet the career officers' standards of training at all levels, they offer a reasonable solution for the staff problems of the military institution, in the same time being a "buffer" between the values of civil society and the army's values.



## RECIDIVIST'S CORELLATES OF PERSONALITY

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**Abstract :** *The present study was carried out at Codlea Penitentiary in 2008 and it included 82 male recidivists with ages between 22 and 74. The control group had 40 men with ages between 21 and 68. The correlational survey was based on several psychometrical instruments (Clinciu Questionnaire of Self-esteem, Rockeach Questionnaire of Values, Längle Questionnaire of Existential Sense, Questionnaires of impulsivity IVE of Eysenck and BIS-10 of Barratt), together with a questionnaire of factual data. The data analysis was made according to the recidivists – control group criterion and also according to the criteria parents' studies, sentence length of time and age factor. The drawn up hypotheses are supported by the research data which reveal significant differences on a multitude of recidivist personality dimensions. The general conclusion is that the recidivist delict behaviour has a distal causality (level of culture and socio-economical level of the origin family) and a proximal one in which self-esteem, value horizon and capacity of giving sense to the own existence play the fundamental explanatory role.*

**Key words:** *recidivists, self-esteem, existential sense, values.*

### 1. Introduction

The interest of psychology for the area of human delictness is profound and for long time, which has brought about setting up new distinct domains (judiciary psychology or forensic psychology), because infringement of law, through its high potential of social noxiousness, stimulates not only the need of delinquent's understanding but also the need of developing adequate methods and techniques of intervention and recuperation. As a specific form of delinquency, recidivism presumes repeated relapse into crime (at least twice) by the same person. Relapsing the infringing activity after a definitive sentence for a previous offence draws psychologists' attention on some features of structuring the delinquent's personality and also on the difficulty in mending infringing behaviour through common procedures which the law makes provision for.

There are many forms of recidivism (general and special, relative and absolute, temporal or everlasting, territorial or international etc.), but the categories that are most often taken into account for analysing are

the post-conviction one and the post-execution one.

What draws the attention on psychological malignity of recidivism is that prison, as an institution of social punishment and recuperation of criminality, appears – in the case of infringement of law – as an institution of learning and specialization in the “art of crime”. Some of the criminal “blows” have long been mentally deliberated, premeditated and practised during the detention time, very often with the concurs of some experienced infringers of law, turned into ad hoc mentors at the crime school. Chances of reducing criminality often come from the relations field with significant others, affective investments of long time in family, education, career and future or from authentic adherence to reference values (especially ethic and religious). Chances of perpetuating and refining the criminal behaviour are bigger for certain types of personality or for certain socio-economic contexts such as the ones marked by the values crisis, unemployment, poverty or moral anomaly.

Early diagnosis of risk factors for

delictness, criminality and recidivism is a preventive measure of first order because due to it we can determine psychological, economic, cultural and social factors which, separate or together, predispose towards this type of antisocial behaviour. In the same time, the effects of freedom privation through incarceration can significantly erode the feeling of self-esteem, personal value, value of own life and of peers. The behaviour of integration and adaptation to prison itself has disputable effects to the extent in which complying with the freedom-deprived treatment makes that penitentiary environment should be the only well known environment the prisoner disposes of necessary adaptive reserves for. Repeating the offence can occur in this case not only as a wrong use of freedom regained after atoning for a first punishment, but also as a coming back place, the only “home in the world” the prisoner still holds.

The present study was carried out at Codlea Penitentiary in 2008 and included 82 male recidivists with ages between 22 and 74. The second group, which plays the role of control group, comprises 40 men with ages between 21 and 68. Although creating paired groups was tried according to several criteria (age, sex, level of studies and vocational training), their equivalence degree is relative. The group of delinquents is “naturally” constituted, its approaching rising no special selection problems at all, just problems of motivation for taking part in the survey. The problem of the control group can be better solved through subsequently enlarging the group up to a number which should be equivalent with the group of delinquents, taking into account the already mentioned criteria.

The tests selected in the battery were applied collectively, in small groups, where it was possible and where the instruction level was very low the questions were read by an authorized operator who wrote down the answers on the test paper. The procedure being hard, a special attention was given to motivating the subjects in the penitentiary by offering them small verbal or material bonuses (chocolate, cigarettes). The recidivists took a great interest in the survey for which they

manifested an authentic wish of involvement.

## **2. Hypotheses of the survey**

- 1 The general hypothesis of the present study is that there are significant differences at the level of psychological factors (impulsivity, adventure seeking, empathy, self-esteem, capacity of existential sense, value horizon etc.) between the control group and the recidivists group.
- 2 Besides the mentioned psychological factors, there are background factors and demographic variables (age, instruction level, marital status) which are directly associated with recidivist behaviour.
- 3 The sentence length of time and the number of offence repeating are directly associated with the above mentioned categories of psychological and demographic factors

## **3. Instruments and methodology of the research**

### **1. Barrat -10 Scale of Impulsivity**

One of the causal factors most often evoked in criminal behaviour is primarity (in terms of the French-Dutch school) which consists in the tendency towards quick action, without deliberative strategies and without anticipating consequences. Therefore, we can speak about a factor of impulsivity which is based on a level of highly autonomous excitability and which is doubled by the very low capacity to postpone behaviours gratifying and the lack of inhibiting behaviour. According to the model of behaviour inhibition proposed by Gray, an activating system (BAS) is associated with behaviour initiation which is to be rewarded while an opposite system (BIS) develops elements of suppressing behaviour in order to avoid punishment. So, we essentially talk about an antagonistic system BIS-BAS that consists in seeking pleasure and avoiding suffering, which – with the people who have a tendency towards delictness – is unbalanced in favour of the exciting and gratifying branch (BAS). This is one of the reasons for which I selected Barratt-10 Impulsivity Scale as an instrument

of investigating the recidivist criminal personality. It measures three components of this personality, namely motor, cognitive and unplanned impulsivity.

2. **Eysenck Questionnaire of Impulsivity (IVE)** was included in the research in order to have a more suggestive image on impulsivity because, besides this dimension, it also comprises Seeking adventure and Empathy, factors which are supposed to be linked with delictual behaviour.

3. **Cliniciu Questionnaire of Self Perception (SP)** justifies its presence in the battery due to the need of determining the alterations of self-esteem which recidivist delinquents have and which might be emphasized in accordance with the sentence length of time and the severity of their infringement. The scale consists of 30 bipolar items which give expression to a negative component and a positive one for self-esteem, out of whose game the general level of this indicator is finally outlined. The questionnaire has a good inner consistency (alpha Cronbach is 0.94), in spite of the fact that the factorial analysis separated the existence of three compound factors of the global self-esteem, namely the attitude towards risk, facility in decision making and personal self-assessment. In this research there were used only the negative, positive and total components of self-esteem.

4. **Längle Scale of Existence (SE)** was selected as a psychological instrument in order to go thoroughly into the supposition that criminals, and especially recidivists, have a low capacity of giving a sense to their own existence and of bringing it into accord with the world of the values. According to Längle's theory, the master mind of existential analysis and descendent of Frankl's logotherapy, the authentic fulfilment of life supposes successfully covering four steps representing an individual's ability of giving sense not only to his/her own person but giving sense to the world he/she lives in. The Scale of Existence SE is developed on two major categories, Person and Existence, the former is compound of the factors Self-

distance and Self-transcendence, the latter on Freedom and Responsibility. Although it is known in advance that the scores for the Scale of Existence are highly dependent on the general educational level, its selection in our battery was especially imposed by the need of verifying the problem of the relationship between the criminal behaviour severity and the capacity of existential sense, as well as the need of differentiating between categories of recidivists with regard to the sense of their existence.

5. The necessity of including **Rokeach Questionnaire of Values (RVS)** in the battery was imposed by correlating recidivist criminal behaviour with the value horizon, which is closely connected with the capacity of giving sense to own existence. The questionnaire consists of 18 terminal values, namely goal of existence values (comfort, liberation, pleasure, freedom etc.) and of 18 instrumental values (means through which the ones in the former category can be reached, such as ambition, capability, large horizons).

6. **Questionnaire of factual demographic data** is destined to grasp the dimension of socio-economic and cultural status of the recidivist personality. This leads not only to enlarging the explicative possibilities, by including the background elements that are necessary to his/her understanding, but also offers statistical categories that are necessary to a more analytical processing of the resulted data.

#### **4. Results of the survey**

The data processing was made according to two major criteria: the former was applying the T test to independent samples in order to make the comparison between the control group and the quasi-experimental group of recidivists; the latter was ANOVA test for three categories of recidivists obtained by splitting into three the sentence length of time. Initially, I tried this splitting to be made according to the severity of the delict, but the criteria after which the legislator works give few opportunities of coherently ranking the norm deviations in

accordance with their degree of severity.

The most significant results obtained after the first criterion of analysis are summarized in table 1 below. The data in this table clearly confirm the causal hypothesis of impulsivity as a major element in releasing the recidivist behaviour: the differences between the control group and the experimental one do not reach the statistical significance level at any subscales of the two questionnaires of impulsivity that were applied. The exception lies only in the empathic behaviour, dimension that is found again significantly smaller at the group of recidivists:  $t(82.40) = 1.98, p = 0.05$ . But an explicable element that is available for the recidivist behaviour is that of a very low self-esteem which makes recidivists perceive themselves as unimportant persons, with no value:  $t(82.40) = 2.53, p = 0.01$ . We notice a remarkably eloquent thing: it is not the positive component of self-esteem which is affected (it is completely comparable with the control group), but the negative one, self-depreciative, which makes stronger the idea of eroding capacities of decision making, of correctly assuming the risk and of favourable self-valuing:  $t(82.40) = 4.10, p < 0.001$ .

Länge Questionnaire of existential sense (SE) also differentiates very significantly, on the whole the scores are much

smaller for the recidivists:  $t(82.40) = 2.16, p = 0.03$ . They obviously have a significantly decreased capacity of giving an existential sense to the own life, being carried away by fate without aiming at a higher goal or ideal. More analytical, the Person category differentiates significantly statistic compared to the Existence category. From the former category, self-transcendence has a very low level at the recidivists, signifying their difficulty of getting distanced of themselves, in the decentre sense, in order to have an objective view on the world. Among the factors of the Existence category, only the Freedom factor gives significantly smaller scores than at the control group:  $t(82.40) = 1.96, p = 0.05$ . The Responsibility factor, which also records smaller scores at the recidivists, does not give significant differences with the control group.

An incursion in the world of Rockeach values indicates important particularizations according to the analysed criterion. Thus, the recidivists give a share that significantly statistical is more important to freedom and wisdom as terminal values, and to ambition, pureness or forgiveness as instrumental values. Specifically, the control group prioritize inner harmony as terminal value and the fact of being intellectual as instrumental value.

	Group <sub>1</sub>	N <sub>1</sub>	Mean	St. Dev.	Difference	Student	Semnif.
	Group <sub>2</sub>	N <sub>2</sub>	x	σ	Δ = x <sub>2</sub> -x <sub>1</sub>	t	p
	Recidiv.	82	-23.46	11.91			
	Control	40	-13.53	13.78			
	Recidiv.	82	41.99	17.47			
	Control	40	45.75	20.25			
	Recidiv.	82	18.20	27.36			
	Control	40	32.23	31.20			
	Recidiv.	82	26.90	6.23			
	Control	40	28.30	7.13			
	Recidiv.	82	57.98	10.07			
	Control	40	63.63	8.63			
	Recidiv.	82	42.73	8.15			
	Control	40	45.88	8.77			
	Recidiv.	82	50.74	11.13			
	Control	40	53.45	13.55			
	Recidiv.	82	84.88	14.15			
	Control	40	91.93	13.85			
	Recidiv.	82	93.48	17.31			

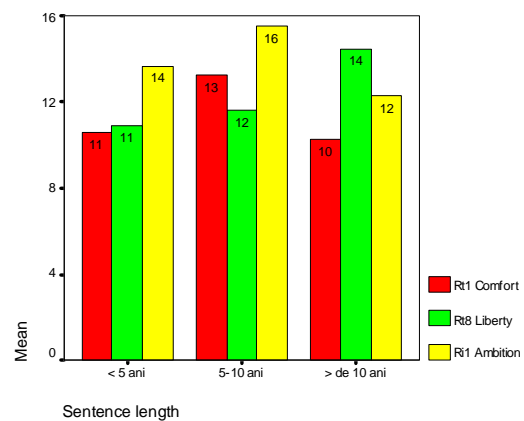
	Control	40	99.33	21.68			
	Recidiv.	82	178.35	29.42			
	Control	40	191.25	34.08			
	Recidiv.	82	7.89	3.20			
	Control	40	7.38	3.54			
	Recidiv.	82	8.59	3.66			
	Control	40	9.43	3.76			
	Recidiv.	82	11.26	3.01			
	Control	40	12.48	3.51			
	Recidiv.	82	21.90	4.66			
	Control	40	22.15	5.96			
	Recidiv.	82	23.60	4.35			
	Control	40	23.20	4.37			
	Recidiv.	82	24.01	6.18			
	Control	40	25.00	5.69			

**Figure 1.** *T test for independent samples (recidivists – control group) for the variables of the questionnaires used in research.*

We think that the sentence length of time can be considered a valuable indicator which synthetically expresses both severity of committed delicts (for more severe delicts, longer sentence), and a plurality of sentences imposed by the recidivism itself. In accordance with the number of years of sentence, we settled three categories: shorter or equal with 5 years sentences, between 5 – 10 years and longer than 10 years. ANOVA, for this trichotomic variable, does not indicate significant differences at the level of tests belonging to the applied battery, which shows a lack of links between the two series of variables.

Only in the value horizon level the sentence length of time leaves its mark on a dominant value, this being illustrated by the below graphic (figure 2). Thus, the ones having short sentence lengths of time prioritize particularly ambition and will qualities, as well as elements that might help them overpass the present situation. With the ones having a medium sentence length of time, the need that tend to become dominant (next to ambition) is the need of comfort, which let be seen a certain saturation confronted by the penitentiary treatment and outlining the aspiration towards a more comfortable life. The ones with sentence lengths of time longer than 10 years come to rank first the need of freedom, seclusion caused by the prisoner's life determining an over-evaluation of this type

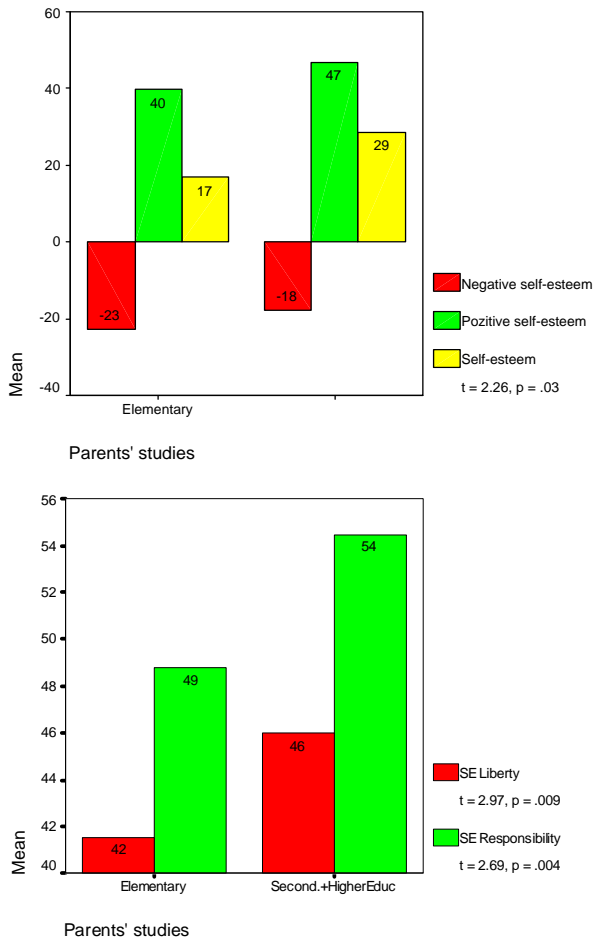
of terminal value.



**Figure 2.** *Dominant values depending on sentence length of time.*

One of our survey objectives was to grasp the importance of some demographic factors in producing the recidivist phenomenon. Among the variables we took into account, the parents' studies seem to give the most significant differences as against the other variables that were approached through questionnaires and tests. Due to the fact that the distribution of these studies is profoundly atypical, most of them coming from families with elementary education studies, we created only two working categories, namely elementary studies versus secondary studies and higher education (the last ones being extremely rare among the recidivists' parents). The parents' studies variable is confounded with other variables that can define not only a

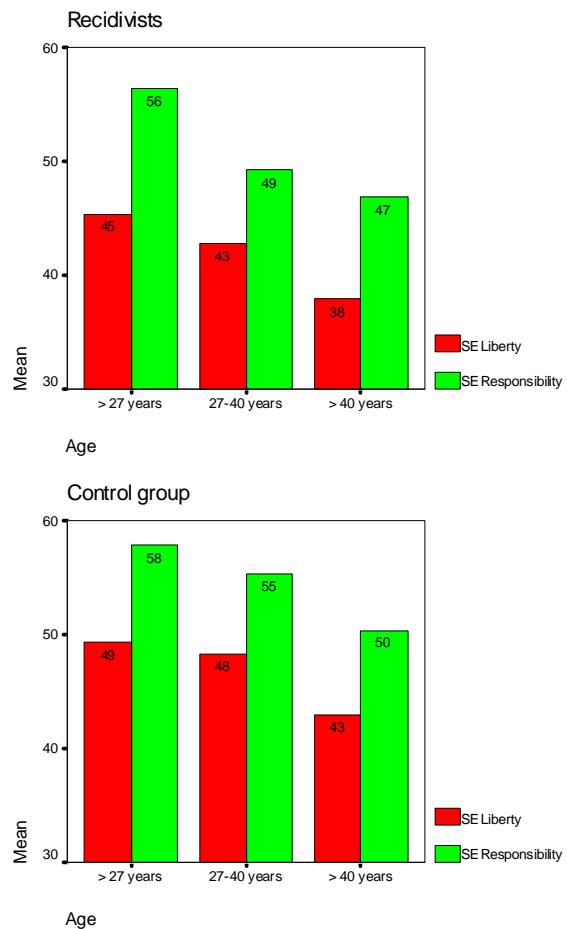
socio-cultural level of the family, but an economic one as well, the access at better paid jobs being severely censored during their training through studies. In our group, secondary studies and higher education are associated with urban area in a greater extent, with less numerous families and also with the sentence length of time and the number of convictions which is significantly lower than the opposite category. Though the causal link cannot be invoked in a design of correlational type, we think that the parents' elementary or very low studies are a matrix generating severe social maladjustment which directly favour the phenomenon of delinquency and repetition of an offence.



**Figure 3.** Relation parents' studies – self-esteem, freedom and responsibility.

The educational climate in the family, so dependent on the level and quality of the parents' schooling, has an extremely high impact on the level of self-esteem, and also on the children's capacity of giving a positive

existential sense to their own lives, of strongly valuing freedom and of responsibly adapting to the needs of society. At the terminal values level, the dominant value of the recidivists coming from families with a low studies level is liberation, a way of placing into abstract solving the problems of personal life. As opposed, the ones with studies of a higher level prioritize the authentic friendship to a greater extent, which is one of the fundamental elements of pro-social behaviour and of helping attitude.



**Figure 4.** Relation age and freedom, responsibility at recidivists and at control group .

An extremely important demographic variable is the age factor because age is the effective reserve of time in which the recidivist might correct himself/herself so that he/she would come back to a useful social life. Studying the factors the questionnaire of existential sense is composed of, we notice it indicates for both the recidivists category and the control group a decline, as time goes by, of

the capacity of giving sense to the own life, for all the four factors that compose the test, but more emphasized for the Existence category. Out of the above diagrams (figure 4) there result two very important conclusions:

- 1 For each of the three categories of age we took into account, the scores for Freedom and Responsibility (and also for Self-distance and Self-transcendence) are much higher for the control group;
- 2 A more emphasized decline of scores appears at the control group as they are passing towards the late maturity age, while at the recidivists group much earlier, in the same time with the beginning of the young and mature age.

Both aspects draw attention that preventing the most malign forms of criminality, associated with repeating the offence, depends not only on rising the education level of the origin families, but also on the society capacity of offering its members a personal evolution which should give sense to existence and in which fulfilment through creative work seem to be the key element. We also notice that the age factor brings a marked decline for adventure seeking to the recidivists.

### 5. Conclusions and discussions

If Foucault (1997) places prison around the relationship power-knowledge, its role being simultaneously that of punishing but also of correcting, other points of view (Florian, 1996) rather see in prison a pathogen institution, the condemned preponderantly developing conducts of adapting to the world of prisoners and less to the values that are supposed to help coming back into the real life.

Our study reveals the importance of some demographic elements, out of which the parents' studies and the age factor seem to play a considerable role in apparition and consolidation of the recidivist delictual behaviour. A multitude of associated factors (marital status of their parents and of their own, type of qualification and present job etc.), although approached through the questionnaire of the used factual data, were

left aside for future developments of the present study.

The comparison with a group of men of similar ages and studies level made evident a lot of important differentiating elements. It seems that precariousness of the background represents just the distal element for a more complex phenomenology of crime. The most relevant results indicate a progressive depreciation of the delinquent's self-esteem, a pauperization of the world of values to which the recidivists adhere, a poorer sense-making capacity alongside with aging and with the number of years spent within the penitentiary. Thus, we can say that the tasks for the prevention of the criminal behaviour start in the world of childhood, cross the area of self-esteem and human dignity in connection with the capacity of meaningfully inserting themselves into the values world, especially through work, marriage and family. But it is obvious that a fragmented analysis of the infringement of law cannot exhaust the studied phenomenon complexity which lies especially in the multitude of the relationships networks that are established among a multitude of variables.

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# RECOGNITION OF AUTHORITY AND SOCIAL ORDER CONSTATATIV STUDY, ON AN HIGH-SCHOOL AND UNIVERSITY LEVEL

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**Abstract:** *The paper tackles the „authority” as a problem of the modern and democratic society, within the correlation authority – social order. Starting from the many manifestations of dissolution of authority within the institutions of the Romanian state an observational study is proposed, regarding the authority perception of the teenagers and young people from the high school and university environment. The paper reaches the conclusion of the need for educating the teenagers and the young people for authority; this education must be directed on two targets: a) the recognition of authority as it correlates to the social order, required to a modern democratic society; b) of building of educators as recognized bearers of the authority.*

**Keywords:** *authority, education*

## 1. AUTHORITY - AS A PROBLEM OF THE MODERN AND DEMOCRATIC SOCIETY

„Authority” represents an interpersonal relationship criterion in every social form known by now. And more, it is developing at the animal level too: between individuals, couples or droves.

Another phenomenon that has to be identified is the one of passing authority in an act of power, being difficult to separate it epistemologically. In our age, under science and techniques impact, „authority” is defined accordingly to these criterions and is more easily to discriminate it from the act of „power”.

If we defined it by reporting to science and the competences owned by his carrier, authority is a correlation of democracy, in the postmodern society: the operation of this postmodern society system will not be possible without order assurance, but this is an outcome of acting authoritative. Human relationships are under the direct or indirect impact of the authority and this creates a complex issue in the behavioral space.

## 2. DEFINING THE PROBLEM

We begin from the assertion that in human communication appears distortions when we understand different things for the same concept. Human relationships from the scholar and university environment suffer the influence of the meanings of these two values - „authority” and „power”. Setting some inadequate meanings of these two concepts disrupt proper functioning of the human relations from these organizations. The unwanted effects lie from indiscipline up to violence acts. Considering these frequently kind of acts, it imposes an investigation on the meanings of „authority” and „power” for educational agents, as those who are the carrier and the beneficiaries.

## 3. THE RESEARCH HYPOTHESES AND THE OBJECTIVES

**Hypothesis no.1.** The students, high-school pupils and their teachers give inadequate meanings of „authority” and „power”.

**Hypothesis no.2.** The students, high-school pupils and their teachers accept the competences that define the teacher’s „authority” and „power”.



The research objectives:

O1. Inventory of the most well known meanings of the concepts „authority” and „power” from the specialty literature.

O2. Inventory of the students, high-school pupils and their teachers meanings of the concepts „authority” and „power”.

O3. Inventory of the students, high-school pupils and their teachers preferences on competences that defines teacher’s „authority” and „power”.

#### 4. RESEARCH STAGES AND LOT CHARACTERISTICS

Duration: May 2008 – November 2008. Place: Colegiul Național „Unirea” – Brașov, Liceul „Grigore Antipa – Brașov, Colegiul Național „Grigore Moisil” – Brașov, Școala Normală „Andrei Mureșanu” – Brașov and University *Transilvania* from Brașov. Subjects: 114 students of *Transilvania* University from Brașov (different faculties), 66 teachers and 257 students from IX and X class, according to table no. 1.

Table 1. Research subjects

Subject Institutions	Pupils	Teachers	Students
Col. Naț. „Unirea” Brașov	76	5	0
Liceul „Grigore Antipa” - Brașov	70	32	0
Col. Naț. „Grigore Moisil” - Brașov	58	4	0
Școala Normală „Andrei Mureșanu” - Brașov	53	25	0
Universitatea <i>Transilvania</i> - Brașov	0	0	114
<b>Total number</b>	<b>257</b>	<b>66</b>	<b>114</b>

**First stage – objectives:** 1) identification of the dysfunctional phenomena of the teacher-student relations, in scholar environment

(through focus-group) and in mass-media; 2) theoretical information and documentation about „authority” and „power” issue; 3) design the questionnaire.

**Investigation stage and collecting dates – objectives:** 1) applying the questionnaire; 2) recoding the results.

**Final stage – objectives:** 1) interpretations of the dates; 3) conclusions.

#### 5. THE RESEARCH RESULTS

##### 5.1. Inventory of the most well known meanings of the concepts „authority” and „power” from the specialty literature

J. Bochenski defines „*authority*” as a “*relation with 3 terms, between the authority carrier – P, a subject – S and a field - D*”. [1, p. 22]. The author sees two kind of authority: the epistemic and the deontic one. The epistemic authority comes from the specialist competence in a knowledge field. But, it is a necessary condition: “every authority has to be justified”[1; 4].

„*The deontic authority*” is the one that comes through hierarchical position (social or professional). The field of this authority concerns a class of instructions. These instructions are defined as “ideals configurations that tell us what has to be and give a decision for acting in a particular way” [4].

J. Bochenski defines the deontic authority, using the exposed premises, thus “*P is the deontic authority for D, only when there is a goal – O, there by: S wants O to be accomplished; S believes that the execution of the orders communicated by P, orders that depend on D, the necessary condition to achieve* [cf. 4].

Of course a P of the deontic authority can be a P of the epistemic authority; it is also wanted to happen and is highly recommended to teachers. When the deontic authority extends over the epistemic one, it happen that phenomenon reported by M. Posit: “the authority relation passes into a power one” [2].

**Olivier Reoul** establishes more forms of authority, using the criterion that legitimized it [3; cf. 4].

**1) The contract authority**

The contract is defined as a “convention between parts, that has to be respected by parts, otherwise it means fraud, that attract punishment”. This way the contract generates authority. Applying “the contract authority”, used in “Dalton’s system” may be applied in the Romanian school, in time dirigente. Even if it “depersonalizes” class mater’s authority, through this “the contract” pass the decisions from the subjectivity plan to the objectivity one (the violated rules are sanctioned).

**2) The expert authority** (with the same meaning, like defining the epistemic authority) has to be proven by teacher and has to obtain student trust.

**3) The referee authority** – it manifests in conflicting situation of a disciplinary, - but it manifests in “cognitive discordant”, in learning process. In both situations, the teacher has to prove his competence. If he is not competent, the decisions are seen as abuse.

**4) Model authority** is a sustainable one (not a conjuncture one, like previously). Its base is „the model prestige” and the caused attitude is *admiration*. Based on affectivity, it is resistant to demolition’s tries.

**5) Leader authority** „respond to those who need to admire and to listen; cause listening calm down and remove “to want”. [3].

The Romanians dictionaries, [5; 6], defines the concepts „authority” and „power” like this:

**Authority** = 1. Right, power to command, to order, to enforce obedience; 2. *Political* or administrative power; 3. *Prestige*, esteem, consideration; 4. The person that inspire through *his prestige or his knowledge* [5].

**Prestige** = 1. *Moral* authority that someone has; 2. consideration, importance [5].

**Power** = *authority*, domination. [5].

Analyzing the definition, we find that it is violated the logical identity principle, generating confusions. *Authority is defined as prestige and / or power and these two as authority.*

Table 2. Analyze of definitions *authority, prestige and power:*

	Authority	Prestige	Power
1.	Right, power to command, to order, to enforce obedience	<i>Moral</i> authority that someone has	<i>Authority</i> , domination
2.	<i>Political</i> or administrative power	Esteem, consideration, importance	
3.	prestige, esteem, consideration		
4.	the person that inspire through his prestige or his knowledge		

We propose a definition, logically build, through proximal genre and significant difference: *Authority and power are relations between variables that can belong to diverse fields (state, economic, politic, financial, socio-human, scientifically (mathematics, physic, etc.). – We are interested by relating in social pedagogy field.*

**5.2. Investigation of the „authority” and „power” concepts comprehension**

Investigation of the „authority” and „power” concepts comprehension (objective no.2) we made it through 2 items from the applied questionnaire. The first: “How you define the teacher authority?” and the second: “How you define the teacher power?” Believing that for students was difficult to define these concepts; we offer them the alternative to define it by examples.

**The research results**

The research results are in table no. 3 and 4. 20.62 % students and 48.48 % teacher define authority correctly, mentioning the most important elements of the definitions given above.

Regarding the inadequate meanings, the situation is different from high school students (79.37 %), to teachers (51.51 %), and the university students are on an intermediary level (59.64 %).

On high school students we find that the highest percent is understanding authority as imposing discipline – 23 %; and for the meaning “Control / punishment”: 8.17 % and for severity, exigency 2.33 %, resulting a total of 33.80 % . Same of them rich the extreme, on this direction, defining authority through autocracy -10.90 %. A percent of 15.17 % is represented by the sense of „respect”, which we can attach the one of „self-assurance”1,16 %; totally 16,33 %.

Of course, the „respect” and the „self-assurance” are welcome in the teacher – student relation, but these are only a consequence of the teacher authority. We observe a vicious circle in defining authority 10.89 %; and 7.39 % students didn't know any meaning. The teachers confused authority with “to enforce obedience” 18.19 %, adding “severity, exigency” 10.60 % and “authoritarian style” 7.57 %, in totally 36.36%. It is a joy that only one teacher made a illogical definition (1.51 %); but exist 13.63 % teacher that don't give an answer and they don't recognize this, probably because of their attitude showing they are not allowed to not know.

Defining „power” count a lower percent for correctness, comparing to authority, there by, at high school students: 5.83%, at students: 7.89 % and teachers: 25.75%. The percent for incorrect answers is higher: 94.55 %, at high school students, 92.10 % at students and 74,25 at teachers.

Between incorrect senses, 20.62 % is the meaning of “autocracy/discretionary way of acting”, 14.78 % “physical / psychical aggression”, 8.56 % representing “the absolute right to decide” and added makes a percent of 43.96 %.

These results have to concern us, because the provoked attitudes at students will be those to reject teacher, as a symbol of power – totally opposite with the role that has it in a modern institution / organization. The other meanings are: “gameness – personality force; charisma - prestige” in a proportion of 5.44 %.

A percent of 27 % students reduce „teacher's power” to his professional competence regarding evaluation. 9.33 % identify „power” with „authority”. Incorrect definition, that builds a vicious circle count 7.78 %. 1.94 % denies and rejects „teacher's power” – maybe because what we don't know we reject. The incorrect answers are 202, meaning 78.59 %.7.78 %students declare they don't have an answer.

„A fan” of incorrect meanings of „power” we discover on teacher's answers. There are teachers that identify the concept with “physical / psychical aggression”, “autocracy / discretionary way of acting”, “the absolute right to decide” (12.12%). Instead of “gameness – personality force”, some teachers identify power with “persuasive ability” – 7.57%. A percent of 4.54 % reduce power to teacher's evaluation competence. A significant percent – 24.24 % - confuse power with epistemic authority. 6.06 % say that power is „an attribute of the teacher”, without specifying the meaning. 3.03 % deny teacher's power – deductive, they don't find themselves as carriers of power in educational field.

Table 3. Defining „authority” by students and teachers

Subjects		Pupil		Teacher		Students		Totally	
		Nr	%	Nr.	%	Nr.	%	Students %	Teachers %
Authority									
Semantically confusions	Autocratic	28	10,90	0	0	1	0,87	10,90	0
	Respect	39	15,17	0	0	10	8,77	16,33	8,77
	Self assurance	3	1,16	0	0	0	0,00		
	Enforce obedience	60	23,30	12	18,19	7	6,14	33,80	36,36
	Control / punishment	21	8,17	0	0,00	0	0,00		
	Severity/exigency	6	2,33	7	10,6	12	10,50		
	Authoritarian style of teaching	0	0,00	5	7,57	18	15,78		
Illogical answers (vicious circle)	28	10,89	1	1,51	12	10,52	10,89	1,51	
Total incorrect answers		185	71,98	25	37,87	60	52,63	71,98	37,87
Without answer		19	7,39	9	13,63	4	3,50	7,39	13,63
I don't know		0	0,00	0	0,00	4	3,05		
<b>Total inadequate answers</b>		<b>204</b>	<b>79,37</b>	<b>34</b>	<b>51,51</b>	<b>68</b>	<b>59,64</b>	<b>79,37</b>	<b>51,51</b>
<b>Total correct answers</b>		<b>53</b>	<b>20,62</b>	<b>32</b>	<b>48,48</b>	<b>46</b>	<b>40,35</b>	<b>20,62</b>	<b>48,48</b>
Total subjects		257	100%	66	100%	114	100%	100%	100%

Table 4. Defining „power” by students and teachers

Subjects		Pupil		Teacher		Students		Totally	
		Nr.	%	Nr.	%	Nr.	%	Students %	Teachers%
Semantically confusions	Physical / psychical aggression	38	14,78	4	3,50	2	3,03	43,96	12,12
	Autocracy/discretionary way of acting	53	20,62	12	10,52	*2	3,03		
	The absolute right to decide	22	8,56	18	15,78	4	6,06		
	Gameness – personality force; charisma – prestige/persuasive ability	14	5,44	28	24,56	*5	*7,57	5,44	*7,57
	Evaluation /teaching competence	26	10,11	*20	*17,5	3	4,54	10,11	4,54
	Authority	24	9,33	0	0	16	24,24	9,33	24,24
	Illogical answers (vicious circle)	20	7,78	18	15,78	4	6,06	7,78	6,06
	Denying teacher's power	5	1,94	1	0,87	2	3,03	1,94	3,03
Total incorrect answers		202	78,59			38	57,57	78,59	57,57
Without answer		20	7,78	2	1,75	11	16,66	15,56	16,66
I don't know		20	7,78	2	1,75	0	0,00		
<b>Total inadequate answers</b>		<b>243</b>	<b>94,55</b>	<b>105</b>	<b>92,10</b>	<b>49</b>	<b>74,24</b>	<b>94,55</b>	<b>74,25</b>
<b>Total correct answers</b>		<b>15</b>	<b>5,83</b>	<b>9</b>	<b>7,89</b>	<b>17</b>	<b>25,75</b>	<b>5,83</b>	<b>25,75</b>
Total subjects		257	100%	114	100%	66	100%	100%	100%

### 5.3. Teachers and students' preference's investigation about the competences that define “teacher's authority” and “teacher's power” (research objective no. 3)

If social order in modern society is determined by authority and power relations, the question “Why there is so much social/ educational disorder?” became a rhetoric one, seeing the subjects answers. The proportion of given inadequate meanings to words that names the

two relation value category – authority and power – are so high, that undermine any pedagogic optimism.

But we have to investigate an essential aspect: which are their attitude toward the key note of the „power/authority carriers”, in their socio-pedagogical defining.

Table no. 5. Teachers and students preference's investigation about the

competences that define “teacher’s authority” and “teacher’s power”

Authority and power attribute		Students		Teachers	
		No.	%	No.	%
Competences	specialty	255	99,2	66	100
	social	189	73,5	57	86,4
	pedagogical	248	96,5	66	100,00
	psychological	254	98,8	61	92,4
	social assistance	<b>48</b>	<b>18,7</b>	<b>46</b>	<b>69,7</b>
Teachers – specialist forms of manifestation as:	expert	178	69,3	<b>31</b>	<b>47</b>
	model	254	98,8	62	93,9
	leader	<b>72</b>	<b>28</b>	<b>8</b>	<b>12,1</b>
Teachers (as a specialist and guide) forms of manifestation as:	expert	124	48,2	61	92,4
	model	249	96,9	65	98,4
	leader	<b>62</b>	<b>24,1</b>	<b>28</b>	<b>42,4</b>
	arbiter	<b>18</b>	<b>7</b>	<b>17</b>	<b>25,7</b>
	without such tasks	3	1,2	0,0	0,0

Extracting from the received answers, both students and teachers want a relation based on authority and power teacher’s attribute. Lower score on some attribute can have different explanations, that doesn’t affect the anterior enunciation: *the specialty-leader and the guide-leader aren’t to large aspirations, nor for students, neither to teachers*; the social assistance competence are the less request one for students – 18 % - (but much more for teachers – 69,69 %), possible students social origins are ok ; teacher as an arbiter, has a low score (7,0 % on students and 25,75 % to teachers) – possible they related it only with discipline conflicts, not also with the cognitive one, meaning a positive correlations with the lower percent of teacher’s role as an expert.

## 6. CONCLUSIONS

Analyzing the answers, we confirm the first hypothesis: “The students, high-school pupils and their teachers give inadequate meanings of „authority” and „power”. We believe this situation is owe to the fact that this valuable categories aren’t study in school nor in faculty, excepting Sociology faculty , by a side, by the

other side, the explicative dictionaries of Romanian language give incorrect definitions, making a vicious circle and determined confusion.

Another conclusion deduced confirms the second hypothesis: The students, high-school pupils and their teachers accept the competences that define the teacher’s „authority” and „power”. The essences of the conclusion are the discipline need in education and the order deduced from teacher authority and power is a condition of it. These two concepts make didactic activity to be an efficient one. In conclusion, there is a stringent need in education for authority; this education should be directed on two objectives: a) to recognize authority as a correlative to social order, extremely important for modern democratic society; b) to form teacher, as recognized carriers of authority. This research generates new investigation directions that can response to these questions:”Why aspiration for “leader - teacher”, as a specialist and educator is so insignificant? What kind of relations teachers and students prefer now? In which measure these are concordant with the requirements of authority and power, in educational field?

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## ECONOMIC ASPECTS OF LEARNING FOREIGN LANGUAGES

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**Abstract:** *Language is often thought of as the crowning human adaptation, the one that allowed Homo sapiens to conquer the globe. The assumption underlying such ideas is that verbal transmission of information provides unalloyed benefits, by reducing the costs of learning about the environment. Once language has become widespread, it can increase human adaptability, by increasing the efficiency of individual learning. Foreign language studies focus on general knowledge of a country, its language, history, culture, political and economic systems, and literature. The linguistics of the language is also studied. When learning a foreign language, one will gain the ability to speak, comprehend, read, and write that language. In addition a broad knowledge of literature, an appreciation of different cultures, an understanding of organization and structure of a language, and the ability to analyze religion, economics, and language will be developed.*

*Whether you are smart or stupid,  
Insignificant or great,  
How can we be really sure,  
If a word you never said.  
Saadi, 13th century*

**Key words:** *language, foreign language, economics, labor market, public goods*

### 1. THE ECONOMICS OF LANGUAGE

The relationship between language and economics receives relatively little scholarly attention.

The **economics of language** is an emerging field of study concerning a range of topics such as the effect of language on income, markets for language-related goods and services, and the costs and benefits of language planning options, preservation of minority languages, etc. The history of the economics of language, as a field of research on the fringes of economics, dates back to the mid-sixties.

A **foreign language** is a language not spoken by the people of a certain place or a language not spoken in the native country of the person referred to.

People learn a second language or a foreign language for different purposes. It not only

gives them a competitive edge but also gives them new opportunities such as making new acquaintances or building new business prospects. Learning a foreign language also provides new employment opportunities. There are more opportunities for people who are bilingual. Moreover, people tend to trust those people more who speak their native language.

Foreign language knowledge has always provided a good basis for a successful exchange of ideas, facts, and information among different nations and cultures. Contemporary society and science with rapid flow of information and cultural diversity strongly impose the need for foreign language learning.

Many of the benefits of learning a foreign language can be summarized into four categories: **personal** (learning another language allows people to communicate –

speak, read, and write – with more people and gives them an opportunity to learn and appreciate different cultures and customs); **cognitive** (for example, students who receive second language instruction are more creative and better at solving complex problems than those who do not, and learning the vocabulary and grammar of a foreign language will improve one's knowledge in their own mother tongue); **academic** (knowing another language seems to contribute to high academic achievement); **economic** (knowing another language gives people a greater number of career opportunities, many companies will pay more to an employee that knows two or more languages, in one's career life, there would be a higher opportunity to deal with overseas branches; plus it enhances the country's economic competitiveness abroad).

## **2. ADVANTAGES OF FOREIGN LANGUAGES ON THE LABOR MARKET FOR EMPLOYEES**

Foreign languages are an advantage on the market of labor, both for employees and for employers.

Learning a foreign language makes you more competitive for jobs around the globe. Knowing how to communicate effectively in another language can lead to opportunities in today's global marketplace. Being bilingual could mean that you have more job opportunities, you can get a promotion, and you have more opportunities to travel for business purposes.

Whatever your career goals, knowing a language certainly won't *hurt* your employability. Chances are that knowing languages will open up employment opportunities that you would not have had otherwise. And you will be able to command a greater salary in the workplace. All else being equal, knowing languages gives you an edge over monolingual applicants competing for the same jobs.

A foreign language is one of the most practical skills you can acquire. It gives you the ability to move freely without the aid of an intermediary. This has many implications. You will be able to do your own market research,

talk to the employees who work on the assembly line in your company's overseas manufacturing facility, call a company in a foreign city without having to worry if the phone will be answered by someone who speaks English.

Learning a foreign language teaches you that there are often several ways to express a concept or an idea. In the business world, it gives you an incredible edge in being able to communicate directly with your customer. It creates a relationship you could never achieve through an interpreter.

Another aspect is that the mere fact of belonging to a language group (particularly if this group holds a relatively lower share of physical or financial capital in the economy) may result in a wage rate disadvantage. Such language-based differentials may arise as a result of a deliberate intent, by another (presumably dominant) language group, to exert discrimination, possibly by manipulating the rate at which the goods primarily produced by one of the two groups are bought and sold.

## **3. ADVANTAGES OF FOREIGN LANGUAGES ON THE LABOR MARKET FOR EMPLOYERS**

Research clearly shows that multilingual societies have a competitive advantage over monolingual ones in the area of international trade.

Foreign languages skills contribute to a firm's profitability (higher profits, lower production costs, more efficient distribution, etc.). The firm can also have certain benefits related to costs of translation, interpretation, editing, teaching, teaching materials, thus being able to make savings in translation efforts to/from other languages.

If businesses are to effectively compete in a global economy, they must learn to deal with other cultures on their own terms. This ability will ensure the company a privileged position both in negotiation and in conflict.

Companies that plan to do business abroad therefore have a dire need for bilingual or multilingual employees. Businesses that intend to compete internationally need employees who can competently communicate in the

locales where they do business. Employees who speak one language can communicate only with people who speak that same language.

The phenomenon of **globalization** has led to the dramatic rise of English as 'the global language'. It is well known that many millions of people in countries all over the world are learning the language. At the same time, many of the developing economies are also embracing the learning of other languages, as English more and more comes to be seen as a 'universal basic skill'.

#### **4. LANGUAGES AS PUBLIC GOODS**

Within a speech community the use of a language and of the services that are dependent on it can be considered a **public good**. Public goods are in fact defined as goods that exhibit consumption indivisibilities (that is, one person's consumption of a good does not diminish the amount available for others) and, additionally, are fully accessible to all.

Consider, for example, a linguistically heterogeneous community, such as Switzerland, where different groups speak different languages. The diffusion of bilingualism or multilingualism would lower the cost of information processing, communication, mobility of the labor force across the borders of linguistic areas, and the cost of sharing services between different linguistic groups within that community. This would free resources and bring about opportunities that would not have been economically feasible in a linguistically clustered environment. Since the potential gains from multilingualism, once in place, would be enjoyed by everybody within the community, multilingualism is a public good. Notice that the benefits associated with the diffusion of a common language stem from three different sources.

The first is the reward obtained by each individual who joins a language community, and is due to the new potential for communication thus acquired.

The second source is the reward each member of a language community obtains

whenever their community expands, and is due to network externalities. Because the communication opportunities offered by the larger speech community are enjoyed by all those who have joined the network by learning that language--and the gains from the network obtained by one individual do not conflict with those obtained by others--the common language within that community is a public good. It is, indeed, the public good nature of a common language that gives rise to the externality.

The third source of benefits spills over the boundaries of the speech community. The spread of a common language enhances trade, the sharing of knowledge and hence the creation and the diffusion of innovations, and it facilitates organization, coordination and management in most economically and socially relevant activities. In a linguistically fragmented society the prevailing form of communication tends to be horizontal--that is, taking place within homogeneous communities and social strata. A society that overcomes fragmentation and develops a common language breaks the impediments to vertical communication between the different levels at which individuals and groups interact within that socio-economic system. A widespread proficiency in one language that meets all the communicative needs of that system is a powerful engine of social and economic integration. A common language, therefore, makes for lower production as well as transaction costs within an economy, and hence for lower prices in exchange: it enhances competition.

Empirical observation seems to confirm that linguistic fragmentation, in the absence of a lingua franca, is not compatible with a high socio-economic development - at least in terms of the standard parameters of conventional economic evaluation and accounting.

At least two considerations stem from this line of argument. First, though the benefits are distributed over the entire collectivity, the native speakers of the language that becomes dominant do not share in the costs of expanding the network and developing it into a lingua franca. By the simple fact that the common language happens to be their mother



tongue, people from dominant linguistic groups earn a benefit that required no specific investment on their part—what is called the "seigniorage of language". Countries (or linguistic groups) that enjoy such seigniorage can obtain a real economic gain thanks to the positive effect on their terms of trade. And countries (or linguistic groups) that instead have to make an investment in order to join the network cannot exact a payment in return for their "private" contribution to the provision of a public good.

The second consideration is that, as it always happens with public goods, voluntary private provision underestimates the true demand for the good within the community. Take a typical example of a public good such as street lighting. Even though most people would attach a positive value to the comfort and safety of a city which is not left in the darkness at night, there is no incentive for individuals or private companies to invest and supply such a service. There would be no way to ascertain the benefit that accrues to each member of the community, nor to compel a payment for that benefit. In addition, it would not be possible to exclude from the benefit those who are unwilling to share in its costs. A few individuals, presumably those who get the highest net utility from the investment, may still install street lights. The equilibrium outcome will however not be that which would be collectively the best. The investment in a common language is in many ways analogous to an investment in street lighting. The fact that for many individuals the cost of personally investing in a second language may exceed the expected benefits (and consequently they would not undertake such

an investment) does not mean that their own perceived benefit, and hence their willingness to pay, is zero: it simply means that the benefit is less than the market price they would have to pay to privately engage in learning a second language.

Public provision of services meant to enhance language learning could, in these situations, increase collective benefit. The optimal level of public investment would result from summing the willingness to contribute of all members of the community corresponding to a given level of provision of such services - rather than, as it happens in a private market, by looking at the total amount of language-learning services demanded within that collectivity at the market price.

Keeping in mind the fact that economics is perceived as the social science that studies the production, distribution and consumption of goods and services, we may very well conclude by saying that the world of languages is another field to which economic concepts and principles can be applied in order to better understand them and put them to better use.

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## FEMINIST ECONOMICS

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**Abstract:** *Feminist economics is a very young field within economics, which is still looking for its own definition. As the field is so young, and the number of books and articles is still quite limited, there is no canon, nor are there canonical authors. The development of feminist economics had been built both on insights from feminist theory and on growing disapproval by feminists of dominant practices in mainstream economics. Originally the word “economics,” from its Greek root, meant the management of the household, a particular concern and responsibility of women. At the beginning of modern economics in the 17<sup>th</sup> century, the focus of the purpose of economics shifted to the creation and distribution of “wealth.” With this shift the concepts of the “rational economic man” and “economic rationality” emerged as the norm for human behavior and the way to ensure the proper functioning of the market o establish the most efficient allocation of resources. Feminist political economics is one among several heterodox systems of economics that challenge the reigning orthodox neo-liberal economic model. It focuses on the provisioning of human needs and human well-being. It employs **gender** as a defining category and focuses on the actual lived experience of women, men and families and what it means to be a human person.*

**Key words:** *feminist economics, mainstream economics, gender economics, feminist theory*

### 1. A LITTLE HISTORY

Originally the word “economics,” from its Greek root, meant the management of the household, a particular concern and responsibility of women. At the beginning of modern economics in the 17<sup>th</sup> century, the focus of the purpose of economics shifted to the creation and distribution of “wealth.” With this shift the concepts of the “rational economic man” and “economic rationality” emerged as the norm for human behavior and the way to ensure the proper functioning of the market o establish the most efficient allocation of resources.

Feminist political economics is one among several heterodox systems of economics that challenge the reigning orthodox neo-liberal economic model. It focuses on the provisioning of human needs and human well-being. It employs **gender** as a defining category and focuses on the actual lived

experience of women, men and families and what it means to be a human person.

The key feminist lenses for analyzing economic issues from household to global structures are the role of gender and the asymmetrical power relations and division of work/labor in both production and social reproduction which gender sets up.

Gender is a central analytic lens in a feminist political economic analysis. The meaning of the terms “gender” and “sex” differ. Sex is biologically based whereas gender is defined as the set of socially and culturally constructed roles and expectations for women and men in a given society. Gender roles are not fixed, but vary from society to society and can change over time as comparisons across cultures and generations illustrate. However, across cultures and generations one constant can be identified: women have primarily been responsible for the care and nurturing of the human family - the

work of social reproduction -sometimes called the “care economy.”

Gender dictates the division of work/labor in both the public sphere of production and the private sphere of the household. The majority of people subsist by combining paid employment and unpaid domestic work to maintain themselves and their households. Production and consumption in combination generate the household’s livelihood. With a focus on the importance of the role of women in unpaid provisioning work, feminist political economics emphasizes the significance of unpaid work to the functioning of a national economy.

Feminist political economics embraces and attempts to integrate into a coherent account of a just, productive, and sustainable global economy a number of values such as: human well-being is the foundational value; gender equality is central to human well-being; human rights, especially economic and social rights; women’s personal autonomy within relationships of reciprocity; women’s moral and political agency; recognition and valuation of women’s work of social reproduction—a value and an activity; embracing differences and eliminating discrimination—racial, ethnic, sexual preferences, class/caste, religious and national origin; ecological and environmental sustainability in the promotion of well-being and social reproduction; social cohesion and solidarity across families, communities, regions and nation states; global common good.

Feminist economics is a very young field within economics, which is still looking for its own definition. As the field is so young, and the number of books and articles is still quite limited, there is no canon, nor are there canonical authors.

The development of feminist economics had been built both on insights from feminist theory and on growing disapproval by feminists of dominant practices in mainstream economics.

From the early 1970s, the feminist movement played an authoritative role in many fields of action and human knowledge traditionally reserved to men, creating disorder and disputing commonplaces, truths,

principles, and consolidated methods. Political economy was not exempt from attack and was forced to suffer its disruptive and deconstructive onslaught.

Feminist economics is a very young field within economics, which is still looking for its own definition. As the field is so young, and the number of books and articles is still quite limited, there is no canon, nor are there canonical authors. The development of feminist economics had been built both on insights from feminist theory and on growing disapproval by feminists of dominant practices in mainstream economics.

## **2. FEMINIST ECONOMICS VS. MAINSTREAM ECONOMICS**

What makes feminist economics different from mainstream economics as well as from most other heterodox economics is the persistent questioning of the underlying gender dimension of particular phenomena, or the gender implications of a policy proposal or policy change.

Feminist economics has criticized the incorrectness of several mainstream ontological assumptions and the limitations of its methodology, as well as priorities it has on what economists should consider their field of inquiry.

The first neo-classical assumption questioned by feminist economists is that on human nature. According to this assumption, humans are autonomous individuals who behave selfishly on the markets but altruistically in the family. Feminist economists have argued that these assumptions of human nature both in relation to family members and in relation to others are exaggerated and hence misrepresent reality. Furthermore, they are biased in favor of men’s interest. The optimal arrangement for families – the traditional family with a gender division of labor: the man specializes in market labor, while the woman specializes in household labor – is potentially at the disadvantage of women, both in their families and on the labor markets.

This debate of feminine economics in the 1970s focused on the role of housework in

capitalist accumulation. Women produce use values by transforming consumption goods and looking after their children and husbands. Nevertheless, they do not produce exchange values, since their products are not sold on the market. Therefore they do not directly create value and surplus value. However, they certainly participate in creating overall surplus value. In fact, their services contribute to raising the productivity of wage workers and lowering their wages. In this way, the direct exploitation of workers in the factory ends up by also being an indirect exploitation of domestic labor. Women who carry out this kind of work are exploited if the value they produce or contribute to producing is higher than the value of the goods they consume. But things have come a long way since those times and reality has changed over the years.

### **3. FEMINIST ECONOMICS VS. GENDER ECONOMICS**

Feminist economics and gender economics both have the same domain of study: the differences a phenomenon makes for men versus women. But feminist research has a goal which gender research has not: to bring into question existing hierarchies, authorities, norms, traditions and conventions.

Gender economics can be seen as research in mainstream economics that is involved with issues which particularly concern women (fertility, child care, gender discrimination) or the household and family.

The topics covered by gender economics appear as a sub-set of the topics covered by feminist economics. All feminist or gender related topics for which the mainstream methodology is not suited will be ignored by gender economics. In other words, we might describe gender economics as feminist neoclassical economics.

As far as the difference with mainstream economics is concerned, gender economics introduces gender instead of gender-less individuals and makes policy analyses gender-aware. Feminist economics differs from mainstream economics in all aspects.

Gender economics uses the term 'gender' in its thin definition, while feminist economics uses it in its thick definition.

Gender economics uses mainstream methodology, while feminist economics is pluralist, with inter- and multi-disciplinary discussion.

Gender economics enjoys acceptance by economists, while feminist economics often does not.

### **4. FEMINIST ECONOMICS VS. FEMINIST THEORY**

Feminist economics has taken up some of the constituents of feminist theory, which works both within mainstream theories, as well as over different disciplines. Feminist economics shares with feminist theory in general this deep interest and belief in the potential value of interdisciplinary work. Mainstream sciences consider that a disciplinary approach is better or higher quality science and that interdisciplinary works lowers the quality of research.

Feminist theory tries to re-conceptualize the relationship between different forms of social inequity rather than simply to empower women. Furthermore, over the last two decades, there has been a notable shift within feminist theory from the social sciences towards the arts – a shift from things to words. So, feminist economics is apparently not very well represented or integrated within feminist theory. There are many unanswered questions with regard to the relation between feminist economics and feminist theory.

To conclude, we may say that feminism proves to be a generic term that is used to define an extremely complex phenomenon. Generally speaking, it expresses the interest towards the role of women by contrast to the role of men in society, in the past as well as nowadays, an interest fueled by the belief that women have suffered various injustices because of gender. The specific language and the political objectives of modern feminism date back to the French Revolution and to the Enlightenment period, when feminism was defined as a struggle to gain acceptance and rights for women (to own property, to have

access to higher education, to vote). In time the emphasis of the movement shifted to the goals of equal social and economic opportunities for women, including employment.

A continuing area of concern in industrialized countries is the contradiction between the generally accepted principle of equality and the inequities that remain between the sexes in state policies and everyday life.

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## EFFECTS OF TRAINING IN MENTAL ROTATION TASKS

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**Abstract:** *Mental rotation is used extensively in piloting and plane guidance tasks. Gender differences are also acknowledged in the literature. In the present study the interest was to assess the training effect using computer games upon psychometric tests in boys and girls. 283 students (mean age = 14,10 years, 55,5% boys, 45,5% girls), control group = 105 subjects, “one month” experimental group = 83 subjects, “3 months” = 95 subjects) were assessed using general cognitive and specific spatial abilities tests. Repeated measure 2(gender) x 3(group) showed significant improvement of test performance after training:  $F_{(2, 277)} = 13,96$   $p < 0,001$ . Computer games are a useful tool in training mental rotation, girls showing the most benefits.*

**Key words:** *spatial ability, gender differences, experience, computer use, training effect*

### 1. INTRODUCTION

Mental rotation is a type of spatial ability frequently used in piloting and plane guidance tasks. They are defined as the ability to mental rotate two or three dimensional figure rapidly and accurately and to imagine the aspect of the figure after it was rotated around an axes with a certain number o degrees [1].

The present research is a part of a more large one aimed to evaluate the relationship among computer games and spatial abilities. An extensive review of the explanatory theories of gender differences in mental rotation are presented in David [2]. The trainability of mental rotation is still on debate, but there are numerous studies that shwed improvement after intervention [3,4]. The idea of using computer as a training tool is supported by children enthusiasm toward it. Sternberg in his theory of intelligence [5] is mentioning the role of every day exerience in shaping the adaptative behavior, learning taking place not only in school or following a formal curricula.

### 2. METHODS

The sample investigated is formed from 283 subjects (mean age = 14,10 years, 55,5% boys, 45,5% girls), coming from four schools from Brasov (48% for 2 secondary schools and 51% for 2 high schools).

All subjects were investigated two time’s pre and post intervention, using seven tests in the first session and four in the second assessment. Distribution of the subjects in the three groups (two experimental and one control group) was randomized for about a half of the subjects, the other half being assigned in order to obtain equivalent groups for the following criteria: gender, age, IQ, initial level of mental rotation ability. Subjects from experimental group “1 month” (N=83) were instructed to play computer games for at least 6 hours and those from experimental group “3 months” (N=95) for at least 15 hours. Because not all the subjects followed the instruction, it was necessary to separate the subjects under a new criteria: numbers of hours of computer play, resulting four groups: zero hours (N=105 students, the control group), one hour (N=74 students), six hours (N=62 students) and 15 hours (N=42 students).

The subjects were investigated with a complex battery, but for the present rapport

only two of them are described, because they were used to assign the students in-groups and to compare the results of the intervention.

#### Measures

*Standard Progressive Matrices Test* (Raven, 1938) a paper and pencil nonverbal intelligence test, contains 60 items of increasing difficulty, grouped in five series. In order to give the solution one must operate with abstract figural stimuli, understand the gestalt and activate flexible strategies of solving. The test was administered in-groups with a time limit of 25 minutes.

*Mental rotation task* is a component of a cognitive abilities battery proposed by a psychologists team from Babes Bolyai University and it measure the ability of a person to transform mental images especially through rotation. Each participant was tested individual given five minutes to respond to 10 problems.

Our intention is to demonstrate the usefulness of computer games for the training of mental rotation. We anticipate superior results in test results for students who participate in experimental groups compare with control group. Also, female will benefit more from computer's game training.

#### Training games

Students from experimental groups received CDs with computer games, playing rules, follow up sheet and also they maintained contact with experimenter on a regular basis (two times a week).

*Shapes*: the game contains 50 levels, on each level one must fill the black shape on the screen with no gaps using smaller shapes along the bottom of the screen. There are only a certain number of shapes available that can be placed in the given orientation or rotated. A password can be re-entered to start to a level previously reached. The game use mental rotation and spatial visualization, is somewhat monotone, but in the present of the motivation to see and solve all the levels, the game resemble tangram rules.

*Blockout*: a classic game, requiring mental rotation of three-dimensional shapes in order to complete fill the distant surface of a cube.

The shapes can be rotated along axes X, Y and Z, clockwise and counter-clockwise. As the level are completed, the speed increase and the player must be quicker in deciding which of the possible rotation is better to complete the background.

*3D Blocks* is a combination of Tetris and Blockout. The task is the completion of the lines, using 15 different options of presentations. The main mental operation is rotation, the player needing to anticipate the consequences of different possible rotation in order to select to proper one.

*Cram Jam* is an atypical puzzle, the task consisting in taking out a piece using as little movements as possible. In order to succeed different other pieces must be moved to clear the way for the main one. Each level can be replayed in order to improve the strategy and to decrease the number of movements. The game requires anticipatory strategy and spatial visualization.

*Cyclanoid* is also a kind of puzzle game, the task being the placement of similar figures on the same line using successive rotation. Depending on the level of difficulty on each rotation 4 to 8 figures will move, and the number of lines and columns can be choose by the player. The game requires mental rotation and anticipatory visualization in order to succeed.

*Kiki the nano bot* is a game with story, the player moving a nano bot in a kind of virtual space. The nano bot is symmetric and also are some elements from the three-dimensional space here the nano bot is moved. Other elements are transparent, so the player must have excellent orientation ability. The game is difficult but motivates those who enjoy challenge.

### 3. RESULTS

ANOVA with repeated measures was performed, mental rotation test performance being the dependent variable. Test score on mental rotation was transformed in IQ scores (mean 100 and standard deviation 15). Between subjects variables were sex (2) x group (3) x hours of play (4) and time of testing (pre and post intervention) represented within subjects' variable.

Within subjects differences for mental rotation (in IQ scale) are significant:  $F_{(1, 277)}=196.18$   $p<.001$ , effect size  $r = .64$ . The interaction between time of testing, group and hours of play were also significant as follows:  $F_{(2, 277)}= 13.96$   $p<.001$ ,  $r = .21$  for group, and  $F_{(3, 275)}= 11.53$   $p<.001$ ,  $r = .20$  for hours of play.

Contrast analysis (Helmert) shows significant differences between control group and both experimental groups  $t_{(277)} = 3.43$   $p<.001$ , with no significance between one month and three months training. (fig. 1).

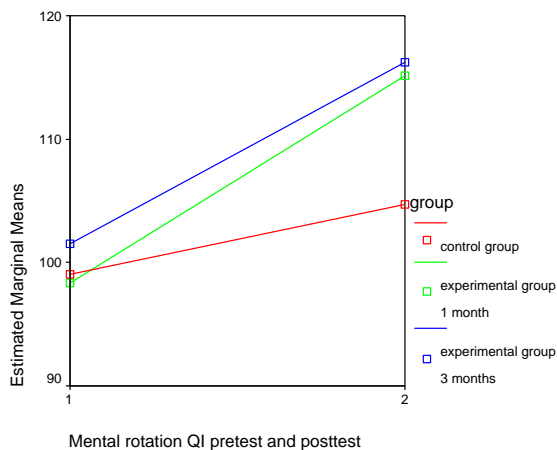


Fig. 1 Changes in mental rotation scores compared by groups

Regarding number of hours spent playing computer games (fig. 2), contrast analysis showed significant differences between control group and groups who played computer games, for six ( $t_{(166)} = 5.51$   $p<.001$ ,  $r = .2$ ), and 15 hours respectively ( $t_{(146)} = 5.24$   $p<.001$ ,  $r = .22$ ). There are also significant differences between those who played only one hour and those who played six hours ( $t_{(135)} = 2.56$   $p<.001$ ), or fifteen hours ( $t_{(115)} = 2.63$   $p<.001$ ). There is no significant difference between six and 15 hours of play.

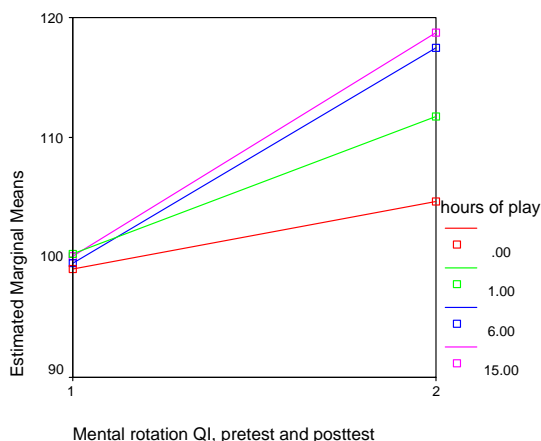


Fig. 2 Changes in mental rotation scores compared by hours of play

In order to establish how much of the final test results is due to training, gender of the subjects entering as a secondary explanatory factor we performed regression analysis. The results of mental rotation scores are explained through simultaneous contribution of group and gender in a proportion of 13% ( $R = .36$ ;  $R^2 = .13$ ;  $F_{(2, 282)} = 21.09$ ,  $p<.001$ ).

Separating the results for male and female, the results showed a better contribution of training in the case of female. Therefore, for male 4.5% of the final results are due to the belonging in an experimental group ( $F_{(1, 156)}=7.32$   $p<.008$ ), but the percent improved in the case of female to 10% ( $F_{(1, 125)}=13.82$   $p<.001$ ).

Table 1 presents multiple correlation indices and regression coefficients for boy and girls depending on groups.

Taking into consideration that number of hours played on computer is a more discriminating indicator the same procedure of regression analysis was performed once again only this time the predictor was hours of play.

Tab.1 Multiple correlation indices and regression coefficients with type of group as predictor

Gender	R	R Square	Stand. Coeff.	t	Sig.
male	.212	.045	Beta		
			.212	2.706	.008
female	.317	.100	.317	3.718	.000

Explanation value improved significant for girls, increasing to 15% of explanation of the mental rotation test scores. For boys, the difference was not so evident, 5% of the test scored being explained by the hours of computer play (table.2).

Table.2 Multiple correlation indices and regression coefficients with hours of play as predictor



Gender	R	R Square	Stand. Coeff.	t	Sig.
male	.223	.05	Beta		
			.223	2.36	.01
female	.390	.152	.390	4.72	.000

#### 4. DISCUSSION

Experimental groups improved significantly their performance for mental rotation, with no statistical difference between one and three months training. The analysis of number of hours played showed that only one hour is not enough to increase the performance the effect being obtained after six hours. With more than double of hours (15 hours) the improvement is not statistically significant. Regression analysis is also more sensible when hours of play are the predictor, female getting more benefits from play compared to males. Therefore, two types of analysis show the same results: mental rotation can be improved through computer games. Giving the well known gender difference, the results of the present study are even more encouraging, demonstrating that girls can improve their performance. The effect size ( $r = .64$ ) is similar with that cited in literature [6].

The fact that the improvement is not significant between six and fifteen hours of play may be explained by the fact that the effect is more subtle for those who already have a good ability, and in order to differentiate their improvement there are

may be necessary more than 15 hours. But, for a more rough effect the visible improvement is obtained after six hours of computer games.

In conclusion, non academic experience can have a formative value, and computer games can be used as a mean of training mental rotation.

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## A FEW CONSIDERATIONS ON POLITICAL CORRECTNESS

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**Abstract:** *This paper presents a few considerations on political correctness, a widely used term applied to language, ideas, policies and behaviour, which seeks to minimize offense to cultural or identity groups. Political correctness is one of the brilliant tools that the American Right developed as part of its demolition of American liberalism. It is a form of coercion rooted in the assumption that in a political context, power refers to the dominion of some men over others, or the human control of human life; by this argument, ultimately, it means force or compulsion. Political correctness has corrupted the news media, universities, business, Congress, politics, etc. Declaring that some thoughts and words are "correct" while others are not permits those who are among the correct thinkers to escape free competition of ideas by using threats, intimidation, and force against non-correct thinkers.*

**Key words:** *political correctness, politically correct, stereotype, power, multiculturalism, disfunction, orthodoxy.*

### 1. INTRODUCTION

Political correctness (adjectivally, politically correct; both forms commonly abbreviated to PC) is a term applied to language, ideas, policies, or behavior seen as seeking to minimize offense to gender, racial, cultural, disabled, aged or other identity groups. Conversely, the term politically incorrect is used to refer to language or ideas that may cause offense or that are unconstrained by orthodoxy.

Political correctness is defined in the Oxford English Dictionary as conforming to a body of liberal or radical opinion, especially on social matters, characterised by the advocacy of approved causes or views, and often by the rejection of language, behaviour, etc, considered discriminatory or offensive. It finds the earliest use of the term in a book, *Black Woman*, by T. C. Cane, published in 1970 stating that a man cannot be politically correct and a chauvinist too. It became so widely used a term that, by 1985, *The Washington Post* used it to describe a cafe that served Nicaraguan coffee and at which the staff were known as waitpersons. Thus was it already losing much of its true meaning. By

1993, we find this in the *Utne Reader*: "Killing mosquitoes, flies, midges and other summer pests is known to politically correct people as 'speciesism'. The original idea had more to do with not endorsing imperialist and racist political positions than with not offending people, as it does now.

Some of the wilder critics of political correctness claim to be able to trace the roots of the idea back to the Frankfurt School of philosophy of 1923, which, apparently, sought to spread the idea that talking about certain beliefs must be avoided to make up for past inequities and injustices, a sort of cultural application of Marxian economic and political thought. In the 1930s, Mao Tse Tung wrote about the correct handling of contradictions through sensitive training. The term was later adopted by the radical Left in the 1960s, initially seriously and later ironically, as a self-criticism of dogmatic attitudes. In the 1990s, because of the term's association with radical politics and communist censorship, it was used by the political Right in the United States to try to discredit the Old and New Left.

Yet whatever its philosophical and linguistic roots, by the 1980s it had become a rallying point for those who wanted to liberate academia from the Dwems - dead white European males - such as Shakespeare or Chaucer, and to open up the literary canon to minority groups. In the 1970s in the US and the 1980s in Britain it did a lot of good, especially in rooting out the casual, popular racist language many indulged in without thinking or, indeed, necessarily meaning offence.

Negroes became "Afro or African-Americans", on a par with Italian- Americans or any other hyphenated group. Some now want to be called "persons of colour" and that seems to have been as easily accepted. And if women who work for airlines would rather be called flight attendants than air hostesses or trolley dollies, that, again, is something we now easily and calmly accept.

Critics consider that now it has gone too far. Yet many of the stories about things that are done in the name of political correctness are exaggerated. Descriptions of the dead as "terminally inconvenienced" exist only in joke books. Norwich council cutting down its conker trees may have been silly but it was not "politically correct". One nursery school in Birmingham was advised by the city council, on comments from the Working Group Against Racism in Children's Resources, that whenever the word black is attached to another word it creates a negative meaning which can make children feel embarrassed and confused about their identity - Black Monday, Black Wednesday and black sheep all conjure up negative images. Teachers should become more aware of the negative feelings this can evoke in children. Bloodsports such as fox hunting are nowadays "field sports" or even more absurdly "a way of life". The British Field Sports Society has mutated into much friendlier sounding Countryside Alliance. And killing animals for fun and demanding subsidies for farmers goes under the more catchy "Liberty and Livelihood". That, many would argue, really is political correctness gone mad.

## **2. POLITICAL CORRECTNESS.**

As a linguistic concept, the term, using inclusive and neutral language is based upon the idea that language represents thought, and may even control thought. Moderate conceptions of the relation between language and thought are sufficient to support the reasonable deduction of cultural change via linguistic change.

Other cognitive psychology and cognitive linguistics works indicate that word-choices have significant framing effects on the perceptions, memories, and attitudes of speakers and listeners. The relevant empirical question is whether or not sexist language promotes sexism, that is sexist thought and action. In some cases, what critics call political correctness, its advocates defend as the usage of inoffensive language whose goal is multi-fold.

The rights, opportunities, and freedoms of certain people are restricted because they are reduced to a stereotype. Stereotyping largely is implicit, unconscious, and facilitated by the availability of pejorative labels and terms. Rendering the labels and terms socially unacceptable, people then must consciously think about how they describe someone unlike themselves. When labelling is a conscious activity, the described person's individual merits become apparent, rather than his or her stereotype.

A further complication is that terms chosen by an identity group, as acceptable descriptors of themselves, then pass into common usage, including usage by the very people whose racism and sexism, et cetera, the new terms mean to supersede. The new terms are thus devalued, and another set of words must be coined, giving rise to lengthy progressions such as Negro, Coloured, Black, African-American and so on.

Some commentators, primarily on the Left, claim that the term political correctness was re-engineered by American conservatives after 1980 as a way to reframe political arguments in the United States. Hutton states that political correctness is one of the brilliant tools that the American Right developed in the mid-1980s as part of its demolition of American liberalism.

What the sharpest thinkers on the American Right saw quickly was that by declaring war on the cultural manifestations of liberalism - by levelling the charge of political correctness against its exponents - they could discredit the whole political project.

Such commentators say that there never was a Political Correctness movement in the United States, and that many who use the term are attempting to distract attention from substantive debates over discrimination and unequal treatment based on race, class, and gender. It's not unusual, however, for people who are so clearly aware and conscious of their thoughts and actions, to be completely oblivious and unconscious of the consequences that emanate from these same thoughts and actions. In the "blind rage" of their "correctness", they cannot see nor can they imagine the wide and meandering ramifications of outcomes their precepts are engendering, and in the darkness of their blindness, they cannot perceive where the latter are leading. For once you proscribe, even by implication, certain ideas and opinions, or by giving them red neck status, and forbid their voicing or prescribe the form of their expression, you erode the value-hold these ideas have in the general community, hence making it more easy for people not to adopt and not to express them in the form of their own liking. Consequently you deprive people their inalienable right, in a democracy, both to voice and express ideas in accordance to their individual wishes and preferences, i.e., to choose the forms and figures of speech by which to articulate them. In the past, phrenologists use to put mad people in straitjackets. Presently, the high priests of political correctness are putting reasonable conventions in the straitjacket of their own "madness".

The followers of political correctness have deliberately chosen not to conduct the debate of their propositions before the court of reason, but in the emotionally charged precincts of the boudoir. Whence they can dub and castigate their opponents with the emotive terms of racist, sexist, etc. with the purpose of shutting them up. Where reason is absent, however, the issues that

are important to the advancement and public good of a society tend to swing to-and-fro without resolution. Even when a resolution is reached its outcome, more often than not, arises from a bad compromise that the best side of the argument makes to the worst, due to the mistaken belief that it's better to come to some sort of conclusion, even by means of a bad compromise, than to no conclusion at all.

The protagonists of political correctness, in the torpor of their satiated intellectual state, are not aware that they are conceiving and are giving birth to a Frankenstein who will wreak havoc on the institutional values of a democratic society. Nor are they conscious that by succeeding in dubbing certain forms of speech and expression as socially unacceptable, they will crack the foundation upon which a democratic society functions. The vigor and robustness of liberal institutions depend wholly and utterly in the strong disposition and will of the people to exercise their democratic rights regularly and fearlessly and not let them fall in a state of desuetude.

The latter is a real danger and no hyperbole. In contemporary democratic societies, when human rights and social justice are strongly stitched in the social fabric and have great political and moral appeal among the people, it would not be difficult for a small group of political activists, who ostensibly profess to represent the interests of the less privileged and less favored among us, to persuade a sizeable part of the majority that political correctness not only protects and augments the rights of the under privileged, but it's also a better fit to our democratic structure in alleviating, and, indeed, in eliminating injustice, than the "formal freedoms", according to them, that emanate from liberal institutions. The latter, after all, from their radical perspective, are no more than the instruments by which the powerful are depriving the socially indigent from their rights, with the outcome of keeping the latter in a permanent state of disempowerment. The acceptance of such a proposition by a large number of people, as well as by many Labor politicians, is already becoming *de rigueur*.

Especially, when it's supported and promoted by the artfully "credible" voice of sections of academia, as well as by the fourth estate, the media, which has chosen, with some exceptions, to shroud its critical faculties behind a veil of darkness, avoiding to criticize the paltriness of reasoning that is embedded in such a proposition. That the influence of political correctness is real, and that it can determine the discourse of political and civil debate in our society, or stifle it, is demonstrated by three recently published events.

### **3. CRITICISM**

Some critics, primarily on the Right, claim that political correctness is a Marxist-inspired effort aimed at undermining Western values. Lind and Buchanan have characterized PC as a technique originated by the Frankfurt School whose work aimed at undermining Western values by influencing popular culture through Cultural Marxism. Critics argue that political correctness is censorship and endangers free speech by limiting what is considered acceptable public discourse, especially in university and the political forums. University of Pennsylvania professor Alan Charles Kors and lawyer Harvey A. Silverglate, connect political correctness to Marxist philosopher Herbert Marcuse, particularly his claim that liberal ideas of free speech were, in fact, repressive, viewing this Marcusean logic as the base of speech codes formulated in American universities. Kors and Silverglate went on to create the Foundation for Individual Rights in Education, which campaigns against such speech codes.

Other critics say that politically correct terms are awkward euphemisms for truer, original, stark language, comparing them to George Orwell's Newspeak. Some critics of PC use the terms PC brigade or the diversity dictators. Another term used in both a serious criticism and jokingly manner is the PC Police.

Some critics of political correctness claim that it gives more power to the Left's enemies and alienates the masses against feminism, marginalizes certain words, phrases, actions or

attitudes through the instrumentation of public It is a form of coercion rooted in the assumption that in a political context, power refers to the dominion of some men over others, or the human control of human life; by this argument, ultimately, it means force or compulsion. This argument holds that correctness in this context is subjective, and corresponds to the sponsored view of the government, minority, or special interest group that these conservative critics oppose. They claim that by silencing contradiction, their opponents entrench their views as orthodox, and eventually cause it to be accepted as true, as freedom of thought requires the ability to choose between more than one viewpoint. Some conservatives refer to political correctness as "The Scourge of Our Times."

Critics of political correctness have been accused of showing the same sensitivity to choice of words they claim to be opposing, and of perceiving a political agenda where none exists.

Opponents of mainstream scientific views on evolution, global warming, passive smoking, AIDS, race, and other issues have argued that political correctness is responsible for the failure of their views to get a fair hearing. Thus Ted Steele, an associate university professor of biology, says, in his book, *Lamarck's Signature*: "We now stand on the threshold of what could be an exciting new era of genetic research. However, the 'politically correct' thought agendas of the neo-Darwinists of the 1990s are ideologically opposed to the idea of 'Lamarckian feedback' just as the church was opposed to the idea of evolution based on natural selection in the 1850s. Mainstream science is dominated by politically correct thinking.

Allegations of political correctness, in the sense of an enforced orthodoxy, have been directed against the political right.

During the run-up to the invasion of Iraq, several weeks after their Grammy success, the country band the Dixie Chicks performed in London at the Shepherd's Bush Empire theatre. During this 10 March 2003 concert, the band introduced their song "Travelin' Soldier", during which Natalie Maines, a Texas native, was

quoted by The Guardian as saying, Just so you know, we are ashamed that the President of the United States (George W. Bush) is from Texas. Though this is the official circulation of the comment, the full text of the statement Maines made was as follows: "Just so you know, we're on the good side with y'all. We do not want this war, this violence, and we're ashamed that the President of the United States is from Texas."

The resulting backlash against the band was described by columnist Don Williams as an example of exacting a price for expressing views the right considered politically incorrect. Williams wrote that the ugliest form of political correctness occurs whenever there is a war on. Then you had better watch what you say. Williams noted that Ann Coulter and Bill O'Reilly called it treason.

In 2004, then Australian Labor leader Mark Latham described conservative calls for civility as The New Political Correctness.

Other examples include attempts to rename French fries as Freedom fries, and the name Liberty cabbage used for sauerkraut during World War I.

Political correctness has frequently been a target of satire. Two early and famous examples are 1992's "Politically Correct Manifesto" by Saul Jerushalmy and Rens Zbigniew X and 1994's "Politically Correct Bedtime Stories" by James Finn Garner, in which traditional fairy tales are rewritten from an exaggerated PC viewpoint. Other examples include Bill Maher's former television program, which was entitled Politically Incorrect and George Carlin's Euphemisms routine. The Politically Correct Scrapbook also further satirizes political correctness. Comedy Central's controversial animated show South Park regularly satirizes political correctness.

In response to the "Freedom Fries" incident, it was suggested that the Fama-French model used in corporate finance might be renamed the "Fama-Freedom" model.

Political correctness involves the translation of Marxism from economic terms into cultural terms. The premise underlying political correctness is that if the elite can change the

language then they can change the way individuals act and thus change society. Political correctness has corrupted the news media, universities, business, Congress, politics, etc. Declaring that some thoughts and words are "correct" while others are not permits those who are among the correct thinkers to escape free competition of ideas by using threats, intimidation, and force against non-correct thinkers.

According to multiculturalism and political correctness, all history is dictated by the power that certain groups defined by race, ethnicity, or gender have over other groups. Some groups are designated as sainted victims and are viewed as naturally good regardless of what any of them do as individuals. For example, radical feminists teach that in the past men had all the power, that they oppressed women, and that men living now have to atone for the transgressions of men of the past. In the world of political correctness, white males are determined automatically and universally to be malicious and immoral.

Multiculturalism leads to politically correct language. Such language must be consistent with multiculturalist principles. This means that language should not favor one group over another, should not infringe on any group's right to sovereignty, should not interfere with the peaceful relationship of any minority group with those from other groups, should not hinder society ( the state) in its attempts to protect cultural groups ( social, economic, and ethnic minorities) whose views are declared to be equally valid and who have the right to equal opportunity, integrity, and point of view; and should not promote stereotypes of any kind.

The obsession of the morally superior, sensitive, and conspicuously compassionate elite with the subjective feelings of people is part of today's prevailing therapeutic vision of man. This infatuation with sensitivity has spread throughout the media and academia, leading to the creation of feel-good euphemisms which part with accuracy and unambiguity in the interest of feeling and sympathy. Unfortunately, these linguistic smile buttons simply camouflage reality rather than change it.

Advocates of political correctness attempt to homogenize our language and thought not only to enhance the self-esteem of minorities, women, and beneficiaries of the welfare state but also to preserve the moral image of the welfare state itself. One approach to reaching this goal is to eliminate disparaging, discriminatory, or offensive words and phrases and the substitutions of harmless vocabulary at the expense of economy, clarity, and logic. Another approach is to deconstruct a word or phrase into its component parts, treat the component parts as wholes, and focus on secondary meanings of the component parts. For example, the term mankind is said to be exclusive, misleading, and biased when it is employed to refer to both men and women.

The politically correct fail to understand that language is the result of an evolved social process that results in a systemic order achieved without the use of a deliberate overall plan. Language simply arises out of accidents, experiences, and historical borrowings and corruptions of other languages. No one intended to exclude women when generic terms like he or mankind were used. With respect to human beings, the male gender was used to denote the species. On the other hand, both countries and ships are referred to as she. Using he or she or him or her simply clutters the language and conveys no further information. However, such use does imply that those who use the masculine terms hold hostile or exclusionary thoughts toward women! This leads people to believe that every use of generic male terms is evidence of male antagonism toward women when, in fact, such usage merely avoids awkward phrases and cluttered language.

Political correctness supplies a language through which it is easy to be a victim and always someone or something that can be blamed. Think of terms like culturally deprived, developmentally challenged, etc. Political correctness involves a lot of people attempting to explain the reasons for their lack of great success. These victim-type explanations or excuses generally include the idea that a person is having a rough time because of his particular

race or gender. Essentially, political correctness is a way to rationalize who you are and why you are not better than what or who you are.

Victims are taught that their failures and suffering are invariably the result of some unfair and rectifiable condition that social engineers could remedy if the insensitive would simply let them. This reinforces the erroneous views that human life is perfectible and that all suffering is a deviation that can be corrected. People are led to believe that the world should be a place where they never suffer disappointment or failure. Of course, the tragic truth is that people can fail and that individuals are unequal in talents and achievements.

On some campuses seeking higher standards of human accomplishments is no longer valued as highly as politically correct thinking. Academic freedom through free speech is accompanied by high social costs on campuses, where truth is viewed as nothing more than different perspectives being offered by different groups in order to promote their own interests. Education-imposed biases restrict students' thinking when curricula are developed to be nonsexist, peace centered, antibiased, and politically correct.

On America's college campuses, students are taught that value systems are subjective and constructed according to race, ethnicity, gender, and social class. The result is warped curricula, women's studies departments, black studies departments, thought police, campus speech codes, etc. Students are not taught that men and women really are different or that races and ethnic groups actually do have specific characteristics.

Political correctness (and multiculturalism) threatens free speech in both the academic sphere and the nonacademic workplace and ultimately the very foundation of American society. The government has, in essence, eliminated most free speech protection in the workplace. Free speech, which is an economic good to academics through which they make their living, has fared slightly better in the educational world.

Broadly conceived, political correctness includes a number of initiatives such as: altering vocabularies in order not to offend particular groups, affirmative action in admissions and hiring, multicultural education, and broadening the scope of classical texts to include those written by minority authors and women. Then there are the workshops in which people are taught by experts how to be attuned to others' feelings and how to avoid being found guilty of sexual harassment, racial insensitivity, and so on.

Political correctness is used to eliminate debate and discredit opponents of various social reforms by labeling them as racists, misogynists, and bigots. Political correctness is a multicultural tool to limit thought in education, science, and culture by intimidation and coercion. While victims have the right to articulate their views, the same right does not belong to people who oppose their views.

Political correctness insists on truths contrary to reality, human nature, and experience. It follows that state power must be employed in order to impose politically correct thought, language, and behavior that are not in accord with perceived reality. The state has become the protector of designated victims, the promoter of diversity and tolerance, the sensitizer of citizens' consciousness, and the promoter of victims' self-esteem. To accomplish the above, the state intervenes into human and commercial activities through affirmative action, hate speech laws, hate crimes legislation, the approval of quotes for admission to universities, and so on.

The state rewards those who personify the favored victims and expropriates political rights and cultural recognition from individuals who do not. Politically correct politicians generally heed the agenda of any minority that claims that they or their forbears have been treated unfairly. The victims find a victimizer and demand compensation in the form of money or positive discrimination with respect to obtaining jobs or admission to universities. In addition, victims often seek affirmation by insisting that history be rewritten.

Political correctness is a perversion of morality and a contradiction of reality that requires constant state interventions for its successful implementation. Political correctness threatens free society by encouraging group-think and by attaining conformity through intimidation and force. We must fight political correctness by striving for truth through the use of reality-based rational and logical arguments. Because political correctness is crippling Western society, it is imperative that we recapture language, reestablish the private ownership of the means of expression, challenge PC concepts, and stand up in defense of reality.

#### **4 CONCLUSION**

In a society that prides itself on its individualism, the freedom to do as we please with little or no concern about the consequences of our behavior, there is no doubt, that social and political correctness seems a cultural imposition that would inhibit one's personality or even be socially and politically repressive.

But, let us think about the alternatives. Do we usually like to be at the end of someone else's insensitivities? Do we enjoy being offended or stepped on or portrayed as an outcast or as something unworthy of respect? Further, if we do not acknowledge some limitations on our behavior, we should expect retaliation; greater social disfunction, even violence, as a result of our actions. Is this type of freedom worth increased social acrimony?

Individuals who oppose social and political correctness, quite often to justify their behavior, tend to advance the argument that people need to lighten up and be less sensitive. Doesn't that mean having to be less sensitive about being offended, ridiculed? While there might be some out there who enjoy this type of cultural masochism, the numbers are not great. On the other hand, being socially and politically incorrect can be a lot of fun, particularly when we are not on the receiving end. The show trials of the future will be staged therefore by a radical



elite of political correctness ensconced in academia, and by a motley of followers, i.e., feminists, gayists, indigenists, multiculturalists, and a miscellany of lobbyists, who, under the august values of justice, tolerance, equal opportunity, and diversity, will be setting up new “Gulag archipelagos”, where freedom of speech and expression will be incarcerated and muzzled. Political correctness is the continuation of revolution by other means. But the pushers of this revolution are like an ageing actor's face full of often acted artificial passions, as Orson Welles said, and feigned roles. And like all the artificial and extreme experiments of the social, political, and economic engineers of the past, who by a set of panaceas and fanciful ideas tried to change the course of history and

failed, the attempt of the adherents of political correctness to cripple the march of reason and put it on crutches, will also fail.

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## MEANS OF ENCODING FUTURITY IN ENGLISH AND ROMANIAN. A TEMPORAL-ASPECTUAL-MODAL PERSPECTIVE

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*Abstract: The paper aims at examining various means of encoding futurity in English, with a view to establishing their appropriate Romanian equivalents in certain given contexts. In addition to the temporal values of the respective constructions, we also examine their aspectual and modal meanings, as they prove extremely useful in translation activities.*

*Keywords: tense, aspect, futurity, modality, English, Romanian*

### 1. INTRODUCTION

In the practice of teaching English for Business Communication, we have noticed that students find it challenging to accurately render into Romanian English sentences which contain future tenses and/or other means of expressing futurity. For reasons of space, this article only deals with sentences containing English *Present Simple and Continuous*, as well as other means of encoding futurity. We leave the contrastive analysis of English and Romanian future tenses for further research.

The aim of the current paper is to examine the semantic equivalences which hold between the various means of encoding futurity in English and their Romanian counterparts, starting from the temporal-aspectual values exhibited by the respective structures. It is our firm belief that a greater awareness of the latter could help students understand, hence use, the English and Romanian means of expressing futurity more appropriately.

Before we begin, we must emphasize the fact that all the means of expressing futurity under consideration share a future reference time, as they point to events which will take place after the moment of speech. What differs

is the range of aspectual values<sup>1</sup> a tense may obtain in a given context, which leads to the above mentioned translation difficulties.

The article is organized as follows: section 2 presents structures which are equivalent to the English *Future Simple Tense*, section 3 presents equivalents of the English *Future Perfect Tense*, whereas section 4 examines contexts with equivalents of the English *Future-in-the-Past*. Last but not least, section 5 summarizes the findings of our study.

### 2. FUTURE SIMPLE EQUIVALENTS

The current section deals with several equivalents of the English *Future Simple Tense*. The latter has been regarded as a 'neutral' way of expressing prediction, or as a construction with an adjacent 'volitional' modal meaning, depending on the context of occurrence [18]. Its equivalents will be shown to highlight one of the two above-mentioned values.

#### 2.1. THE PRESENT TENSE SIMPLE

The English *Present Simple Tense* and its Romanian counterpart, the *Prezent*, behave in an idiosyncratic way when compared to the other English or Romanian tenses. Not only are they used in sentences about the present or

about the past, but, in combination with future time adverbials, they may refer to future situations, as well. Because of this idiosyncratic behaviour, the *Present/ Prezent* have been labelled ‘unmarked’ tense forms [4-6]. Along this line, the term *tenseless future* has been used in the literature to designate the use of the *Present Simple/ Prezent* in future contexts.

In order to acquire a future reference time (RT), the *Present Simple* and the *Prezent* morphemes require the co-occurrence of a definite future time adverbial, as illustrated in (1) below:

(1) a. Tomorrow is Saturday. ([19]: 65)

*Mâine este sâmbătă.*

b. [...] a ministerial meeting is held next week<sup>2</sup>.

*O întâlnire la nivel ministerial are loc săptămâna viitoare.*

c. [...] high tide is at 6 a.m. tomorrow morning.<sup>3</sup>

*Fluxul vine la ora 6 am mâine dimineață.*

The sentences in (1) above share a tinge of certainty, in addition to the more general meaning of ‘prediction’ associated with future contexts. Linguists have argued that the connotation of ‘certainty’ might be derived from the use of the definite time adverbial, as well as from the use of the present tense morphemes, both in English and Romanian. The *Present Simple* and the *Prezent* morphological markers are, therefore, used in contexts which describe plans or arrangements viewed as unalterable (as in (1b.) above), statements about the calendar (as in (1a.)), or about cyclical natural phenomena (as in (1c)).

In other words, the *tenseless future* encodes not only temporal – aspectual features, but certain modal meanings, as well. In fact, some modal connotations or another are inevitably attributed to every construction used in future sentences, since a future situation is not a real situation, but one which is imagined by the speaker as either certain or merely possible.

## 2.2. THE PRESENT TENSE CONTINUOUS

Similarly to the *Present Simple Tense*, the English *Present Continuous Tense* may obtain a future RT in combination with future time adverbials. The term *futurate progressive* has been employed to label this value of this tense form, as opposed to its regular use denoting situations in progress at speech time [23].

Although both the *Present Simple* and the *Present Continuous* tense forms may obtain a future reading in combination with a future time adverbial, the meanings of the two morphemes differ one from the other. More precisely, the degree of certainty that the situation will occur is greater in the case of the former morpheme and smaller in the case of the latter.

The difference of meaning between the two present morphemes in English leads to their occurrence in distinct contexts. While the *Present Simple Tense* occurs in sentences predicating about objective plans or arrangements, the *Present Continuous Tense* occurs in sentences which predicate about subjective plans, programmes or arrangements ([19]: 62). Furthermore, “the factor of ‘plan’ or ‘arrangement’ in the future meaning of the Present Progressive restricts its use in the main to ‘doing’ verbs involving conscious human agency” (idem: 64), as illustrated by the well – formedness of (1a.) as opposed to the unacceptability of (2b.) below:

(2) a. John is rising at 5 o’clock tomorrow. ([19]: 64)

*Ion se trezește mâine la ora 5.*

b. \*The sun is rising at 5 o’clock tomorrow.

*Soarele răsare mâine la ora 5.*

In the English versions of sentences (2a.) and (1) above, the two values (i.e. ‘personal planning’ and ‘objective planning’) arise from the presence or absence of the *be...ing* progressive marker, respectively. In Romanian, however, the *tenseless future* may have both values (i.e. “certainty and planning on the part of the speaker”) depending on the context of occurrence ([2]: 206).

However, Carlotta Smith argues that in the case of *futurate progressive* sentences, “the aspectual viewpoints do not have precisely

their usual values presenting closed or open events” ([23]: 190). In other words, the *futurate progressive* sentences do not present a situation in progress, but rather encode other connotations of the *be...ing* marker; thus, “they are sometimes taken as more tentative, or more dynamic, than their counterparts with the simple, perfective viewpoint” (idem: 191).

### 2.3. BE GOING TO + INFINITIVE, BE ABOUT TO + INFINITIVE, BE TO + INFINITIVE, BE ON THE VERGE OF + GERUND

English possesses a series of idiomatic structures which represent grammaticalized ways of referring to future situations. On the one hand, there are several structures containing the infinitive: *be going to* + infinitive, *be about to* + infinitive, *be to* + infinitive. On the other hand, English possesses a synonymous structure which is formed with the gerund: *be on the verge of* + gerund. In what follows we briefly exemplify each of the structures just enumerated.

We begin by discussing the structure *be going to* + infinitive. Although this structure historically derives from the present continuous form of the verb ‘to go’, today the two constructions represent distinct grammatical means of encoding futurity. On the one hand, the *futurate progressive* combines only with agentive predicates (as evident from (2) above), while the *be going to* construction allows the combination with the infinitive form of either an agentive or a non-agentive verb (as in (3a.,b.) below, respectively). On the other hand, the modal value of *be going to* + infinitive differs from that of the *futurate progressive* in that the former does not imply certainty. In other words, imminence is not a semantic accompaniment of *be going to* ([19]: 61), which means that the situations it describes are not seen as certain but merely as probable.

- (3) a. She is going to return home tomorrow.  
*Ea se va întoarce acasă mâine./ Ea urmează să se întoarcă acasă mâine.*  
 b. She is going to have twins. (She is already pregnant.) ([19]: 60)

*Ea are să nască gemeni. / Ea urmează să nască gemeni.*

The sentences in (3) above illustrate a similarity of functions between the English *be going to* + infinitive construction and the Romanian *Viitor*. Both means of encoding futurity obtain a future RT irrespective of whether they co-occur with future time adverbials or not. In addition, they are assigned the same values; (3a.) above illustrates their use as ‘future fulfilment of present intention’, while (3b.) exemplifies their use as ‘future fulfilment of present cause’ (idem: 59 - 60)<sup>4</sup>.

The structures *be about to* + infinitive and *be on the verge of* + gerund are synonymous in that they both refer to events seen as future fulfilment of present intention, as in (4a.)-(5a.), or events seen as future fulfilment of present arrangement, as in (4b.)-(5b.). In these situations, neither of the two structures requires a future time adverbial.

- (4) a. I am about to leave my current employment for which I have given two months notice.<sup>5</sup>

*Sunt pe cale să plec / Sunt pe punctul de a pleca / Urmează să plec de la actualul loc de muncă, fapt pentru care am depus un preaviz de 2 luni.*

- b. Astronauts are about to add a pair of 115-foot-long solar wings to the International Space Station.<sup>6</sup>

*Astronauții sunt pe cale să adauge / sunt pe punctul de a adăuga / urmează să adauge o pereche de panouri solare de 35m la Stația Spațială Internațională.*

- c. The husband is about to leave in a few minutes [...].<sup>7</sup>

*Soțul este pe cale să plece / este pe punctul de a pleca / urmează să plece în câteva minute.*

- d. I am about to leave in a month to go study in Aix en Provence [...].<sup>8</sup>

*\*Sunt pe cale să plec / \*Sunt pe punctul de a pleca / Urmează să plec peste o lună să studiez în Aix en Provence.*

- (5) a. I am on the verge of leaving my job at a large game company (the largest) in order to start work elsewhere.<sup>9</sup>

*Sunt pe cale să plec / Sunt pe punctul de a pleca / Urmează să plec de la o firmă mare de jocuri (cea mai mare) pentru a începe lucrul în altă parte.*

b. Many online businesses are on the verge of adding social media facilities on their websites for improving the user friendliness.<sup>10</sup>

*Multe afaceri online sunt pe cale să adauge / sunt pe punctul de a adăuga / urmează să adauge platforme de rețele sociale (comunități online) pe site-urile proprii, cu scopul de a mări atractivitatea pentru utilizatori.*

c. Nina [...] is on the verge of leaving in a day or so for Los Angeles [...].<sup>11</sup>

*Nina este pe cale să plece / este pe punctul de a pleca / urmează să plece la Los Angeles peste o zi sau două.*

d. Milan is on the verge of losing another important player this summer.<sup>12</sup>

*Milan \*e pe cale să piardă / \*e pe punctul să piardă / urmează să piardă un alt jucător important vara aceasta.*

As evident from (4c.,d.)-(5c.,d.) above, both structures can also co-occur with future oriented adverbials to denote future fulfilment of present intention or arrangement. However, the time span of the future adverbial restricts the Romanian translation. On the one hand, when a near future adverbial is used in English, as in (4c.)-(5c.), the contexts can be translated either by semantic equivalents of *be about to* + infinitive and *be on the verge of* + gerund (i.e. *fi pe cale să / a fi pe punctul de a*), or by the semantic equivalent of *be going to* + infinitive (i.e. *a urma să*). On the other hand, when a far future adverbial is used in English, as in (4d.)-(5d.), the contexts can only be translated by the semantic equivalent of *be going to* + infinitive (i.e. *a urma să*), since the latter does not ban the co-occurrence of a far future time adverbial.

The structure *be to* + infinitive may refer either to events seen as future fulfilment of present arrangement, similarly to *be about to* + infinitive and *be on the verge of* + gerund, or to events seen as future fulfilment of present orders. The two uses are exemplified in (6a.,b.) and (6c.,d.) below, respectively. As evident from (6a.,b.) below, the structure *be to* + infinitive may co-occur with either near or

far future time adverbials. Moreover, the Romanian translations point to the fact that this English structure lacks the 'immediacy' reading associated with *be about to* + infinitive and *be on the verge of* + gerund.

(6) a. I am to leave in the morning.<sup>13</sup>

*?Sunt pe cale să plec / ?Sunt pe punctul de a pleca / Urmează să plec mâine dimineată.*

b. I am to leave in a week from tomorrow.<sup>14</sup>

*\*Sunt pe cale să plec / \*Sunt pe punctul de a pleca / Urmează să plec de mâine într-o săptămână.*

c. You are to leave the school grounds immediately.<sup>15</sup>

*Trebuie să pleci de la școală imediat!*

d. You are to leave your habit of excess drinking, so you have decided with full force that you will not touch the drink from to day, and then you are to maintain this decision for rest of your life.<sup>16</sup>

*Trebuie să te lași de băut, așa încât te-ai hotărât ferm să nu te mai atingi de băutură de azi înainte, și trebuie să respecti această hotărâre pentru tot restul vieții.*

In sum, this section has illustrated the use of several idiomatic structures used to express futurity in English. We have seen that all of them have additional modal meanings, be they epistemic or deontic. The former are represented by probability, and objective or subjective planning, whereas the latter are represented by orders or commands.

### 3. FUTURE PERFECT EQUIVALENTS

The current section deals with the equivalents of the English *Future Perfect Simple* and *Continuous*, namely *Present Perfect Simple* and *Continuous*. As illustrated below, the latter are employed in contexts where sequence of tenses rules disallow future morphemes.

#### 3.1. THE PRESENT PERFECT SIMPLE

Linguists have argued that the temporal – aspectual values of the English *Future Perfect Simple* are future equivalents of the *Present Perfect Simple*. More precisely, the former

refers to “a state or event seen in the past from a point of orientation in the future” ([19]: 58 – 59), whereas the latter refers to a state or event which begins in the past from a point of orientation in the present and may or may not extend into the present ([9]: 98).

Depending on the aspectual class of verbs they combine with, the *Future Perfect Simple* and the *Present Perfect Simple* may have either a perfective or an imperfective aspectual value. The perfective (experiential and resultative) reading and the imperfective (continuative) reading of the *Future Perfect Simple* are illustrated in sentences (7a.,b.) – (7c.) below, respectively. Moreover, the examples provided in (8a.,-c.) below show that the *Present Perfect Simple* is used to render similar values in temporal clauses, where sequence of tenses rules ban the appearance of future morphemes.

(7) a. And by tomorrow, he will have done that three times in a row.<sup>17</sup> (experiential)

*Până mâine, el va fi făcut acel lucru de trei ori la rând.*

b. [...] by then the surge of adrenalin will have woken me up.<sup>18</sup> (resultative)

*Până atunci mă voi fi trezit din cauza creșterii de adrenalină.*

c. [...] in 2020 over half of non-western foreigners will have lived here for more than twenty years.<sup>19</sup> (continuative)

*În anul 2020, mai mult de jumătate dintre străinii care provin din țări non-vestice vor fi trăit aici de mai mult de 20 de ani.*

*În anul 2020, mai mult de jumătate dintre străinii care provin din țări non-vestice vor locui / trăi aici de mai mult de 20 de ani.*

(8) a. I will not rest until I have visited the ice hotel.<sup>20</sup> (experiential)

*Nu mă voi opri până ce nu voi fi vizitat hotelul de gheață.*

b. As soon as I have done that, I will take the day off.<sup>21</sup> (resultative)

*De îndată ce voi fi făcut acel lucru, îmi voi lua liber pentru restul zilei.*

c. I wonder if in a few years when I have lived here longer than I have lived in Chicago whether I'll prefer the gray corned beef?<sup>22</sup> (continuative)

*Mă întreb dacă, peste câțiva ani, când voi fi locuit aici mai mult decât am locuit în Chicago, îmi va plăcea specialitatea sărată de piept de vită.*

*Mă întreb dacă, peste câțiva ani, când voi locui aici mai mult decât am locuit în Chicago, îmi va plăcea specialitatea sărată de piept de vită.*

The sentences in (7)-(8) above indicate that, while the English *have..en* marker is ambiguous between a perfective and an imperfective reading, the Romanian *a fi (be) + past participle* is unambiguously perfective. Thus, those who want to render the continuative reading of the *Future Perfect Simple / Present Perfect Simple*, have to use the Romanian *Viitor* instead of the Romanian *Viitor anterior*, as in the second Romanian variant of (7c.) and (8c.) above.

### 3.2. THE PRESENT PERFECT CONTINUOUS

Grammars have pointed to the fact that the temporal-aspectual readings of the English *Future Perfect Continuous* and *Present Perfect Continuous* are similar only up to a point. On the one hand, the former exhibits a more restrictive meaning pattern than the latter since the former refers to events that take place after the speech time. Hence, a resultative reading of the *Future Perfect Continuous* would seem awkward. On the other hand, due to the fact that a *be...ing* form may not obtain an experiential value, this is unavailable for *Future Perfect Continuous*, as well. Consequently, the only available reading for a *Future Perfect Continuous form* is the continuative one.

The continuative reading of the *Future Perfect Continuous* is illustrated in (9a.-b.) below, whereas (10a.-b.) show that the *Present Perfect Continuous* is used as an equivalent in temporal clauses, as a result of the application of sequence of tenses rules.

(9) a. She will have been doing all of these things for 14 months before she applies for residency.<sup>23</sup>

*Ea va fi făcut toate aceste lucruri timp de 14 luni înainte de a aplica pentru permisul de rezidență.*

*Ea va face toate aceste lucruri timp de 14 luni înainte de a aplica pentru permisul de rezidență.*

b. Long before student performers take their place on the Kanbar Auditorium stage, they will have been studying and practicing their instruments [...].<sup>24</sup>

*Cu mult înainte ca studenții să devină instrumentiști pe scena de la Kanbar Auditorium, ei vor fi studiat și exersat la instrumentele la care cântă.*

*Cu mult înainte ca studenții să devină instrumentiști pe scena de la Kanbar Auditorium, ei vor studia și exersa la instrumentele la care cântă.*

(10) a. I shall wait until he has been doing it for a bit longer before I start to worry...<sup>25</sup>

*Voi aștepta până ce va fi făcut asta timp de mai mult timp, înainte de a mă îngrijora.*

*Voi aștepta până ce va face asta timp de mai mult timp, înainte de a mă îngrijora.*

b. Most learners of English as a foreign language do not achieve this until they have been studying English for five to six years.<sup>26</sup>

*Majoritatea celor care învață engleza ca limbă străină nu vor reuși acest lucru până ce nu vor fi studiat limba timp de 5-6 ani.*

*Majoritatea celor care învață engleza ca limbă străină nu vor reuși acest lucru până ce nu vor studia limba de 5-6 ani.*

The Romanian translations of the examples in (9)-(10) above point to the perfective aspectual value of the Romanian *Viitor anterior*. Hence, in order to render the continuative (i.e. imperfective) values of the English *Future Perfect Continuous / Present Perfect Continuous*, the Romanian *Viitor* has to be used instead, as shown in the second Romanian variant of (9a.,b.) and (10a.,b.) above.

#### 4. FUTURE-IN-THE-PAST EQUIVALENTS

Future-in-the-past sentences represent a special case of 'future' sentences. This type of utterance obtains a past RT; however, its event

time (ET) is posterior to another past moment or interval. Consequently, there are two available readings for the state/ event described by the verb – i.e. a historical reading (with ET preceding ST) or a non – historical one (with ST preceding ET) events.<sup>27</sup>

English possesses a variety of constructions which may obtain a future-in-the-past value. They are exemplified below as follows: *Future-in-the-Past Simple* and *Continuous* in (11a.,b.), *Future-in-the-Past Perfect Simple* and *Continuous* in (12a.,b.), *Past Tense Simple* and *Continuous* in (13a.,b.), the past of *be going to* + infinitive, *be about to* + infinitive, *be to* + infinitive and *be on the verge of* + gerund in (14a.-d.):

(11) a. For a few hours we did not know whether we would marry the next day or not [...].<sup>28</sup>

*Timp de câteva ore n-am știut dacă ne vom căsători a doua zi sau nu.*

b. But she hadn't found out much about the airline or the country she would be visiting regularly.<sup>29</sup>

*Dar n-a aflat mare lucru despre compania aeriană sau despre țara pe care urma s-o viziteze cu regularitate.*

(12) a. By June the following year we would have met twice already.

*Până în iunie anul următor ne vom fi întâlnit deja de două ori.*

b. They would have been repairing the car by 10 o'clock the following morning.

*Ei vor fi meșterit la mașină până a doua zi dimineața la ora 10.*

(13) a. The next day was Saturday.<sup>30</sup>

*A doua zi era sâmbătă.*

b. John was rising at 5 o'clock the next day.

*Ion se trezea a doua zi la ora 5.*

(14) a. Crying passengers feared they were going to die as plane plunged thousands of feet after pressure loss<sup>31</sup>

*Pasagerii înspăimântați se temeau că vor muri deoarece avionul era în picaj după depresurizare.*

b. [...] they were about to face the antitrust division [...].<sup>32</sup>

*Erau pe cale să se confrunte cu Divizia Antitrust.*

c. French negotiators were to meet Reyes the day he was killed<sup>33</sup>

*Negociatori francezi urmau să se întâlnească cu Reyes în ziua când acesta a fost ucis.*

d. [...] the couple were on the verge of splitting up [...].<sup>34</sup>

*Cuplul era pe punctul de a se despărți.*

Examining the sentences in (11)-(14) above, one cannot escape the feeling that they are incomplete in the absence of a higher context to establish an RT for the events described by the verbs in the respective sentences. Provided that a past RT is established by the larger context, the sentences in question indicate that there are certain correspondences between the constructions used to denote futurity with respect to ST and the ones employed to denote posteriority with respect to a past RT. On the one hand, the English structures described in section 2 have equivalent readings, as their RT precedes ST and/or ET. On the other hand, the Romanian counterparts of the sentences in (11)-(14) above illustrate the fact that a future-in-the-past reading is translated by means of the *Viitor* or the *Viitor anterior*, apart from the *Imperfect*.

## 5. CONCLUSIONS

The aim of the present article has been to describe several means of encoding futurity in English and their most appropriate Romanian counterparts. We have examined three types of future constructions: *Future Simple* equivalents, *Future Perfect* equivalents and *Future-in-the-Past* equivalents. We have highlighted the temporal, aspectual and/or modal meanings associated with each structure under discussion, as we believe that they are the keys to successful translations of English future sentences into Romanian.

## 6. NOTES

<sup>1</sup> For a brief review of the theoretical assumptions regarding tense, aspect and the temporal-aspectual interpretation of sentences in isolation, see [10], whereas for lengthy discussions see [2, 8, 9, 14, 23].

<sup>2</sup> [www.wtcenter.org.tw/SmartKMS/fileviewer?id=98936](http://www.wtcenter.org.tw/SmartKMS/fileviewer?id=98936)

<sup>3</sup> [www.democraticunderground.com/discuss/duboard.php?az=view\\_all&address=104x4488019](http://www.democraticunderground.com/discuss/duboard.php?az=view_all&address=104x4488019)

<sup>4</sup> For further discussion on whether the existence of these two contextual readings of the *be going to + infinitive* construction in English entails polysemy or not, cf. [21].

<sup>5</sup> [www.justanswer.com/questions/1x8d7-leave-current-employment](http://www.justanswer.com/questions/1x8d7-leave-current-employment)

<sup>6</sup> [science.nasa.gov/headlines/y2009/17mar\\_bigconstruction.htm](http://science.nasa.gov/headlines/y2009/17mar_bigconstruction.htm)

<sup>7</sup> [blogs.theasiannews.co.uk/asiannews/2007/02/post\\_2.html](http://blogs.theasiannews.co.uk/asiannews/2007/02/post_2.html)

<sup>8</sup> [detroitartworks.blogspot.com/2006/07/darcel-deneau.html](http://detroitartworks.blogspot.com/2006/07/darcel-deneau.html)

<sup>9</sup> [ask.metafilter.com/tags/quit](http://ask.metafilter.com/tags/quit)

<sup>10</sup> [https://www.amazines.com/article\\_detail.cfm/526831?articleid=526831&title=free%2Cinternet%2Cmarketing%2Ccourse%2Cfree%2Conline%2Cmarketing%2Ccourse%2Cfree%2Cinternet%2Cmarketing%2Ccourse%2COnline](https://www.amazines.com/article_detail.cfm/526831?articleid=526831&title=free%2Cinternet%2Cmarketing%2Ccourse%2Cfree%2Conline%2Cmarketing%2Ccourse%2Cfree%2Cinternet%2Cmarketing%2Ccourse%2COnline)

<sup>11</sup> [www.fancast.com/tv/Everwood/88056/episodes/season/4](http://www.fancast.com/tv/Everwood/88056/episodes/season/4)

<sup>12</sup> [news.softpedia.com/news/Real-Madrid-Are-Close-on-Signing-Kaka-25113.shtml](http://news.softpedia.com/news/Real-Madrid-Are-Close-on-Signing-Kaka-25113.shtml)

<sup>13</sup> [www.rollingroads.com/gary/miwi.shtml](http://www.rollingroads.com/gary/miwi.shtml)

<sup>14</sup> [www.austen.com/phorum/read.php?5,30873,30873](http://www.austen.com/phorum/read.php?5,30873,30873)

<sup>15</sup> [www.quizilla.com/stories/7404508/10-signs-you-should-leavetwentytwo](http://www.quizilla.com/stories/7404508/10-signs-you-should-leavetwentytwo)

<sup>16</sup> <http://www.socyberty.com/Lifestyle-Choices/How-to-Get-Advantage-of-Your-Willpower.57838>

<sup>17</sup> [patunru.blogspot.com/](http://patunru.blogspot.com/)

<sup>18</sup> [www.independent.co.uk/opinion/dont-spoil-my-train-of-thought-br-the-bike-and-the-bass-1593438.html](http://www.independent.co.uk/opinion/dont-spoil-my-train-of-thought-br-the-bike-and-the-bass-1593438.html)

<sup>19</sup> [www.cbs.nl/en-GB/menu/themas/bevolking/publicaties/artikelen/archief/2005/2005-1717-wm.htm](http://www.cbs.nl/en-GB/menu/themas/bevolking/publicaties/artikelen/archief/2005/2005-1717-wm.htm)

<sup>20</sup> [www.fictionwise.com/ebooks/eBook3935.htm](http://www.fictionwise.com/ebooks/eBook3935.htm)

<sup>21</sup> [www.clair.or.jp/e/forum/pdf\\_205/jet.pdf](http://www.clair.or.jp/e/forum/pdf_205/jet.pdf)

<sup>22</sup> [flexibleparenting.com/2009/03/grays-corned-beef.html](http://flexibleparenting.com/2009/03/grays-corned-beef.html)

<sup>23</sup> [www.city-data.com/forum/north-carolina/469829-state-residency-college-students.html](http://www.city-data.com/forum/north-carolina/469829-state-residency-college-students.html)

<sup>24</sup> [www.bowdoin.edu/bowdoinmagazine/archives/features/004383.shtml](http://www.bowdoin.edu/bowdoinmagazine/archives/features/004383.shtml)

<sup>25</sup> <http://www.mumsnet.com/Talk/sleep/710361-So-proud-of-DS-lt-lt-coughs-gt-gt-and>



<sup>26</sup> www.asian-efl-journal.com/june\_2003\_PN.php - 53k

<sup>27</sup> For the distinction between ET, RT and ST see [22], as well as [10].

<sup>28</sup> milanandarchana.com/aboutus.html

<sup>29</sup> www.bized.co.uk/educators/16-19/tourism/working/activity/prepare1.htm

<sup>30</sup> rschool.hit.bg/docs/Iordanka%20Nedkova.doc

<sup>31</sup> http://www.guardian.co.uk/business/2008/08/27/ryanair.theairlineindustry

<sup>32</sup> www.wired.com/techbiz/it/magazine/17-02/ff\_killgoogle

<sup>33</sup> http://ipsnews.net/news.asp?idnews=41513

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## THE ARMY'S PRESENCE FOR HOLIDAYS AND FESTIVITIES IN CONSTANTA, STARTING WITH THE REINTEGRATION AND UP TO THE INTEGRATION WAR(1878 – 1916)

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**ABSTRACT:** *At the end of the 19th century and the beginning of the 20th, there were various reasons for celebrations in Constanta; some events turned into real fairy-like shows, while the army would be present at all these celebrations specific to the „La belle époque”. „The Epiphany” (also known as „consecrating the waters”) on the 6th of January; celebrating the Union of the Principalities on the 24th of January; King Carol's birthday; The Kingdom's Proclamation; the 10th of May, the day when the foreign monarchy was brought to power and which became the national day; the 15th of August, „ The Navy's Day”; the 30th of August, the assault on the Grivita sponce during the Independence War and the 14th of November, the day when Dobrugea was taken over by the Romanian administration; there were also events such as the visit of different personalities of the time , for example the Russian Tsar; all these were events which brought forward the army's image in Dobrugea giving the manifestations an official and holiday-like character.*

*On the other hand, the army's presence at such events would strengthen certain national aspirations, such as the launching of various slogans which pointed out to the union of all Romanians, to the forming of The Great Romania.*

*One shouldn't neglect the other aspect concerning the army, meaning the facilities which it could offer at different festivities; for example, the fireworks, the artillery gun shots, the brass band („the military music”), retiring with torches but especially the military ships that were ornated with flags and lights, the boat contests, etc., elements which round up the picture of the age, the citizen's taste for fairy-like shows.*

*Other military branches were present at the festivities: the police state, policemen, firemen, also wearing festive uniforms. But the sailors were the ones who would mostly impose themselves; Constanta has always been associated to what should be the citizen's main concern.*

*Key word : Constanta, army, events, festivities, „The Epiphany”, the national day, „The Navy's Day”.*

The army has played an important part in Constanta, especially when we refer to the city's image; this role was conferred by Carol I since 1878 when the Romanian troops have crossed over Dobrogea in order to occupy it according to the rules established by the Peace Treaty from Berlin; the former was also an act of territorial integration, given that the province had been a part of the Romanian territory since Mircea the Old's rule. That is why the Romanian state has not hesitated to affirm its suzerainty over the province; all these events show that the military parades given on different occasions ,have also had the

role to show the army's power. The same would take place in all European countries during „La belle époque”; such celebrations were one of the distinctive traits of those times. Carol I has started the national celebrations which had a military flavor, since the end of the Independence War. On the 29th August/30th of September 1878 he disposed that „the next day (the 30th of August), the anniversary of the battle in Plevna( Grivița, n.a.), should be celebrated all over the country.” Because the 30th of August was also the Russian Tsar's birthday, Carol I sent him a telegram in which he eulogized the 2 allied armies' bravery; the 2” have shed their blood

in front of the resistance at Plevna”; he then sent another telegram to the War Minister whom he asked to „ express his love to the armies and to assure them of his concern for them”<sup>1</sup>. A month later, on Sunday 8/20 October 1878, the solemn entry of the troops in Bucharest, was celebrated.

The way in which those who had fought on The Balcans were celebrated, was to become an symbol for the national holidays held under Carol I’s rule. The citizens would be announced since dawn, by 21st cannon shots that „the day was to have a rare celebration”.

At 11.15 the ruler on horseback, surrounded by his retainers, has inspected the troops and has received General Cernat’s report on the field in Baneasa. He, then, has received the troops’ parade, has attended the sermon and has decorated the battle flags” accompanied by music and cheers”, has read the daily programme and has ended saying” Thank you, children”, an expression which was symbolic of the ruler’s assuming the parent’s role for his people.

Then the cortege has made its entrance in the capital city passing under a triumph arch ornated with flags and guns. Here, the ruler was received by the mayor with bread and salt, accompanied by the audience’s frantic cheers; he received a crown with oak branches, a symbol of durability and listened to the authorities’, scholars’ and corporates’ speeches; the latter offered him „ flowers and crowns”. The cortege crossed the city going along Kiseleff street and the Victory Avenue, the main through route in Bucharest, bearing its name in the memory of the events which led to obtaining the independence.

They went along an ornated road, while the crowd cheered and acclaimed its winners. In the theatre Market, the ruler and his queen have watched the troops’ parade; a major interest was shown to the cannons taken from the Turks. The latter were placed near Michael The Great’s statue.<sup>2</sup> Everything turned into a true procession full of symbols which would

become the model for these celebrations; it must be mentioned that in the provinces, the ruler’s place was fulfilled by the prefect, the bishop according to the type of celebration to be held. At nights there were soirees at the palace accompanied by the military music which was always present; the crowds would always admire the lights<sup>3</sup>. All these manifestations are to be seen in Constanta, year after year; they became almost mandatory! The army, the police officers and the peace officers were always present at the national holidays, the greatest being on the 24th of January which celebrated The Union of the Principalities.

But the most important holidays were the ones dedicated to the foreign monarchy or to its achievements: Carol I’s birthday, The Kingdom’s Proclamation and the 10th of May, the day the foreign ruler was installed and which became the national day; the 30th of August, the assault on Grivita during the Independence War or the 14th of November, the day Dobrogea was taken over by the Romanian administration. There were also religious celebrations: The Epiphany, Sain Mary, the latter becoming one of the most important religious celebration held up to the present; and the Navy’s.

What part did the army play in these manifestations? As previously mentioned, its role was mainly to sustain an image, the uniforms and the parades were in the headlines! On the other hand the army would bring forward the brass-band’s music, the fireworks ordered from the Army’s arsenal, the ships decorated with flags and lights, the artillery fusillades, the torches and even the elements of logistics. Surely the celebrations would have appeared poor, maybe even lacking sense without the army’s support; in a world in which the only source of information were the press, later the cinema while the promenades and the public celebrations were a the only ways of spending free time and of socializing.

#### THE EPIPHANY

The celebrations in Constanta started with a religious event which was highly regarded due

<sup>1</sup> Stelian NEAGOE (Editor), *Memoriile regelui Carol I al României de un martor ocular*, volumul IV, Editura Machiavelli, Bucureşti, 1994, p. 155.

<sup>2</sup> *Ibidem*, p. 165-167.

<sup>3</sup> *Ibidem*, p. 167-168.

to the importance of the naval space. On the 6th of January, people celebrated the Epiphany, also known as the day when "waters are consecrated" and dedicated to The Lord's baptism.

The bishop of the Lower Danube would come to the ceremony to conduct the sermon; other local high officials would also attend. The sermon was held at Greek Church, initially the only Christian church in the city; then the cortege would move to „the seaside, stopping near the harbour's headquarters where the waters were consecrated”<sup>4</sup>. The route changed, beginning with the end of the 19th century when the Christian Cathedral was open to use. The authorities and the military attended the sermon. After the sermon was concluded, the cortege went to the harbour, in the following order: the policemen, wearing ceremonial helmets (as well as the military), who made way through the crowds, then came those carrying the Holy Cross, the choir, the bishop and the clergy, who blessed and incensed the crowds, the military and civil authorities; the cortege was ended by the military units and the brass-band. Then, came the committee for consecrating the waters together with the city's high officials, announced by 21st cannon fusillades. The cortege would return in the same order to the cathedral. The costs for the celebration were high; building the arbour (pavilion) cost 1250 lei in 1916<sup>5</sup>.

#### THE UNION OF THE PRINCIPALITIES

The Union of the Principalities has had a special significance for the Romanians, especially for the citizens of Constanta.

The 24th of January usually started with celebrations held in schools and inaugurated by the students' choirs who interpreted the national hymn in front of the high officials and the audience (parents, the priest and teachers). Then the principal delivered a speech about the importance and the signification of the Union.<sup>6</sup> On the 24th of January 1909, at the

boy school №2 in Constanța there was even a sketch, entitled „The Union of the Principalities” played by the students; the Town Hall spent 33 lei for putting the show on.<sup>7</sup>

There were parties thrown in the evenings, usually at the Constanta's Youth Club; the mayor and the prefect would attend them. The mayor usually delivered a speech and then the celebration would actually start. The two of them were also involved in the celebration: reciting poems or singing, sometimes accompanied by their wives. The wives usually took piano or canto lessons, either privately or at the boarding school. The songs had a strong national character (ballads or romances with lyrics written by famous poets) and the celebration would be ended by a powerful „Awake thyself Romanian!”, sang by everyone present.<sup>8</sup> The golden jubilee held in 1909, was celebrated with grand pomp.” At the church, at the theater, at the military base, at the literary, the arts and the sports societies, people no longer had room to fit in Everywhere, the crowds were animated by the same powerful feelings just like 50 years ago”.<sup>9</sup>

#### THE KING'S BIRTHDAY

„His Majesty's birthday and proclamation” was celebrated on the 8th of April; a Te-Deum was officiated: the Town Hall's officials had to attend. At the beginning it took place in the Greek Church with all” the rightful honours”.<sup>10</sup>

#### THE 14TH OF APRIL, THE KINGDOM'S PROCLAMATION

This anniversary was a moral obligation; thus, the city's officials had to imbue it with a festive character:” Us, the mayor's replacement, Alexandru Logaride, given that tomorrow 14/26 current( April.n.n), is the celebration of The Kingdom's Proclamation, and thus it has to be celebrated, we decide.....”<sup>11</sup>. And then, the city official delegated the chief of police to illuminate the Town Hall's

<sup>4</sup> Direcția Județeană Constanța a Arhivelor Naționale, Fond Primăria Constanța, (infra F.P.C.), dosar 11/1885, f. 1.

<sup>5</sup> *Ibidem*, dosar 9/1916, f. 1.

<sup>6</sup> „Dobrogea jună”, an I, nr.9, 6 februarie 1905, p. 2.

<sup>7</sup> F.P.C., dosar 30/1909, f. 10.

<sup>8</sup> „Constanța”, an X, nr. 359, 28 ianuarie 1901, p. 5.

<sup>9</sup> „Conservatorul Constanței”, an I, nr.3, 1 februarie 1909, p. 2.

<sup>10</sup> F.P.C., dosar 11/1885, f. 4.

<sup>11</sup> *Ibidem*, f. 2.

festivity room, for which the latter received 50 lei. The celebration also included a Te Deum, at first at the Greek Church; the army was always present for the military honours together with the Communal Council and the Town Hall's clerks, gathered especially for this occasion.<sup>12</sup>

#### 10TH OF MAY, THE NATIONAL DAY

The date was considered extremely important: "given that the 10th of May is the anniversary of the Kingdom's Proclamation of Independence, it follows that it will be celebrated with pomp"<sup>13</sup>. After the Te Deum, the authorities' reception party was held. The event gathered lots of personalities such as: representatives of the foreign powers, local authorities, teachers, doctors, the Christian and Muslim clergies, businessmen; a special place was reserved „for the military body of the harbour's captain."<sup>14</sup> the commander of the Active Division of Dobrogea was asked to provide the prefect with the necessary fireworks"; in 1898 the fireworks' price raised to 400 lei<sup>15</sup>.

The papers used to write all kinds of articles, showing the event's importance<sup>16</sup>, thus publishing patriotic slogans which seemed to be taken out from Caragiale's plays. For example „Young Dobrogea" eulogized „the boyar's sons who have eaten loaves of bread abroad and have learnt to suffer and to sacrifice themselves for the people" and ended with the following" have you ever asked yourselves what the flag means for a military? It signifies the union. It signifies the glory. It signifies the country."(chic!)<sup>17</sup>.

The Town Hall wouldn't fall behind, constantly sending adhesion letters for the monarchy"<sup>18</sup>.

The city was decorated and arches of triumph were built<sup>19</sup>, while the traders and the common citizens competed in decorating their houses and shops. At night, the city was lit, especially The Independence Market, which was crowded with people.<sup>20</sup> The day usually ended with a recession accompanied by torches and the brass band's music. The 34 infantry regiment was irreplaceable for its logistics:" This regiment's playing on the 10th of May along the Avenue, when it will take its march at the administration Palace and the Town Hall, needs 8 torches and 8 lamps with candles"<sup>21</sup>.

The day was greatly celebrated in 1909, since it symbolized Carol I's jubilee for 40 years of ruling. The Town Hall built a stage(platform) for the march(parade) and the recession was to be done late at night with torches; lots of flags were manufactured.<sup>22</sup>

The mayor received the medal in order to wear it the next day for the meeting with the sovereign where the rest of the mayors were expected.<sup>23</sup> At 8 o'clock in the morning 21 artillery fusillades were fired from the „Elizabeth" cruiser; the boats were ornate with flags and banners. The national flag streamed on top of every house.<sup>24</sup>

At the Administrative Palace, on such occasions, the council's clerks, the officers and the clergy( including the Muslims) as well as the chiefs of every public services congratulated the prefect.

The military units marched along the previously well cleaned streets, by the firemen. At night the recession group, with torches and accompanied by the brass-band's music, would go along the Independence square, where music was performed until 11 at night. Meanwhile, inside the Town Hall a reception was held; the guests would serve campaign and crackers.<sup>25</sup> Te-Deums would also be

<sup>12</sup> *Ibidem*, f. 3.

<sup>13</sup> *Ibidem*, dosar 8/1893, f. 9.

<sup>14</sup> *Ibidem*, f. 12.

<sup>15</sup> *Ibidem*, dosar 10/1898, f. 4.

<sup>16</sup> „Constanța", an IX, nr. 333, 9 aprilie 1900, p. 3-4.

<sup>17</sup> „Dobrogea jună", an I, nr.23, 15 aprilie 1905, p. 1.

<sup>18</sup> Such a letter (signed by the mayor Polizu-Micșunești) expressed „feelings of unconditional love and devotion towards the monarchy", ends with: „Respectfully Sire, please receive Constanta's Communal Council's fidelity insurance" – F.P.C., dosar 12/1900, f. 20.

<sup>19</sup> *Ibidem*, f. 15.

<sup>20</sup> *Ibidem*, dosar 11/1906, f. 62.

<sup>21</sup> *Ibidem*, dosar 10/1898, f. 5

<sup>22</sup> *Ibidem*, f. 66.

<sup>23</sup> *Ibidem*, f. 84, 85.

<sup>24</sup> „Conservatorul Constanței", an I, nr. 15, 14 mai 1909, p. 3.

<sup>25</sup> F.P.C., dosar 10/1898, f. 67 și f. 69. Concerning the subject, see Constantin CIOROIU, Marian MOISE,

organized when the queen celebrated her birthday<sup>26</sup>, and letters of fidelity would be sent:” Today is a day of luck and joy for the people. On behalf of the City council and of Constanta itself, we bound with love and devotion, wishing you many more years in order to be able to dedicating your pride, virtue to our beloved sovereign”; thus, sound the telegram sent to queen Elizabeth, while in Lugano, Italy in 1906<sup>27</sup>.

### GRIVIȚA AND PLEVNA’S VICTORY DAYS

The 30th of August, when people celebrated the taking over of Grivita in 1877, was mainly a military celebration, famous for its artillery fusillades and the pyrotechnic effects. That is why the Town Hall had to order the fireworks ahead from the ”Army’s Pyrotechnic Unit”; the budgets were mostly insufficient to cover the expenses needed for these light shows.<sup>28</sup>

This day also started with a Te Deum at the Christian church” celebrating this glorious day and the memory of the brave soldiers who have died in the battle. ”Being a military celebration it was the troops’ commander’s turn to invite the Town Hall to the ceremony.

The celebration re-edited on the 28th of November, on the occasion of Plevna’s taking; both celebrations had a special significance for the city which was taken over by the Romanian administration in 1878. orders were placed at the ”Army’s Pyrotechnic Unit” which couldn’t manufacture „torches” but could ”manufacture fireworks with different colours”; the prices ranged from 2,30- 5 lei, according to the colour”<sup>29</sup>

### THE 14TH OF NOVEMBER

The 14 th of November, although a celebration specific to the people from Dobrogea, was a favorable moment for launching political slogans which regarded the people’s integration with the other” daughters scattered far from the mother country towards the nest where our nationality was born”. The

newspapers articles ended with a hope that” devotion will make our dream of being united within A Great Romania, come true!”<sup>30</sup>.

### THE NAVY’S DAY

The Navy’s Day represented a special local celebration, which required huge expenses and pomp. Alongside the religious service, previously mentioned, a water carnival was also organized; the expenses and the fantasies growing by the year.

The Navy’s Day originates in the famous „boat races” organized on the 16th of August as an amusement for the people coming for the baths, since the end of the 19th century. The organizing party included important people such as:” A committee made up of the county’s prefect, Mr. H. Haris, vice council of Spain, Mr. Reid, vice council of Holland, De Rolfe, commander of „Kokatrice”, Colonel Eustațiu, commander of the „Elizabeth”, the harbour’s captain, Atanasiu, The Navy’s inspector and the subscriber, have organized a series of diversions for the public present.

„Among these celebrations the most important is „The Boat Race” held this Sunday, in the harbour”. The races needed police protection due to the large amount of people attending them<sup>31</sup>. The Boat Races comprised, as announced by the organizers:” races with yawls, war ships, commercial boats, swimming races for people, children in order to catch ducks and divers; hilarious races with prizes.”<sup>32</sup>.

Later on, allegorical manifestations and attractive races were added: runnings, Venetian soirees, balls on water, allegorical boats, America’s discovery, Medusa’s shipwreck, the Argonauts’ship etc. Along these races and allegorical subjects, the organizers came up with new ideas since more and more political personalities attended the events. They started organizing banquets, selling tickets and awarding prizes, using fireworks and fusillades, „apparitions of marine monsters”, soirees with violins and guitars, swimming and polo competitions, bike

*Litoralul românesc la 1900*, Editura Europolis, Constanța, 2001, p. 121-122.

<sup>26</sup> *Ibidem*, dosar 12/1900, f. 13.

<sup>27</sup> *Ibidem*, dosar 11/1906, f. 10.

<sup>28</sup> *Ibidem*, dosar 12/1900, f. 38.

<sup>29</sup> F.P.C., dosar 10/1898, f. 84 și 84v.

<sup>30</sup> „Viitorul Dobrogei”, an I, nr.30, 23 noiembrie 1908, p. 2 apud Stoica Lascu, *op. cit.*, p.411.

<sup>31</sup> F.P.C., file 10/1898, f. 66-68.

<sup>32</sup> *Ibidem*, f. 61.

jumps into the sea, balls at the local casino. Thus, „The Navy’s Day” gradually became a popular celebration, full of glamour, joy and colour; it later turned into a symbol of Constanța<sup>33</sup>.

Let’s not forget that religion still highly influenced daily life in the 19th century, while, in Europe, it represented a political tool, in a world still dominated by the monarchs. Religious life in Constanța, was highly competitive due to the large number of cults a hundred years ago.

The Navy’s Day” was celebrated on the 15th of August. On Thursday the 15th of August 1902, the Navy’s patron was first celebrated. The official festivity took place on the Elizabeth cruiser while important figures attended: the war minister Sturdza, general Vasile Năsturel, commander of the active division, and a few officers operating ashore. Besides, all the officers operating at sea, would also attend the ceremony. Beginning with 1904, the religious service was performed aboard a military ship( that year, the Grivita gunboat).<sup>34</sup>

The royal family was received with pomp in Constanța.

Several military events with marine significations were presented on this occasion. In 1898 the royal family visits Constanța, to inaugurate the harbour’s developments and a citizen, Arap Said, borrows the technical service of the Town hall in order to decorate” the arch of triumph from the Independence square, a small golden war ship with all the necessary items: chains, guns, boats etc”<sup>35</sup>, obviously to please the sovereigns.

It is interesting to notice that on several occasions the wives of various officials were awarded with military titles such as” Mrs. Colonel Maria Kirîțescu, the county prefect’s wife”; the former gave birth to a women’s committee meant to raise funds to buy a wedding present for Mary of Edinborough, on her marriage with the heir prince, Ferdinand.

We should notice that the committee’s vice president was a lady,” Colonel Smaranda Nanu”<sup>36</sup>, due to the militaries’ authority and credibility.

The celebration held on different events have been a way of spending free time and of integrating the new- comers into the city’s life. The festive flavor which characterized these manifestations, represented a good way for participating at the collective frenzy, for making new acquaintances and an important coordinate of the daily life in those times.

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<sup>34</sup> Marian MOȘNEAGU, *op. cit.*, p.19.

<sup>35</sup> F.P.C., file 10/1898, f. 2.

<sup>36</sup> F.P.C., file 8/1893, f. 15.

## THE HUMAN MOTIVATION: THEORIES AND THEIR APPLICATIONS AT THE LEVEL OF THE HUMAN RESOURCES WITHIN THE TEACHING SYSTEM

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*ABSTRACT: The human motivation represents one of the most important parts of each organisation. The syntagm “nothing is more practical than a good theory” best applies at the level of human motivation. Even the communist regime used the human motivation under the form of the Russian regime/ or the local variant of using the working elevation of the foremen in order to meet with the industrial objectives, the final aim being the raising of work efficiency. If in the beginning the communist regime ensured as motivation certain material stimuli, such as: priorities when it came to buy an apartment, tickets for holidays, or the latest gadgets, for example the first TV sets; being assigned several attributions within the party; the party’s canteens, the consolidation of the top nomenclature, Ceausescu’s dictator ship, now motivation is placed more and more within the ideological, abstract level meaning that these mechanisms no longer have results, the latter being one of the reasons for the failure and crush of the regime. After 1989 revealing these ideological mechanisms has turned the scientific world towards the analysis of the motivational mechanisms, including the field of education. The perpetuation of certain authoritative mentalities, based on experience and groups of interests has placed human motivation on the second place.*

*The right analysis of the motivational theories of evolution, places us in a world of the objective. The Anglo-Saxon world has rapidly evolved towards the organised success because it balanced the relation between the employers and the employees within the domain of the managing practice. Moreover the wish to improve efficiency has become the vector of enterprise development, and trying to motivate people to work harder in order to have better results, was a reality which started with practice and ended up in theory.*

*Nowadays, people talk about the classic management and the contemporary one in the field of education, trying to make the difference between the two aspects at the educational level, as well. But, this evolution cannot be properly understood without analysing the theories of: Douglas McGregor, Abraham Maslow and Frederick Herzberg. After all, each of the authors above mentioned, have approached the human behaviour from different perspectives within the working process. Thus, each of them can offer a manager who wishes to be successfully, various ways to improve the organisation performance, based on its informal vantage too. The human resource cannot be debated in theory due to its extraordinary dynamics. Knowing the employees’ pregnant tendencies, acting in order to transform the dissolution factors into beneficial energies, which ensure the organisation’s success , should represent a priority for any manager who looks out to the future.*

*Key word : human motivation , manager, education, working process, performance*

Romanian education suffers nowadays, as everybody working within the domain can see, of a serious crisis of identity. This crisis is caused not so much by the attempt to connect to some successful management patterns, originating from the Anglo-Saxon area, but in fact, have their origins in practice. If the

classical management focussed on standardizing productive developments, the aim being that offering the employers raises in quantity, after World War II theorists relied on a motivational process, seen as generating organizational success but also work satisfaction. In the specialized literature no



less than 140 definitions<sup>1</sup> for motivation were identified, which proves the importance of the concept in our epoch. A skilful leader must avoid the error of assuming that whatever motivates him also motivates the others. The complexity of the problem urged me to tackle in the present study several theories that focused on motivation and which seemed to me very useful for the educative process from the perspective of their practical effects.

**1. “Why do people work?”<sup>2</sup> - Douglas Mc. Gregor**

Douglas Mc. Gregor may be considered a pioneer in the field of human motivation. This theory, shortly entitled X and Y Theory comes from extremely realistic observation: People work or not due to a certain perception of reality, to a certain mood behaviours that can be altered by motivation. In his work “The Human Side of Enterprise” published in 1960, he identified two groups of supposition on people and their work, which he named “Theory X” and “Theory Y”.

and by insecurity of his job position	<i>motivated by the desire to show his own potentialities and the self-imposed discipline is, most often, more severe and efficient</i>
- Most people have a limited creativity, except the instances they want to avoid the rules imposed by their bosses	<i>- Creativity and ingenuity are largely distributed and accelerated</i>

<b>Theory X</b>	<b>Theory Y</b>
- Man dislikes work and, if possible, avoids it	<i>- Work is considered a natural activity, obvious and necessary for man’s full development</i>
- Man must be coerced bribed to take the necessary efforts	<i>- Man wishes an interesting work and, having favorable conditions, works with pleasures.</i>
- Man prefers to be directed (to be led) instead of accepting responsibilities (which he avoids otherwise)	<i>- People seek accepted tasks and, in favorable context, accept even look for responsibilities</i>
- Man is motivated, especially by money	<i>- In favorable conditions, man is</i>

Although Theory X characterizes human nature at a gregarious level, we have to admit that these behaviors are real and their echoes can be noticed more or less in each of us. It all depends on the individual who is aware of them to use them if that person is in the situation to lead a team. A realistic manager, who wishes and who regards the collective as a dynamic body which means a great power to adapt, in a word as an organization, will use them to reorient by motivation in the Y factors. Whereas a boss who is badly oriented and can see in the X characteristics only a way to speculate in his own interest, or to serve to group of interest to which he is a part of, so “to hold to his position”, will use the management science to strengthen his control creating an environment of fear and terror, in which any personal initiative is nipped in the bud or substituted by flattery, will in the end prove to be destructive for that organization, such as practice proved in so many instances.

Obviously, it is more than evident the superiority of “Theory Y” which values people and their activity as such. Romania’s totalitarian system, and not only here, induced (in spite of declaration and ideology seemingly opposite) “Theory X”, a reason which explains its perpetuance in the mentality of institution leaders in own country. On the other hand, as we will notice further on, neither “theory Y” is the fittest in any situation. A combination of the Theories X and Y applied to the manager and employers will lead to four specific situations:

<sup>1</sup> Ticu CONSTANTINESCU, *Evaluarea psihologică a personalului*, Polirom, Iași, 2004, p. 170.

<sup>2</sup> Șerban IOSIFESCU (coordonator), *Managementul educațional pentru instituțiile de învățământ*, ministerul Educației și Cercetării, București, 2001, p. 47-48; Paloma PETRESCU, Lucia ȘIRINIAN, *Management educațional*, Editura Dacia, Cluj Napoca, 2002, p. 72.

The manager supposed		X	Y
The employers act	X	1	2
According to theory	Y	3	4

- Situation 4 is obviously, the ideal one: co-workers work “out of pleasure” and the manager treats them accordingly. Thus, there is a high level performance as well as a self satisfaction during the work process.
- In Situation 1, goals are met, even if satisfaction lacks (or maybe, there is some?) in both sides, because subordinates work out of fear pr for material advantages, and the manager act accordingly.
- In Situation 2, the school principal supposed that his employers work out of fear or for money, whereas the latter are really “in love” with their work. Even if et the beginning of the “relationship”, performance is at high level, this incompatibility in approach leads, in time, to a diminishing of work satisfaction at staff level and, finally, either to conflict, or to a general non-involvement, implicitly to a diminishing in performance.
- In situation 3, the problem is reversed: the manager is indeed convinced that his employees work passionately and, thus, based on a supposed conscientious activity, control is almost non-existent. Whereas the employees could get some results but only under hierarchic pressure.

It follows: failure to finalize job aims because of lack of control and a high dissatisfaction and disappointment for the manager, to which administrative consequences may be added.

The natural tendency is to place the relationships between leaders and staff in situation numbered 4. but this can be done only going deeper into the problems of motivation, identifying the factors that motivate people, that make them work and, especially, to contribute with all their skills (even surpassing themselves, at times) to achieve the final goals of the organization, in our case, education. On the factors that, on the contrary, lead them to lag behind as much as possible, wearing out in all sorts of out of school activities and its purpose. The idea the leader of the institution develops regarding

work motivation in his employers will leave a point in his leading ways.

**2. “Hierarchy of human necessities”<sup>3</sup> – Abraham Maslow**

Maslow’s theory (probably the best-known theory of motivation) can be applied in every domain of human relationship. To create it, the author started from the following prerequisites: human behavior is conducted by those requirements (needs) which are not satisfied:

- A man is never totally satisfied: when some needs are satisfied, other appear
- There is a certain order (hierarchy) in the emerging and satisfying of needs, broadly the same for all people
- Generally, not satisfying inferior needs prevents the appearance for the superior ones

This observation led him to identify and experiment a hierarchic system, on multiples levels, of human necessities, as follows:

- Level I: physiological needs – air, water, sleep, food, sex, shelter, relief of pain
- Level II: needs liked to security (safety) both physical and psysical
- Level III: needs of belonging – to a social group or other, friendship, love, tenderness etc.
- Level IV: needs of esteem and recognition – self esteem but also from others, independence and freedom but also of property
- Level V: needs for self analyses – growing, self fulfillment developing, creation

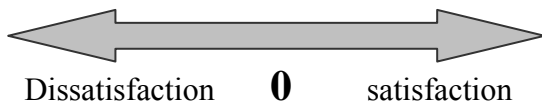
Though later this theory has met with many variants and adaptations, some authors pointing to more (or less), levels of needs or combining the existing ones, its validity and also, utility are still appreciated.

This hierarchy has been imagined by Maslow in the shape of a pyramid, whose top, representing to need for self –development, leans on the basis of physiological needs and the other middle levels.

<sup>3</sup> Șerban Iosifescu (coordonator), *op. cit.*, p. 49-51.

### 3. Global analysis of the satisfaction-motivation system or “The Theory of the two factors” – Frederick Hertzberg<sup>4</sup>

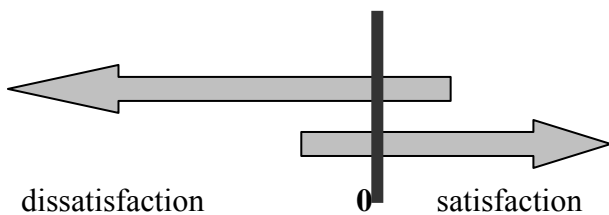
It is generally considered that the presence of some objects, persons, feelings, etc. produces satisfaction, whereas their absence produces dissatisfaction (for instance a good TV film, an able manager...). Or the other way round: the presence of some objects, persons, etc. leads to dissatisfaction, and their absence (e.g., a certain Kind of music, a patronizing boss...), satisfaction. This is a unifactorial concept with places on the same vector satisfaction and dissatisfaction, with an “O” point (which most often means indifference) as in the model below.



Hertzberg analyzing the effort level of different people during work, reached other conclusions, quite interesting:

- generally, people use in the working process about 75% of their total capacity for effort;
- there are factors, named “hygienic” or “for maintains” by Herzberg which contribute to maintain this average effort level, whose presence (or absence) leads mostly to dissatisfaction.
- There are, generally, other factors, named “motivational” by Herzberg, which determine a surpassing of this effort level, whose presence (or absence) leads mostly to satisfaction.

So be remarked, there are two categories of factors (giving the name of theories) which produce dissatisfaction, respectively:



Of the first category of factors for maintains it is worth mentioning those closely related to organization:

- wages
- personal relationship
- work conditions and safety
- means to supervise and control; general policy of organization

The second category has factors with a greater power for motivation:

- work proper
- results
- deserve recognition of achievements
- heaving responsibilities
- growth, personal development

To get from students or teachers – a steady effort and a high quality and also outstanding performance, we must at first set aside those factors that produce dissatisfaction, by creating a proper educational environment which should include also proper relationships with mates, teacher and other persons involved. Only then the teacher/manager principal can provide a growth in effort (i.e. performance as well) bringing forth “motivation” factors.

The learning activity is by itself motivating, if it answers the students’ capacity, needs, interest and experience. We all have noticed that they get better results to the subject they are interested in and for which they have the necessary capacities. This goes for teachers too: starting from the premise that they came to the “teacher’s desk” because they wished this job, we can assume that they like and are interested in the job of being a teacher.

That is why there must be suggested and offered tasks them (in the good sense of the word), to allow them to show their abilities. Once the results are got, the able manager must be all means publicity recognize them: one knows the benefits of a “Bravo!” (Good job!) uttered before colleagues and which can be more motivating than an eventual material reward, but “unadvertised”. Some theorists see in “Deserved recognition” the key to motivational process: on one hand the award is the condition of passing to higher levels of motivation, and on the other hand, not awarding creates situations of non-motivation which lead either to a behavior of “minimal effort”, or to attempt of getting “recognition”

<sup>4</sup> *Ibidem*, p. 51-53.

by other means: criticism, political or union activities and, most often, channeling of energies outside School, e.g. tutoring and small collateral business, both bringing money and recognition. Once his abilities are recognized, the teacher must get enhanced responsibilities in the field he showed he wants and can, by a suitable delegation of responsibilities. The much talked about decentralization should force this process by stressing the growth both in performance and in work satisfaction, if the teachers are given, by delegation, extra tasks which can create a feeling of permanent evolution and self-fulfillment. To amplify the positive effects, the principal looking into the future should supply his colleagues with other means of (self) formation by help of refreshment courses, lectures, etc. diversified in form and themes and adapted to real and expressed needs. Thus a successful manager must not neglect that employees cannot get outstanding results if they do not like what they do and non-existent results should not be “recognized”, whereas the “leap” over the natural steps of the motivational process has reversed effects: lack of any work satisfaction and content to be mediocre.

In the above context the analyses of satisfaction regarding working conditions becomes essential.

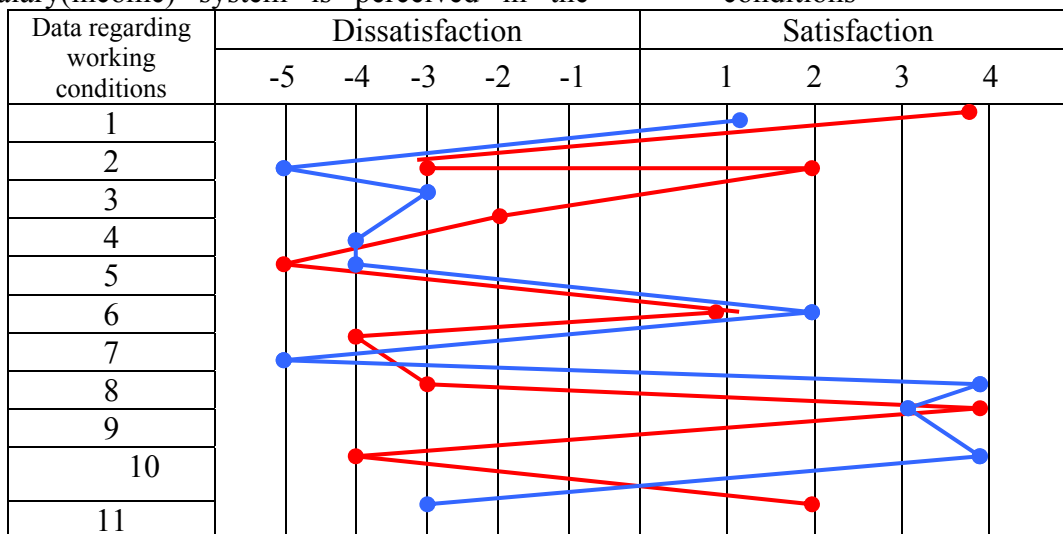
Quantification should have as realistic land marks aspects linked to work satisfaction or the way in which the motivation-salary(income) system is perceived in the

target analyzed institution. One can produce a grill to analyze working conditions, an ingredient directly linked to the “satisfaction” dimension of the professional activity by which we are interested in:

- a. achieving a profile of the appreciations made by a team (company or department employees) regarding working conditions;
- b. exploring the possibilities to get a growth in employees’ satisfaction level;

The steps to apply these procedures are:

1. Team members offer an individual list with satisfaction criteria linked to working conditions, answering the question: “What makes an activity/work be more interesting?” Or: “which are the working conditions you are content with: which are the working conditions you are discontent with?”.
2. The analyst sums up the individual evaluations and makes a list of conditions/criteria be attaches a scale with 5 or 7 levels with which the employees will evaluate each of the conditions /criteria chosen.
3. the analyst evaluates the opinions of all the team members by help of this grill and synthesizes the team results
4. discussing with the team or with “group experts” of trhe results and possibilities to improve working conditions



- Body of teaching

- Body of non-teaching and auxiliary personnel

- 1 = Employment
- 2 = Work organization
- 3 = Material conditions
- 4 = Changing procedures
- 6 = Payment system
- 7 = Promotion system
- 8 = Skill enhancing courses
- 9 = Constant information
- 10 = Relationship with colleagues
- 11 = Relationships with boss/supervisors
- 12 = School belonging

In the same way we can analyze employees' opinions about the way work is organized, the means the communication system works or the efficiency of the motivation or rewarding system in that institution etc.<sup>56</sup>

**4. Management by motivation**

Schoolchildren's motivation to involve themselves in activity management is different from that connected to solving the daily learning tasks and probably the mentality of a statutory authority of the teacher will still inhibit it.

Step by step, a conclusion was reached that more factors lead to obtaining a management success, but human motivation is paramount. The teaching methods used in learning motivation are more and more employed by the teacher: now, also as a manager, and his repertoire can enrich and diversity.

Thus, we can add and adapt, to motivate children as managers for their classroom activities, other strategies explicitly managerial, resulting from the above theories:

- Strategy with reward, mostly moral in case of children, recognition, praise, appreciation, awarding diplomats, encouragement, giving tasks, representation maybe even material rewards;
- Strategy for a progressive growth of performance level expected, within reach, at an individual or group level

- Strategies to redefine tasks, placing in more situations, anticipation of difficulties, preparation to overcome obstacles, prevention of conflicts
- Strategies to train or permanently evaluate and stating of varieties for daily decision to correct, adapt.
- Strategies to solve tasks with minimal resources, but affectively used
- Strategies to promote success in different situation
- Proposal of ambitions objective, but explained
- Awarding autonomy in organization, decision, coordination
- Support for stating and solving management initiatives
- Encouraging intra-intergroup relationship
- Strengthening the thrust in appreciation equality, regularly recognizing of work achievements
- Creating new vision on activity, admitting the need to change the working ways

Thus a participative management can be correlated by help of interactive management<sup>7</sup> and a correct analysis of motivational factors shows that there are dissatisfaction sources, apparently minor, especially in the eyes of the board, which can affect quite seriously the employees' state of mind, indirectly, their work efficiency, whereas there can be motivation factors, apparently minor, but with an stimulative effects. That is why a manager must consider different factors, characteristic to each organization and linked to: description of teachers state of mind, identification of factors leading to dissatisfaction to lower the tension between teachers and managers; identification of a new means to stimulate initiative, to boost up activity, etc.

Data resulting by help of those instruments can be used to produce a motivation system considering the dominant point applying the most employees (at a collective level) or, if

<sup>5</sup> Ticu Constantin, Ana Stoica-Constantin, *Managementul resurselor umane*, Institutul European, Iași, 2002, p. 101-103

<sup>6</sup> *Ibidem*, p. 103.

<sup>7</sup> Elena JOIȚA, *Management educațional. Profesorul manager; roluri și metodologie*, Editura Polirom, Iași. 2000, p. 97-100.

possible, the individual motivation dominant point. If for some employees it is more important to make an interesting work, to challenge them, in condition of free initiative (enterprise), for others it is more important to receive a recognition and verbal appreciation for a well done job.

That is why it is useful to create conditions for everybody to receive what he wishes, in the hope that this will lead to a higher efficiency and quality of the work done<sup>8</sup>.

The above theories must not be approaches in line but together, seen as a whole, each heaving the merit to tackle with a face of the relationship among members of an education unit, seen as an organization.

In essence final results are important, the practical applications of these theories and not their comparative value.

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<sup>8</sup> Ticu Constantin, Ana Stoica-Constantin, *op. cit.*, p. 101-104

## EUROPEAN DIMENSION IN EDUCATION

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**Abstract:** *One objective of European dimension in education is European citizenship, another is European conscience, and European behaviour. The term “citizen” has undergone a transformation from describing the relation to political authority to ‘living in society with other people, in a multiplicity of situations and circumstances,’ “having rights and duties in a democratic society”. Accepting this means that we are all teachers and learners, responsible for the construction of the future of our societies, for creating better and more inclusive societies.*

**Key words:** *European dimension, European values, European citizenship and conscience*

### 1. Introduction

The European dimension of teacher education refers to teacher education which takes into account the fact that we are living in a European society and no longer merely in national societies. The existence of a European economic, social and political area, in which each country is integrated, calls for this dimension; as in the past there was the need to construct a national dimension for teacher education, nowadays there's the same need for a European dimension. It is up to teacher education institutions, to the teaching profession, and to national and Community education policies to develop, with the cooperation of social partners, such a European dimension in the context of the progressive construction of the European Union.

### 2. The European dimension of teacher education curriculum

The European Union needs teachers who are prepared to promote student learning of a European education curriculum. The main reason for the need for a European student curriculum is neither their possible mobility to

study abroad, nor future freedom of movement workers are entitled to, but the fact that their horizon is European rather than national citizenship. The main justification for such a curriculum is not, therefore, the added value of European student and worker mobility stemming from being able to obtain identical education and qualifications in any Member State.

In fact, *the education for European citizenship* constitutes what could be called the first generation of the European dimension of education.

Through specific programmes, European Union institutions have been fostering both the construction of this European dimension in school curricula, by promoting trans-national partnerships among schools and teachers and the mobility of students, including, more recently, those from secondary education. However, there is still a long way to go to implement in all Member States the European dimension of education through school curricula and student mobility.

*European curriculum for teacher education.* As there is a European dimension of education, teachers need to be prepared for promoting it. Therefore, it is obvious that the

teacher education curriculum should also have a European dimension.

Besides the definition of the role of teachers in ensuring the European dimension of education, without establishing input and process-curriculum components, national and community policy measures aimed at supporting and encouraging the development of the European dimension of teacher education are also needed. Finally, policy measures aimed at external quality assurance of each teacher education programme also make sense, as guarantee of the appropriateness of the qualification to the fulfilment of the expected role of teachers.

### **3. Assurance of comparability of teacher qualifications in the European area**

The European dimension of education *curricula* calls for a European dimension of teacher education curricula, as mentioned. However, the latter dimension is also linked to the existence of a European education and employment *area* that calls for the assurance of comparability of professional qualifications of teachers in order to ensure their recognition within this area.

*A European area of teacher education and employment.* A European area of teacher education and employment means that:

- there are equal opportunities for any European citizen to obtain a teaching qualification, as a whole or in part, in each Member State;
- this qualification entitles her/him to teach in any other Member State; and
- s/he can be recruited for a teaching position in any other Member State.

The mobility of prospective teachers and of teachers already qualified in the European education and employment area is, above all, a European citizenship right.

### **4. A policy co-operation priority agenda towards the development of the European dimension of teacher education**

In the policy co-operation agenda towards the development of the European dimension of

teacher education two priority fields of action have herein been outlined:

- *The definition of a European teaching competences profile* that, on the one hand, includes those competences needed to ensure the teaching of a curriculum aimed at contributing to European citizenship education and to European economic, social and political development, and, on the other hand, is a reference for the organisation of teaching education programmes leading to comparable professional teaching qualifications in the European area;
- *Development or consolidation of comparability assurance systems of teaching qualifications obtained in several Member States*; if these systems turn out to be Member State-based, it will be necessary to agree on their common characteristics so they become mutually accepted in all Member States.

It should not be necessary to stress that accomplishing this agenda will mean long hard work, although the work has already begun. Some features of the perspectives herein outlined on the European dimension of teacher education constitute a forward-looking view which is perhaps polemic in nature. In addition, some issues of the agenda of the Common Objectives Process have not been dealt with, such as qualified teacher shortage in several Member States and the corresponding need to promote the attractiveness of the teaching profession. Although these issues are also linked to other factors, the above mentioned policy measures to promote the European dimension of teacher education could also significantly contribute to solve them.

Before concluding, it should also be noted that to make this European dimension effective, it is of strategic importance to consolidate and broaden the range of other Member States' languages future teachers have learned during basic and secondary education.

In a move towards the development of the European dimension of teacher education, the role that national policies and policy co-operation among Member States plays has been privileged throughout this article, as was stated at the beginning. However, the decisive



role of teacher education institutions and of the teaching profession in this process must also be underlined. Moreover, the process will only significantly move forward if there is a close link and joint efforts between these entities and political instances.

### 5. Democratic values and fundamental rights as the basis of European identity

The Charter of Fundamental Rights of the European Union was proclaimed in Nice. It sets out the civil, political, economic and social rights of European citizens under six headings: dignity, freedom, equality, solidarity, citizen's rights and justice. These rights are based on the fundamental rights and freedoms recognised by the European Convention for the Protection of Human Rights and Fundamental Freedoms mentioned above and on the constitutional traditions of the countries of the European Union.

Therefore, one of the main issues in the European Dimension in Teacher Education should be to foster fundamental rights and freedoms at all levels and recognise them as the core tradition of European identity.

### Conclusions

The multicultural approach is to be applied in a wider Europe where more different cultures will co-exist at the same level. In the future, several cultures, each one with its own past and with clearly differentiated development processes, will be in the process of constituting a unique political and cultural setting.

Enlargement will enhance cultural and linguistic variety and diversity within the EU. This will give rise to new requirements in terms of promoting and respecting linguistic and cultural identity, a common heritage of

cultural values and a common European identity. The protection of cultural minorities will also become more important in an enlarged Union.

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## INTERCULTURAL COMPETENCE – AN ASPECT OF PROFESSIONAL COMMUNICATION

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*Abstract:* This paper makes a critical presentation of some recent studies on cross-cultural competence and tries to determine the impact of these developments on the teaching of cross-cultural communication.

*Key words:* cross-cultural, communication, competence, teaching, skills, behaviour, intercultural.

### 1. INTRODUCTION

Many people may consider intercultural competence as the essence, not „an aspect”, of professional communication. They are absolutely right if we take into account the international settings for most of the activities carried out today. The diverse workforce on the global market, the intense labour migration stimulated by globalization and the permanent search of companies for new resources and new markets have contribute to the development of a general belief that everything is internationalized, when we come to discuss about jobs and markets. In such a context, „to communicate professionally” means indeed to be able to speak, write and act correctly on the job, that is, within the boundaries of your profession, no matter where in the world you may perform it. And this means no doubt to react adequately to all sorts of cultural environments different from your own. However, this is only one of the possible approaches to professional communication.

Considered from the perspective of the employee, professional communication means, first of all, to possess a certain set of skills that will help them to act adequately when they make phone calls or respond to phone calls, when they make oral presentations, take the floor in meetings or conduct meetings, when

they negotiate, or write letters, memos and reports at the work place. Unless it is a part of the training programme employees are going through, acquiring intercultural communication skills does not constitute a particular, visible preoccupation of the people engaged in various jobs and thus intercultural competence remains somehow a remote target for many of them. In this situation, one can say that intercultural competence is just an element of professional communication. It is only when an employee is on the point of taking a job abroad or when they are already in the midst of the culture shock that their interest in cultural matters arises. Culture issues may occur at the work place even when people interact with members of their own culture due to individual differences or to differences deriving from the subcultures they belong to. Sometimes this may lead to serious conflicts unless people are ready to accept these differences and learn how to capitalize on them. So, intercultural knowledge is necessary to develop a peaceful, comfortable work atmosphere favourable to positive peers and client relationships. The need to make employees aware of the influence culture has on their work and on their behaviour in general appears as a job requirement for which all those responsible for preparing people to become professionals, including the task of communicating culturally, should take on.

Companies but also educational institutions should get involved in this activity of helping people to acquire the skills they need to perform their profession at the required standard of quality. Under the present circumstances, when globalization has generated a large range of work opportunities, but has also brought strong competition within each profession, the description of highly competent employees necessarily includes the ability to communicate culturally successfully.

In this paper I will try to analyze the impact of the recent research in the field of cross-cultural competence on the teaching of cross-cultural communication at university level.

## 2. CULTURAL COMPETENCE. THEORETICAL APPROACH

Though now we are speaking more and more about the importance of intercultural or cross-cultural competence in many fields of activity, the one that painfully raised the point and stimulated research in this direction was international business. Some researchers have established more precise coordinates of the context in which the preoccupations for cross-cultural communication have occurred:

“The pace of globalization has increased significantly since 1989, with the collapse of the Soviet bloc, the creation of a single Europe, the implementation of the North American Free Trade Agreement (NAFTA), and the establishment of the World Trade Organization (WTO). More recently, China's accession to the WTO, renewed interest in expanding NAFTA to central and south America, a single European currency, the expansion of the European Union (...), and the emergence of the United States from an economic recession have all given added impetus to flows of global trade and investment.” [1]

Some years before, other researchers (Maddox, 1993) who had described the global economy as “a new game with new rules”, had rightly indicated the advances in computerization, telecommunications, and other forms of information technology as contributing tremendously to a “unified global

economy” (Maddox, 1993:2). As expected, business firms have intensified their competition for a share of the new world market. Finding new markets for their products, new sources of raw materials, and new, more cost-effective locations for manufacturing and assembly operations has become a business imperative. As Holstein stated (1989:18, quoted by Maddox, 1993:2), many companies felt that “to survive is to be global”. But not all of them could do that as desired and, as many studies show (Tung, 1982; Harzing, 1995; Doremus *et al.*, 1998; Ricks, 1999; Baruch and Altman, 2001 Apud *et al.*, 2003), there were many failures in international business, whose main cause was the managers' lack of cross-cultural competence or, in other words, their “inability to function effectively in another culture” (Johnson *et al.* 2006). Because of this, many multinationals have had difficulties in choosing a local partner, in managing foreign mergers and acquisitions effectively, in launching their products on various markets and have been faced with a high rate of expatriates early returns.

A large number of studies have been carried out but the diversity of approaches did not result in a unitary theory on cross-cultural communication and a generally accepted definition of cross-cultural competence. Consequently, terms like “cultural competence”, “cultural skills”, “cross-cultural competencies” and “cross-cultural skills/abilities” have been used separately or interchangeably, depending on the scope, the direction of approach and the author's interpretation of the concept. Starting from the existing material on cross-cultural communication, Johnson, Lenartowicz and Apud (2006) have critically analysed a large number of definitions of cultural competence in intercultural communications hoping to find one that could be applicable to international business. Their well-documented study emphasises the merits of the research carried out in the field of workplace diversity which leads to the idea that cultural competence involves three basic categories of elements: personal attributes, knowledge and skills.

Though important, these elements alone cannot justify the success or failure one may have in international business, but they can explain cross-cultural competence. However, preoccupied with defining cross-cultural competence in terms of results or performance, the three researchers mentioned above propose the following definition:

“Cross-cultural competence in international business is an individual’s effectiveness in drawing upon a set of knowledge, skills, and personal attributes in order to work successfully with people from different national cultural backgrounds at home or abroad.” [2]

The novelty of their approach consists in associating this definition with two moderating factors - institutional ethnocentrism and cultural distance – that may explain failure in international business. By taking over the distinction between “knowing” and “doing”, made in the management research, Johnson, Lenartowicz and Apud (2006) uphold that the gap between “the possession of various attributes, knowledge, and skills” (“knowing”) and “the ability to use and adapt them in cross-cultural environments” (“doing”), reflected upon the international business behaviour, is the cause of managers’ failure in successfully completing their assignments abroad. In addition to this, institutional ethnocentrism and the difference between home culture and host culture create serious barriers for expatriate managers who will not always be able to overcome the difficulties they are faced with.

### **3. CROSS-CULTURAL TRAINING. POINTS OF VIEW**

In the light of the above definition of cross-cultural competence, the specific training that business people or other categories of people that have to work abroad have to go through should be conceived and organised such a way as to preclude the weaknesses of various practices that have been taken as adequate training so far. That will also include the way in which such people will be taught to communicate professionally so as to show that they do possess the necessary cross-cultural competence enabling them to act properly in

different cultural environments. Cross-cultural training can have either a culture-general orientation or can be oriented towards transmitting culture-specific knowledge.

Research on cultural training has revealed that most of the relevant courses organised within various companies have focused rather on culture-specific knowledge, since such training courses can be better organised, their syllabus is more convenient to prepare and the training validity more easily demonstrated. However, too much emphasis on a specific culture will result in a limited “inventory of cultural competencies” (Tan and Chua, 2003) and will not help individuals to deal effectively with new situations (Early, 2002:277). It seems that general-culture knowledge is required for increasing cross-cultural competence. Yet, companies may, at least temporarily, have specific, strong reasons to train people intensively for dealing well in a certain culture, depending on the company’s immediate interests. In such a case, it is the training courses based on culture-specific knowledge that are first of all required and, no doubt, they are fully justified, even if the employees involved will acquire knowledge referring to a certain culture. So, when companies devise training courses for developing cross-cultural competence, they have to do that in direct correlation with their goals. Contrary to some researchers’ opinion (Early, 2002; Johnson, Lenartowicz and Apud, 2006), training for culture-specific knowledge is not only justified but surely recommended for short-term objectives, while long-term goals, can be associated with training for culture-general knowledge necessary for developing a complex, highly flexible business behaviour based on a high level of cross-cultural competence. Once this reference system has been established, one can better understand where university cross-cultural training can be placed. In such a context, it appears that cross-cultural university courses should have a culture-general orientation based both on theoretical presentations and on specific applications. Universities often include cross-cultural information in communication courses, but there are also specialised courses like those of cross-cultural

business communication specially devised for students of International Business. Besides what is presently done in universities in this direction, it is absolutely necessary for teachers or trainers to be permanently connected with the specific literature in order to update the existing published course books so as to take over critically the most recent research in the field of cross-cultural communication. The experiments carried out by researchers, the critical incidents coming from the individual experience of international business people may constitute substantial resources for simulations, role plays and other types of classroom work, that can generate what is more difficult to achieve by theoretical courses: tacit knowledge. By emphasising this point, I am in no way against theoretical courses. On the contrary, I do think that training cross-cultural matters imposes theoretical presentations on concepts and principles without which people could not understand the constructs teachers have to resort to in explaining cultural aspects.

Cross-cultural university courses have the advantage that they can be divided into stages and new information can be introduced gradually with better chances for solid acquisition of long-lasting cross-cultural knowledge. Continuous assessment of the students' progress is also affordable. Universities can also organise study trips (Pedersen, 1995) by which students can come into contact with various cultures and test their abilities to react adequately to and act properly in real life situations. Starting from the new definition of cross-cultural competence, teachers can set up clearer objectives for their cultural communication courses and can develop new, better instruments for achieving these objectives. They can also establish the new profile of the professional communicator who should have an easily recognizable

“inventory of cross-cultural competencies” that will help them to work successfully in other cultural environments.

A direction that has not yet been exploited is that of correlating cross-cultural teaching with the developments in the field of cultural intelligence (Early and Ang, 2003). The contribution of the cultural intelligence to the acquiring and practising appropriate behaviour can definitely help people to better adapt to new cultural environment. It only remains that teachers, trainers and practitioners find out the best way of combining them.

#### 4. CONCLUSIONS

The points presented above lead to the following conclusions:

1. The teaching of cross-cultural communication should necessarily take over the recent results of the research on cross-cultural competence. As an important coordinate of professional communication, intercultural competence relies on a set of skills, knowledge and personal attributes that can be taught either in a culture-general framework or in a more specific one.
2. Culture intelligence that “reflects a person's capability to adapt as s/he interacts with others from different cultural regions” (Early (2002:283) has a positive impact on teaching cross-cultural communication by that it makes the student develop metacognitive strategies to overcome problems in new socio-cultural contexts, stimulates the individuals to search for new information beyond the boundaries of their experience (and thus makes them more co-operative and tolerant) and appeals to the individuals' perseverance in overcoming obstacles.

#### 5. NOTES

[1, 2] Johnson, James P., Tomasz Lenartowicz, Salvador Apud, *Cross-Cultural Competence in International Business:*

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## CULTURE SHOCK AND ECONOMIC DOWNTURNS

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**Abstract:** *The paper is directed towards analysing culture shock against the background of the changes brought about by economic downturns.*

*The present economic crisis has caught a large number of people working in cultures other than their own. Foreseen and unforeseen effects may add to their individual effort of adapting to new cultures. How this may affect their behaviour and what can be done to alleviate possible negative consequences is the main purpose of the paper.*

**Key words:** *culture, shock, crisis, migration, labour, behaviour, downturn, change*

### 1. Introduction

In times of economic downturns, when industrial production declines, unemployment rises, banks are reluctant to lend and stock prices decrease, labour migration usually intensifies as those who have lost their jobs are moving towards the areas that have not yet been affected by recession. In their search for a job, people often cross the borders of their own country hoping to be more successful abroad, while others, laid off by their foreign employers, will attempt to get comfort back home.

Because movement of people is definitely a complex process, a question has often arisen whether it is better to leave the existing labour unemployed at home or to employ it abroad. As Papademetriou and Martin (1991:IX) show, most of those directly or indirectly involved in the process (analysts, governments, employers, potential employees) give a plain, positive answer to this question for two main reasons:

- a. labour-importing countries assume that the labour shortage will be over soon and that they could limit the need for migrant workers to a short period of time
- b. labour-exporting countries hope that “the harvest of remittances and returning workers” will generate economic growth.

Though today there about 20 to 30 million migrant workers in the United States, Europe, Africa, the Middle East, and Latin America and they remit \$40 to \$50 billion annually to their home countries, “emigration countries complain that they got the glittering coins of remittances but little development”. Moreover, “Emigration or labour-sending states often become frustrated when the migrant worker patterns which evolve are changed unilaterally by labour-receiving nations, especially if workers are expelled or encouraged to depart just when remittances are most needed, as when migrants are sent home during a recession.” (Papademetriou and Martin, 1991:2)

It is obvious that economic theorists are basically interested in making labour migration a more effective development tool starting from the idea that “People migrate for survival and mobility. Survival migrants are persons pushed abroad by the lack of alternatives at home; mobility migrants are pulled abroad to better themselves.” However, such studies do not investigate deeper layers of the phenomenon to see what happens with the individual migrant worker, the anonymous member of this „reserve army of unemployed persons willing and ready to emigrate” (Papademetriou, 1991:2), when they cross the borders of their own culture to work and live in a new one.



Driven away from their native culture by the need of getting a job and being happy to have been recruited, most of these migrant workers are not aware of the difficulties they will face when they enter the receiving country. *Culture shock* (a phrase first introduced by Kalvero Oberg in 1960) can hardly make sense to them but, no doubt, they will feel the whole anxiety resulting from partial or total removal of the familiar cues they had.

## 2. Approaches to culture shock

As pointed out in some relevant studies (Pedersen, 1995:4), “culture shock applies to any situation where an individual is forced to adjust to an unfamiliar social system where previous learning no longer applies.” Thus, it can be applied to any new situation requiring a role adjustment and a new identity. From this perspective, “culture shock may relate to life crises in a variety of areas other than the experiences of travel to another country. A person experiencing any radical change in his or her life may experience a process of adaptation or accommodation that parallels the conditions described by culture shock.” (Pedersen, 1995:11)

And yet, what individualises the situation when someone enters a new culture is an extremely uncomfortable feeling that the values previously considered “good, desirable, beautiful and valuable are no longer respected by the hosts” and that the skills used to recover meaning do no longer work. The disorientation created brings about an “emotional state of anxiety, depression and hostility against the background of unfamiliar cues, or familiar ones with different meaning. Because of this, early studies on culture shock have described it as a negative experience including elements such as:

- strain resulting from the effort of psychological adaptation
- a sense of loss or deprivation referring to the removal of former friends, status, role, and/or possessions
- rejection by or rejection of the new culture
- confusion in the role definition, role expectations, feelings, and self-identity

- unexpected anxiety, disgust, or indignation regarding cultural differences between the old and new ways
- feelings of helplessness as a result of not coping well in the new environment (Oberg, 1960, quoted by Pedersen, 1995).

In his remarkable review of the studies focused on culture shock, Pedersen (1995) identifies three directions of approach:

1. the stage theory of culture shock
  2. the disease model of culture shock
  3. the growth model of culture shock
1. Though most of the contributions based on the *stage theory* refer to the U-curve, first established by S. Lysgaard (1955), Peter Adler’s study (1975) is perhaps the most popular one. Encouraging a rather neutral perception of the culture shock, the pattern proposed by Adler includes five stages of adjustment: the “*honeymoon stage*”, *disintegration of the old, familiar cues*, *reintegration of new cues*, *autonomy* and *reciprocal interdependence*, where the last two stages may be considered the positive part of the process, the one in which the new comer’s behaviour is marked by a balanced perspective that helps him or her to interpret “both the previous home and the new host cultures”, with the advantage of attaining a bicultural or multicultural identity through the last stage (reciprocal interdependence). In spite of its advantage as a descriptive tool, the U-curve hypothesis has some weak points, among which the implied idea that adjustment is a linear, smooth process is the most evident.
2. According to the disease pattern, culture shock is like a temporary disability that could be cured if the right treatment is applied. This theory was strongly criticized by Furnham (1988), but the idea of stress reaction or lack of reference points and social norms, frustration, loss of control etc. are still present in many theories referring to culture shock (Gudykunst and Hammer, 1988; Stephan and Stephan, 1992; Juffer, 1987).

3. The third pattern, however, places culture shock in a new, more positive perspective, that of a “growth experience” (Juffer, 1987), where behavioural changes that occur as a result of the contact with another culture are conceived as “potentially positive conditions of growth, development and learning” (Pedersen, 1995:6). This approach is basically related with the theory of acculturation, more exactly with that direction of study emphasising the positive, creative force of the acculturative stress that may lead to the development of the skills necessary to the individual’s long-term acculturation (D’Ardenne and Mahtani, 1989). Excluding the studies that describe acculturation as synonymous to assimilation, this approach to culture shock is closer to J.W.Berry’s (1980) description of acculturation as a four-stage process (assimilation, integration, rejection and deculturation). Starting from Berry’s presentation of both positive and negative consequences of acculturation, the recent studies on culture shock have pointed out the potentially positive effect of culture shock as a part of culture learning process, within which a person will learn how to develop one’s intercultural competence, that means the skills needed to communicate and act successfully in a new culture. Placed in this constructive perspective, culture shock can be correctly viewed as a “specialized form of learning and educational growth. In this way learning another culture combines the culture-learning model with a social-skills model in emphasising the potentially positive consequences of culture contact” (Pedersen, 1995:8).

### **3. Labour migration and culture shock**

Considering the points presented above, it is quite obvious that labour migration may become a more difficult life experience when people

come to cross the borders of their culture without any prior intercultural training.

The data I am using as a basis for the statements made in this chapter correspond to a first stage in a more extensive research oriented towards the intercultural training of the Romanian migrant workers. The main objective of the research is to find out what strategies these people have used to adapt to new cultural environments knowing that most of them did not receive any specific intercultural training. The method of work involves interviews, direct observation and questionnaires carried out or distributed at various moments of the period the subjects are working abroad. What I have processed so far is the information coming from a set of 50 initial interviews, carried out before the subjects’ leaving their home country and on various occasions of their coming back home on leave. I am quite aware of the limits of this empirical approach, but I hope that the development of the research will confirm the initial impression that the resulting material can help to identifying the factors generating adaptation strategies when intercultural training is absent.

The target group includes both men and women, aged between 18 and 50, all of them graduates of high school, who are working in Italy, Spain and Northern Ireland. The initial interviews have revealed that they were strongly motivated to accept the jobs abroad particularly because they were better paid for their work. Most of them are working as cleaning people for homes and institutions and in restaurants, as kitchen workers.

What did culture shock mean to them?

- frustration as did not know the local language
- frustration coming from not knowing English well
- the whole range of discomfort deriving from not knowing anything about the local customs, regulations, rules, traditions
- difficulty in finding accommodation and understanding local legislation
- anxiety about their job security
- the danger of losing their self esteem
- homesickness

The list includes those elements that have been mentioned by all of them.

Rate of successful adaptation: in a group of 25 people, 2 returned home within a month and 1 after two weeks spent abroad. The first two did not succeed to come to the level of competence required by the job taken there and the third one refused the offer after balancing the inconvenience of leaving far from his family and the real gains coming from the job.

So far, the research did not reveal anything special as compared to the information provided by the relevant literature. Two elements have proved to be special about this particular category of people. The first one is the intensity of stress they felt at the beginning of their working and living in a new country. All of them, without any exception, have complained about going there without any cultural training. Their urgent need for money did not leave them the necessary time to get the minimum cultural information they would have needed. The subjective perception of culture shock has, in one case, come as a very bitter statement: "Only God knows what I've passed through at the beginning". However, they did not perceive this as a disease. The second special element is their strong commitment to learning the new culture. As their motivation was very high, it seemed normal to them to try to adjust to the new culture. That increased their self esteem. Within the group, women proved more dynamic in learning the language. Men instead have been faster in learning about regulations and procedures. Even if some of them have enrolled in organised language and other training courses, learning the new culture was, for most of them, a matter of "learning by doing". As they have progressed they became counsellors for new-comers. This has also strengthened the group cohesion, though the tough rules of competition may threaten sometimes the group ties. Since culture shock cannot be avoided

#### **4. Recession – a new face of the culture shock**

No member of the target group has left their place of work to spend some days with their family back home, on a short leave, as they used

to do before. No doubt, they feel the threat of recession. As migrant workers, they are now faced with new sources of stress: the imminence of being laid off, the adventure of trying to get a new job in a foreign country that gives priority to local labour now, the necessity to alter some individual projects for lack of finance, the acceptance of new sacrifices (like reducing the number of visits to the family left home, with all the unforeseen consequences coming out from this), the imminence of an early return, the danger of negative stereotyping and even xenophobia feelings of the local people.

Though stereotyping is not as destructive as xenophobia, however, when economic crises occur, negative stereotyping may reach alarming levels. As it is well-known, stereotyping is based on assigning a wide range of generalized attributes to an individual, on the basis of his/her membership to a particular country or social group, without considering the individual's unique characteristics. In various life situations this may turn into a serious source of stress. For instance, if a foreign worker is involved – accidentally or not - in an undesirable event, negative generalizations about the group the individual belongs too will occur very soon. The wave of negative feelings that are created about the whole group will be very frustrating for those who have nothing to do with the case.

In a period of economic downturn, unemployment most often generates friction between local and foreign employees. When job insecurity occurs, local employees often perceive their foreign colleagues as a permanent threat. Incidents like the one described above are highly exploited and the tide of aggressive attitudes can affect the migrant workers even more seriously than the initial culture shock.

Sometimes, the situation may be even worse, with waves of xenophobia. Surprisingly, some official decisions may contribute to this indirectly, by imposing barriers to the migration of labour from certain countries, which may create the idea that some people are not wanted there.

For those who are forced to return to their home country, the situation will not be easier. Though, at the beginning, the euphoria of being

at home again might make them forget their main problems, the re-entry shock will soon occur with its whole range of difficulties.

If we refer to their work only, many of these people may be faced with a more severe recession in their own country, which will turn their attempt to find a job into a more dramatic event. Besides, they will find out that many of the relationships they had invested in before going abroad have been altered meanwhile due to lack of communication or to other, more subtle factors. Not all relatives and friends will be sensitive to the problems of the newly-returned one(s). The psychological consequences can be very serious for some of the former migrant workers, especially for those who could not have the chance to learn about the re-entry shock, within a training programme.

### 5. Conclusions

1. Though culture shock is, in general, associated with moving and living in another culture, people can experience it within their own culture when serious changes occur in their own life.
2. Globalization has stimulated labour mobility, but migrant workers have to be assisted in developing intercultural competence in order to achieve the envisaged objectives .
3. Recent studies in culture shock have shown that it can have both negative and positive effects and that it can be viewed as a specialized form of learning and of educational growth.
4. Intercultural training is necessary before sending people to work abroad. This will help them develop intercultural competence and be successful in adapting to the new culture.
5. People who could not receive intercultural training may develop a positive attitude towards culture shock and can find the right strategies to adapt to a new culture successfully if their motivation is high.

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## THE PROFESSIONAL OPTION BETWEEN VOCATION AND SOCIAL DEMANDS

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**Abstract:** *The activity of school and vocational guidance (SVG) or, the school and vocational counseling or, in its new terminology – career counseling – is tightly connected to the knowledge of the socio-professional area, of its exigencies and tendencies, aspects that influence significantly the individuals' options, and implicitly, the quality of individual and collective existence. School is the anticipating factor and it prepares people for employment, therefore it implies the correlation of multiple features: the organization of schooling styles and curricula, in accordance with the professions dynamics and the labor market, yet, at the same time providing individual progress..*

**Keywords:** *professional dynamics, school and vocational counseling, career option, individual progress.*

### 1. THE CONTEMPORARY WORLD'S CONFIGURATION AND DYNAMICS OF PROFESSIONS

The methods by which human beings have gathered their commodities throughout time have known major mutations, with a huge impact over the evolution of the human beings' society and over the human condition. The social divisions of labor, the industrial and informational revolutions, are but a few of the decisive moments of the change in the professions configuration. These distinctions develop not only from one epoch to another, but also within the same epoch, depending on the development stage of each country. For example, in case of developed countries, the communication and information technology sector occupies a central position in economy. The Organization for Economic Co-operation and Development (OECD) uses data provided by this sector as key elements for comparing the levels of economic development of various countries.

In the contemporary world, the development, diversification and dynamics of professions reach unprecedented standards. During the previous century, the number of

professions increased to an annual average of 370 new titles and specializations, while their mobility was increasing as well. In the year of 2000, eight out of ten professions were new, the occupational classified list being continually outdated by reality. Thus, we witness an avalanche of new specializations, in some instances, limited as necessity and application terms.

The technological and informational explosion, the diversity and multitude of new data provided by development in all sectors of activity represent the cause of this extreme dynamism. In this context, the phenomenon of adjustment a re-adjustment becomes extremely actual, and it is joined by alterations of contents and strategy in the school and vocational counseling activities and in professional guidance.

The time for a unique specialization has long declined. Our society, apparently, will need more and more "polyvalent" individuals, capable of multiple adjustments, with a vast coverage range, and capable of successive accommodations and re-accommodations, in accordance with social demands. The accomplishment of such polyvalence cannot be sustained unless the stage of narrow paths

and diplomas idolatry is surpassed, in favor of pluri- and inter-disciplinary studies.

The professions' evolution, the very human existence and the man's role in the labor field – all have been caused by the spectacular improvement in technology. We witness a gradual increase in the human factor role. If, following the first industrial revolution, the adjustment of man to machine was pursued, after the second industrial revolution (post-machinist, of automation) a new type of adjustment appears. This time, it equals the machine's adjustment to human actions. Automation represents *“a new integration phase, in which cerebral activities connect within the management and production control process, where the individual is no longer imitable by machine or interchangeable with the machine's functions”* [1].

In the informational era, a new re-orientation of labor occurs, which *“does not mean that the individual will stop working physically only, but he will be helped by information and informational or informative tools”* [2].

The Organization for Economic Co-operation and Development (OECD) foresees that the structural change, produced in economy by the communication and information technology, will lead, by 2010, to the situation in which, 55% of the labor force has been included in this sector. This may be called “labor informationalization”. The structural changes on the labor market are the effect of economic, technological and social amendments and these are the cause for economic tendencies on the labor market. Knowing and understanding this interdependence become vital for designing and sustaining educational and vocational training projects.

## **2. ROLE OF SCHOOL AND VOCATIONAL COUNSELLING (AN APPROACH TO THE HUMAN POTENTIAL EXPLOITATION)**

The activity of school and vocational guidance (SVG) or, the school and vocational counseling or, in its new terminology – career counseling – is tightly connected to the

knowledge of the socio-professional area, of its exigencies and tendencies, aspects that influence significantly the individuals' options, and implicitly, the quality of individual and collective existence. Invested with a high social responsibility SVG represents *“an activity of stage planning and decision making, which may persuade a person to attend a certain type of educational institution and to have him engaged in practicing a profession”* [3]. The major purpose of this activity is to develop self-evaluation and self-awareness capabilities, at the individual level, and this constitutes the premise for an adequate school and vocational option. School is the anticipating factor and it prepares people for employment, therefore it implies the correlation of multiple features: the organization of schooling styles and curricula, in accordance with the professions dynamics and the labor market, yet, at the same time providing individual progress. The focus must be on the personal integral development, by granting a proper environment for studying and working, without disregarding the socio-professional background and its exigencies. That is, each adolescent has to correlate the answer to three fundamental questions: What can I do?, What do I have to do?, and What do I want to do?

From a psychological perspective, the vocational option is a complex process involving the entire personality. A central position is occupied by individual convictions and aspirations, the life ideal and the personal system of values. Within the psychological structure of vocational option, there are three distinguishable dimensions: the intellectual dimension (I know), the affective dimension (I like), and the volitional dimension (I want). The motivation for a career selection lies at the confluence of these three dimensions. These internal (subjective) factors are, in their turn, influenced by external (objective) factors, by the socio-economic and cultural environment, or the individual's life experience.

The human existence represents a sequence of choices that make up the individual destiny. Two of such options (career selection and partner selection) hold a decisive role in the self-fulfillment and access

to happiness. In the contemporary world, both choices have been perturbed and vitiated by the lack of stable value references, the extreme life dynamism and the multitude of requirements. Wrong selections, following axiologically inconsistent criteria, irrelevant for the person's capabilities, have negative effects both upon the individual (at the level of his harmonious development and self-fulfillment) and upon society, which will be unable to capitalize its most precious wealth—the human potential.

The extreme dynamics of the social and professional life cause an uncertainty and instability feeling in the individual. Statistics show that a person may change his profession three times and his employment at least seven times in a lifetime [4]. Thus, the issue of professional insertion of young people comes to stage, a process aiming at two interdependent stages: the professional formation (qualification) and the employment (insertion). In order to prevent and diminish the dysfunctions that appear in the professional insertion process, it is important for the educational offer to correspond to the present social demands, moreover, to consider possible future changes.

Peter Grootings, the coordinator of a study on young people from the European Coordination Centre for Research and Documentation in Social Sciences in Vienna, realized that there is not a correspondence between qualifications, expectations and aspirations of young people and the labor realities of the contemporary world, that is a discrepancy between the education products and the labor market requirements. Among the most serious outcomes of this discrepancy are unemployment and under-employment (employment of young people in positions inferior to their education). Under-employment also highlights another phenomenon: the over-education of new generations, which represent *“the education stock incorporated into young people's training, which cannot find a proper and complete use on the labor market”* [5].

This is the major problem of young people in Romania: the selection of a career that may provide employment and decent living. To

what extent does the pressure of this demand leave room for development and capitalization of individual potential in and for the selected profession? If society lets the socio-professional insertion process get out of control, this means that it assumes devastating effect on a long term, while these effects may jeopardize the entire social scaffold. The studies carried out by the Center for Study and Research in Youth Problems from Romania have shown that the greatest difficulties encountered in finding employment are related to the level of education and area of expertise, added to which is the jobs offer. Therefore, young people are highly preoccupied with their professional qualification/ requalification and are perfectly aware that *“only a flexible training and an adaptive behavior to the labor market demands may increase their chance of success”* [6].

### 3. STUDY

The study carried out within the Air Force Academy aimed at identifying professions that interested the high-school students and establishing factors that influenced this orientation and the military career's degree of attractiveness to adolescents, in the current context of configuration and dynamics on the labor market. In addition, the social perception of military institutions and the motivational support for career option in this field of activity were pursued.

The investigation, based on questionnaires, was performed on a sample of 105 respondents, high-school students in their 12<sup>th</sup> grade at a National college from Brasov. The structure of the sample was as follows: age segment – 18 to 20 years old; gender - 70 female students, 35 male students; origins – 90 students from urban area, 15 students from rural area. The applied questionnaire consisted of 10 items. The manner in which questions were formulated presumed that twelfth graders had already made a clear career option, supported both from the aptitudinal, motivational and affective perspectives. Out of the ten questions, six were closed questions and four were open questions. Despite the difficulty in quantifying the open questions,

these offered the respondents the opportunity for free and personal stances. Data analysis showed that:

1) The questionnaire was administered in a vocational high school and one of the questions aimed at the students' motivation of their selection of the school. It resulted that for most of the students (54.3%) the school selection was determined by the final scores obtained at the end of the eighth grade (national tests) and their computer-distribution to this particular high school. Only 24.8% of the respondents declared their interest in the high school's specialization, while 9.5% were influenced by their families.

2) The students' options for various professional fields, although covering a large array, were in tight connection with the specialization provided by their high-school studies (Figure 1).

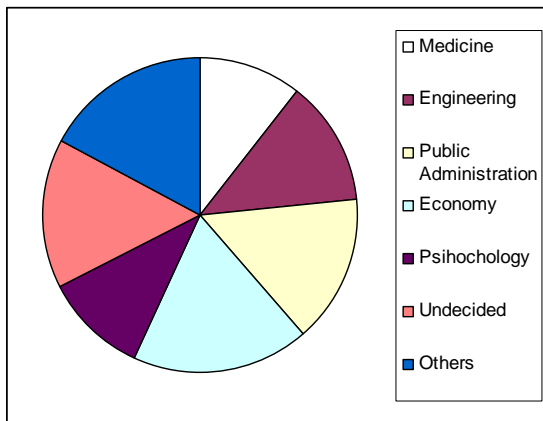


Fig.1 The students' options for various professional fields

3) J.L. Bodden and L.E. James, appreciated, based on experimental data, that the cognitive task of making a realistic and individualized vocational selection surpasses the level of cognitive development of adolescents. Accordingly, the vocational option is strongly influenced by the family's expectations and by the data obtained from interaction with others (friends, relatives etc.). Nevertheless, the adolescents of the informational era, well anchored in the pragmatic and competitive spirit of the time and eager for self-discovery and assertion, estimated (53.3%) that aptitudes and competences played an important role in

selecting and practicing a profession (Figure 2).

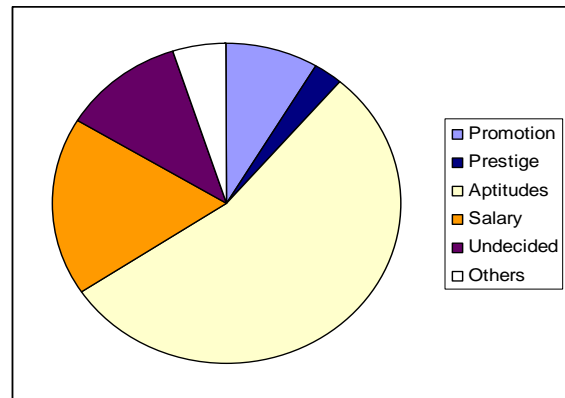


Fig. 2. Motivational support of career selection

This attitude and confidence were strengthened and confirmed by the answers to item 7: *Do you consider that in selecting a career aptitudes/competences are important?* 99% of the students answered affirmative.

The presence of indecision states and the lack of firm plans are quite normal at this age and they prefigure the opening toward new assimilations, which will gradually eliminate ambiguities, accelerating the vocational development.

4) The young people's level of information with regard to the military system, to career, in general, and to the military career, in particular, was very low (Figure 3).

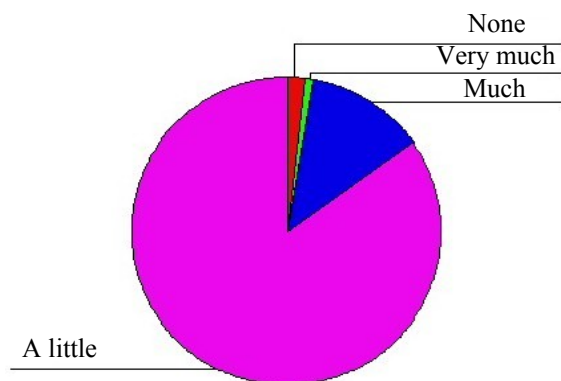


Fig.3 Young people's level of information with regard to the military system

84.8% of the investigated respondents declared their limited knowledge regarding the military system, and the main information



sources were the mass media (60%), followed by colleagues and friends (15.2%) and family (14.3%). In the actual context of the labor market configuration and dynamics, the military career was attractive for 62.9% of the respondents, while 11.4% considered it was not interesting or “did not know” (22.9%). Even under the circumstances of this “knowledge vacuum” of the military organization by the civilian society, three elements that maintain the interest in the military career materialized in the collective mind (Figure 4).

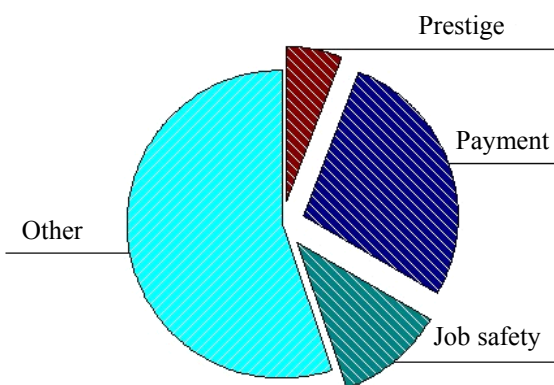


Fig.4 Elements of attractiveness to the military career

For 44.7% of the students, payment, security of the workplace and social prestige were as many arguments favoring the option for the military career. To these added the promotion possibility, able to satisfy the assertion need of adolescents. The social perception of the army configured by establishing three distinctive features of it (Figure 5).

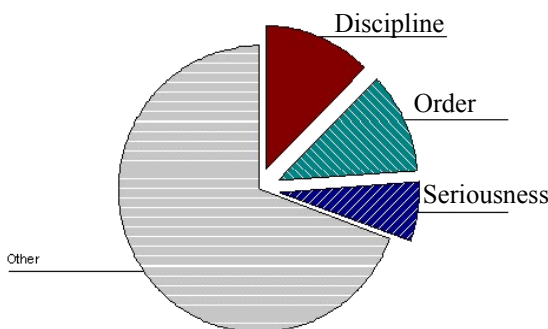


Fig.5 Distinctive features of the military organization

Discipline, order and seriousness were characteristics that coagulated in the collective psychology as specific to the military organization, although within the modern society this model had expanded upon all types of organizations.

#### 4. CONCLUSIONS

To sum up, we can assert that adolescents show maturity and pragmatism in selecting their careers. Even though the extrinsic motivation in making this decision is prevalent (salary, prestige etc.), the necessity of personal qualities, aptitudes or competences in practicing a job is not ignored. The military educational offer is generous, yet, it is not sufficiently known to civilians. At the same time, it is obvious that a sustained and permanent activity of school and vocational counseling is required and it is meant to fill up the informational vacuum and to diminish the young people’s hesitations and indetermination. Moreover, it is intended to offer a better comprehension of the socio-professional area and its tendencies, but also a better self-awareness. This activity, performed with seriousness and responsibility will contribute significantly to the professional integration of young people and to the synchronization of the educational offer and professional formation with the jobs offer on the labor market.

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## THE BRITISH MONARCHY IN THE 21<sup>ST</sup> CENTURY

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**Abstract:** *My entire essay is based on what the future holds for the most enduring relic form of government, the monarchy that nowadays exists in the United Kingdom, Netherlands, Norway, Sweden, Denmark or Belgium.*

Monarchy, form of government in which one person has the hereditary right to rule as head of state during his or her lifetime; the term is also applied to the state so governed. The power of the monarch varies from absolute to very limited; the latter is exemplified in modern-day constitutional monarchies. Monarchs include such rulers as kings and queens, emperors and empresses, tsars, and kaisers .

### I. BACKGROUND INFORMATION

Throughout history many monarchs have exerted absolute power, sometimes based on their presumed divinity. In ancient Egypt, for example, the pharaoh was divinized, as were certain Oriental rulers. By the Middle Ages the monarchical system of government had spread over Europe, often based on the need for a strong ruler who could raise and command military forces to defend the country. European monarchies were dynastic, with the throne usually being passed on to the eldest son or nearest male descendant. Many medieval rulers obtained soldiers and weapons from the feudal lords and thus were dependent on the allegiance of the nobility to maintain their power. The modern concept of a limited, constitutional monarchy arose slowly throughout much of Europe. During the 19th century, parliamentary authority grew while

royal power diminished. Many Western monarchies ceased to exist after World War I, including those in Russia, Germany, and Austria. In later years others were replaced by Communist governments. Some constitutional monarchies still survive, primarily as symbols of national unity. Among the most enduring are those of the United Kingdom, the Netherlands, Norway, Sweden, Denmark, and Belgium.

With the decline of feudalism and the rise of nation-states, power became centralized in the hands of the sovereigns. At first these rulers were supported by the growing middle class, or bourgeoisie, who benefited from a strong central government that maintained order and provided a stable atmosphere in which trade could flourish. By the 15th and 16th centuries absolute monarchs, such as King Henry VIII of England and King Louis XIV of France, ruled the countries of Europe. Abuses of power, as well as growing dissatisfaction among the bourgeoisie, helped bring about the end of many absolute monarchies; revolutions in England in the 17th century and in France in the 18th century were major landmarks in the limitation of absolute power.

### II. THE BRITISH MONARCHY

For a long time no professional scholar would touch the subject. Instead, journalist, belles lettres biographers and a few committed socialists

dominated discussion of the modern British monarchy.

At about the time the Prince of Wales married Lady Diana Spencer in the early 1980s this began to change. The marriage renewed and reinvigorated the monarchy, while scholars re-evaluated their former silence. The first to break the silence were Eric Hobsbawm and David Cannadine, who both wrote about the monarchy in a collection of essays entitled *The Invention of Tradition*. As social historians they took a "social control" view of the monarchy, especially royal ceremonies, were fake, cooked-up rather than real. Bourgeois politicians, they argued, "invented" these ceremonies in the late Victorian era to keep the working classes orderly and loyal.

A decade later, while the "invented tradition" argument took root among academics, the marriage of the Prince and Princess of Wales publicly broke up. While the royal family increasingly came to be identified with the super-rich and irresponsible beneficiaries of the Thatcherite eighties, the Princess of Wales went on television to make clear she was not one of them and that her sympathies were with the man in the street.

We already know far more about Prince Charles and his sons than many would likely care to, and as such, they will come to the throne without the benefit of the bubble of mystery that has protected their predecessor.

Queen Elizabeth was born before the era of the mass media and tabloid culture, and it is very likely that whatever restraint, glamour, and dignity the monarchy currently possesses will die with her.

Prince Harry and Prince William, for example are children of the Internet and MTV generation. Ask the average teenager if he would be willing to devote his entire adult life to cutting ribbons and shaking hands with politicians in exchange for sacrificing every element of his personal freedom and safety. Ask him if he is prepared to surrender his ability to choose his own wife, career, home, and religion in the name of some vague constitutional principle. The answer will be predictable. In the coming post-Elizabeth decades, the British monarchy will face

enormous challenges in continuing to sustain its antiquated Victorian subculture of unthinking, class-based notions of "duty" in the midst of a modern, globalized world dominated by free spirits and individualism. Abdication could easily become the norm, creating all-new constitutional problems.

Monarchist rhetoric often possesses a sort of fatalistic utopianism about the British monarchy, assuming that because it has existed in some form for over 600 years, it is therefore destined to survive until time immortal. Among those in Britain who have analyzed its future seriously, many have speculated the British monarchy may not even survive this century, let alone dozens more.

Dissatisfaction with the monarchy has been increasingly apparent in Britain. In part that has been because of the antics of family members. Criticism is no longer as taboo as it was when the taxpayer funded BBC refused to allow discussion of republicanism.

However, the family has been willing to adapt if necessary in order to hold on to its privileges. When public criticism reached a new high in the 1990s the family set up the "Way Ahead" committee, composed of leading family members and their advisers. Its mission was to reform the monarchy just enough to put off its abolition. One of its first ideas was to take the tax payers' eyes off their picking of British people pockets. They would give up their income support handouts in return for the much greater income from the property portfolio known as the Crown Estates. That kind offer was made although since 1760 the Crown Estate income has belonged to the Treasury! A more realistic reform was to reduce the number of members of the family who would have official status as the existing members died. The committee also agreed on the idea that the family link to the Church of England should be ended and that female members of the family should have an equal right with males to become monarch. Only the latter reform has been implemented.

Abolish the British Monarchy - Yes or No? - is a question discussed frequently by British in the 21st century.

The British people have never had the chance to vote for or against a monarchy. Unlike countries which have a written constitution, much of the British system of government has been inherited from an undemocratic past. Although Parliament might vote to abolish the monarchy, under the Treason Felony Act 1848 it is treason if "any person whatsoever, within the United Kingdom or without devise or intend to deprive our most gracious Lady the Queen from the style, honor or Royal Name of the Imperial Crown of the United Kingdom." Many monarchists argue that advocating republican democracy is therefore seditious and illegal.

The monarchy in Britain has existed in its current form since the 10th century (excluding the period 1649-60). Although the monarch plays only a ceremonial role, having lost all political power, the monarch is still the head of state. Given the cost, out-dated traditions and the fact that 79% of people believe that it has lost touch with society, should the monarch remain as the figurehead of this country.

For reasons of balance, I'll briefly summarize the main arguments put forward by those in favor of keeping the monarchy. It serves no function, so it is harmless, it frees the prime minister from pointless ceremonial affairs, leaving him free to govern the country, it acts as a source of national pride and as a source of national loyalty. The biggest supporting factor is of course the fact that no one can agree on an alternative. As in the case of Australia, the majority wanted to see the Queen removed as head of state, but no one could agree on what to replace her with. Since it serves no purpose, it can do no harm, and so time should be devoted to more urgent considerations.

Firstly, a hereditary monarch representing the feudal society of medieval England is intolerable in a modern democratic state. It represents the pinnacle of the anachronistic class system in Britain, promoting social division, snobbery, and separating them from ordinary hard working people. Britain will never become a meritocracy, where people are given opportunities according to their ability, not

according to their birth, if the monarchy remains. As long as the monarchy survives, so will the class system in Britain

Secondly, it is unacceptable that the British tax payer should be paying £75,000,000 a year to support one of the richest families in Britain (wealth accumulated of course from the people during previous centuries). That would pay the University tuition fees of 75,000 of the poorest students, fund 25 new secondary schools, or pay for the running of an entire hospital. Last year, additional expenses for a £200,000 wardrobe and a £50,000 well, both for Buckingham Palace were made to the tax payer. It may generate income from tourism, but this would increase to unprecedented levels if we were to abolish the monarchy and open up all the palaces as museums, hotels or restaurants. When people are forced to sleep on the streets, we cannot justify spending £75,000,000 on a relic that serves no purpose.

Thirdly, the monarchy encourages the continuation and acceptance of outdated traditions and beliefs. Apart from the image we project abroad of an outdated nation living in the past, it is a relic of an age which no person living in Britain should be proud of. The British empire signifies all that is wrong with society. Whilst Britain as a nation prospered and the monarchy lived a sheltered life of luxury, those who created the wealth, the working classes, were forced to live in unimaginable suffering. Abroad, Britain sold human beings into slavery, and treated inhabitants of her colonies as second-class citizens, causing the long term underdevelopment and tensions that we see today in South Africa and Zimbabwe. Is this really an institution we are expected to show loyalty to?

Fourthly, the monarchy no longer commands the respect or support of the British people. The appalling behavior individuals within this institution renders it unfit to sit at the head of this country. The Duke of Edinburgh is a disgrace to the nation and a hypocrite. Only 12% of the public believe that the monarchy should continue in its present form. Not even William Hague is that unpopular. Clearly, people have lost faith

in the monarchy, and something needs to be done to correct this situation.

### III. WILL THE BRITISH MONARCHY SURVIVE?

The British monarchy, an institution gathers the heritage and long history of its country, has come under increasing criticism in the past decade as an archaic relic badly in need of a restoration if it is to earn its place in the 21st century. What does the future hold? Will it survive?

In conclusion, although the monarchy doesn't physically have a role, it is its symbolic features and what it represents that men we have to abolish it. Unfortunately, certain individuals in Britain are stuck in a time warp of jingoism and isolationism. National boundaries have no relevance in the world, they only serve to prevent progress. There is enough food for everyone, but national boundaries mean that most of Africa starves. The monarchy and national pride is unproductive, and legitimizes (indirectly) racism. Our immediate future is as an integral part of the European Union. However, the monarchy is the last remaining relic to a past where Britain could stand alone, and the last remaining barrier to a future where we most definitely cannot. The monarchy, like slavery, sexual and class discrimination, and colonial exploitation is a throwback to our shameful past, and an impediment to our bright future. On the other hand the British monarchy is increasingly criticized by people who want it abolished.

The Monarchy is a concept which can transcend class divisions in the sense that, in the eyes of the Monarch, all are equal before the Crown.

*"It's a Costly Extravagance"*

The annual cost of around £37 million is good value for money. In any case, Monarchy is meant to be majestic, yet there seems to be a deliberate move to diminish the majesty of the Monarchy.

The pageantry, the ceremonial are all part and parcel of Monarchy – not intended to glorify Mrs Windsor, per se, but intended to elevate

the national icon. So long as the Monarch remains a symbol of the nation, then no expense should be spared. A nation which values itself will treat its national icons with prestige and respect.

*"Look at the Behavior of the Royals"*

Don't confuse the personalities of the Royal Family with the concept of Monarchy itself. Personalities come and go but the principle remains.

*"It Encourages People to Live in a Fantasy Land. They are a Diversion"*

On the contrary, the Monarchy is real. It is television and the media which deliberately diverts people and encourages them to become obsessed with pop stars and soap operas, which are fantasy.

*"Inherited Privilege has no Place in our Society"*

A privilege is a special right. It is the privilege of the Monarch to reign. It is the privilege of the Monarch to serve.

If by "privilege" you mean the enjoyment of an advantage not bestowed upon others, then, you should judge the Monarch by how she uses that privilege.

*"What does the Queen do?"*

She reigns. That is her job. That is her purpose. That is her duty.

*"The Royal Prerogative is Exploited by the PM"*

The unfortunate fact that the Prime Minister has usurped the power of the Crown is not an argument to abolish the Crown or even to reduce its powers, but rather an argument to restrict the power of the Prime Minister and restore the Monarchical authority of the Royal Prerogative back to the Crown, where it belongs.

*"The Monarchy will Eventually be Abolished"*

The truth is that Monarchy is forever.

Even if the Monarchy were officially "abolished", it only takes one person to say, "You are my King" and the Monarchy lives.

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## BREATHING...MASS MEDIA

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**Abstract:** *Mass media has become part of our life...Newspapers, magazines, radio, Internet and television seem to have gained a lot from our attention and free time, each of them affecting us by means of the information provided in a different way. The dependence on the media seems to keep us alive and focused. People working in this branch are always on the run, trying to give the audience their best results, indirectly craving in this way for high audience. Therefore, the growing influence of mass media in modern societies can no longer be denied. Both theoretical analyses and empirical evidence show that, over time, newspapers, television, and even television programs devoted primarily to entertainment, effectively play a significant role in how the public comes to define and perceive major aspects of political and social reality, but it is hard to know precisely to what extent media coverage actually influences the views of the larger public, though we are all aware that it does to a certain extent. If we were to be asked how long we could stay without searching the web for news, or buying a newspaper, what would we answer? A week? Three days? Or only a couple of hours? The paper deals with pros and cons regarding the subject, the liberty of media and reasons for the differences between the European and the American press.*

**Key words:** *media, television, press, journalism, development, technology, politics, business.*

Electronic messages do not make social entrances; they steal into places like thieves in the night. The "guests" received by a child through electronic media no longer can be stopped at the door to be approved of by the masters of the house. Once a telephone, radio, or television is in the home, spatial isolation and guarding of entrances have no effect on information flow. Electronic messages seep through walls and leap across great distances...[1] Stanley Rothman's previous idea of media presented in his book makes us wonder whether the effects of such media on society are good, bad, or neutral, considering the fact that the reprocessing of our physical and social environment is revolutionary.

Let's consider for instance television. There is clear evidence that television, and especially television news, has changed, for instance, the way America votes. It seems that the power of television news astonishes even those who work for it.

It is no surprise that America, despite its kind of short history, took the lead over Europe in establishing a relatively free press. Arguably, tolerance for the free dissemination of ideas and texts was promulgated most forcefully in United States because under these conditions it was not as threatening to a dominant, established order; that order had never existed in the new world. The absence of sharp class prejudices and divisions in America made it easier to envisage a mass press. [2] Further, in the nineteenth century, the rapid and ongoing democratization of American life, under the aegis of the liberal ideology which defined the nation, was partly responsible for the fact that journalism for the masses first developed in the United States, followed closely by England and other Western European countries. The United States pioneered the technology of the mass press, just as it was to lead the world in the development of the mass-produced automobile and of television. By 1910, some 24 million

issues of daily newspapers were being published in this country, as against about two million in England.

The numbers, however, signify other qualitative differences. While Europe and America have both been homes to a freely competitive press, the American media (both newspapers and television) have always differed from the Western European and English media for structural reasons that proceed from cultural, economic, and political variables.

First, the electronic media in the United States have been and still are primarily privately owned businesses, even though radio and television operate within the framework of public regulation of a sort. In most European countries, on the other hand, both radio and television have been primarily public enterprises. Even where private enterprise has recently come to play a more significant role, it is far less important than in this country.

Second, while newspapers in the United States and Europe are privately owned enterprises, the historical tradition in the United States has been quite different from that of Europe. On the European continent many newspapers and magazines began as the organs of political parties and remained closely affiliated with them. [3]

The reasons for the differences between the European and the American press can tell a lot about the nature of the American mass media. The United States was characterized by a broad ideological consensus during the nineteenth and early twentieth centuries. It was assumed that both liberalism and capitalism had a moral justification tied to a Calvinist ideology (even as that ideology was beginning to weaken). America did not develop a mass socialist party; nor did it develop a conservative party. For some of the same reasons, the country lacked explicitly ethnic or religious movements. To become an American meant to see oneself primarily as a free individual, not as the member of some corporate group. Immigrants could join various ethnic or religious groups, but they did not form political parties based upon such associations. [4]

It is no accident that the whole notion of objective news reportage was first fully institutionalized in the United States at a time when most European newspapers still emphasized interpretive commentary. Living within the framework of a liberal consensus, American newsmen, like most other Americans, found it difficult to recognize that their view of the world might be shaped by a particular set of premises, a paradigm or Weltanschauun, which strongly influenced their views of social causation and, hence, their view of what the "facts" were. Under such circumstances the "facts" were merely the facts, as Michael Schudson notes: "Before the 1920s, journalists did not think much about the subjectivity of perception. They had relatively little incentive to doubt the firmness of the "reality" by which they lived. American society...remained buoyant with hope and promise. Democracy was a value unquestioned in politics; free enterprise was still widely worshipped in economic life; the novels of Horatio Alger sold well. Few people doubted the inevitability of progress." [5]

Even in the 1920s and 1930s, as awareness of the inevitable elements of subjectivity in news reporting began to grow in this country, the response was to place greater emphasis upon scientific understanding and training in order to approximate as closely as possible an "objective" reporting of the "facts."

On the other hand, the best European journalists, writing in societies rent by more or less severe ideological social-class conflicts and political parties based upon them, were far more aware that perceptions of social action were at least partly a function of the assumptions that were brought to them. These historical differences continue to influence the manner in which American and European newspapermen approach the news, though the Europeans are coming to resemble those in the United States more closely in some respects. Despite their greater sophistication today, American journalists, for the most part, still find it difficult to recognize that the facts are not merely given, but rather are, at least to some extent, determined by the "paradigm" (or world view or ideology) which one brings to them. [6]



Of course, European countries cannot all be lumped together. In their relative freedom from censorship and belief in the possibility of objective reportage of the news, British journalists have more closely resembled their American counterparts than they did those of continental countries. On the other hand, the English media have always differed from the American in quite important ways, aside from those already mentioned.

Political reporting in England was, until quite recently, very much influenced by the fact that the relationship between journalists and politicians was sharply stratified. Politics in England was the preserve of "gentlemen" with "proper" educations from upper-class families, while most reporters came from lower middle-class backgrounds and had usually left school at age fifteen. Journalists working for the mass press, then, viewed political leaders with a mixture of deference and hostility, and politicians viewed most journalists with contempt. On the other hand, the editors of, and reporters for, a few leading journals were intellectuals who themselves came from "good" families and could mingle freely with leading statesmen. [7]

In the United States, on the other hand, neither class nor educational differences between journalists and politicians were as pronounced. Thus, American newspapermen were never as deferential to bureaucrats or even politicians as their British counterparts tended to be. Indeed, Americans seem to have always been more than willing to criticize, expose, and denounce "political malefactors," though less likely to develop fundamental criticisms of the political system, than were their European counterparts.

Paradoxically, the growing influence of television increased the influence of a few eastern media outlets such as the *New York Times*, *Time*, *Newsweek*, and to a lesser extent, the *Washington Post*, and the *Wall Street Journal*. With the sources of political news increasingly centered in New York and Washington, and those responsible for producing, directing and reporting the news increasingly literate, key newspapers and magazines on the east coast took on new importance. [8]

What television had done, of course, was to nationalize and standardize communication to an extent never before achieved in the United States. And if the *New York Times* was read by the New York and the Washington elites, and those who produced the news for the television networks, it would also be read elsewhere. Even if it were not read, the issues which it considered important, and the approach it took to them, would become national currency.

The influence of the elite newspapers extends to foreign affairs. American diplomats increasingly obtain their information about the world from these media, supplemented by diplomatic or intelligence channels.

It was expected that cable television, because it dramatically increased the number of broadcast channels available, would produce a return to localism as well as encourage special interest broadcasting. Certainly, the development of satellite and other technologies has encouraged local stations to act independently of the networks to some extent in news broadcasting. Other new technologies, including fiber optics, which permit an expansion of available telephone lines, may also encourage decentralization in information processing and distribution. So far, however, national patterns and influences continue to predominate. This is true, in part at least, because cable television has also tended to become concentrated in a few hands. It is also true, one suspects, because the nationalization of television communication has gone too far to be easily reversed. [9]

But, as everybody has noticed, television is a major business in a competitive capitalist society. Whatever the social and political views of those who make decisions are, the bottom line is capturing audience attention and increasing the size of audiences. This is what produces profits. Therefore, commercial television entertainment will seek the lowest common denominator in order to capture mass audiences and the advertisements which accrue as a result. The emphasis of news programs is bound to center on the personal and the dramatic rather than upon the abstract and discursive.

It is hard to see how this emphasis can be escaped except in a society, such as the former Soviet Union, in which television was tightly controlled. Even in Russia, however, attempts have been made in recent years to follow just such a pattern in an effort to enlarge audiences even as censorship has been reduced. Given the expense of producing programs, including news programs and television specials, local network affiliates in America depend upon the networks for both entertainment and news programs.

Of course, decisions as to what, in fact, will capture the attention of audiences are often based on the instinctive readings of audiences by those in charge of production and, thus, the values of such people come into play in a hit-or-miss pattern of decision making. Producers have and exercise more discretion than they (at least publicly) realize and audiences are not turned off or on as quickly or easily as they assume. Nevertheless, audience and audience appeal are always in the minds of those making program decisions, even when it comes to choosing one anchor over another. [10]

It is difficult to separate the effects of television as an instrument of communication from the fact that it is a commercial enterprise. By its very nature television adds new dimensions to the communication of information, and radically changes the rules of the game. The consequences for certain aspects of American life are clear. Far more than newspapers, radio, or movies, television provides its audience with a sense that what it sees is true and real. The audience sees events taking place in its living room. Stories, documentaries, even drama, take on a reality with which other media cannot compete. The written word and even the spoken word remain somewhat abstract to most readers and listeners, but moving pictures seen in the privacy of one's home are extremely compelling. Even if one knows that footage may have been spliced together and, conceivably, presents a somewhat distorted perspective (and few are aware of that fact), it is hard to escape the perception that one is viewing reality. [11]

Television has broken down class and regional boundaries to a far greater extent than other media. Books and newspapers are segregated by area and readership. Only the well educated can read serious books, and the style of the *New York Times* only appeals to those with a certain level of education and affluence. Thus, to some extent, newspapers and books encourage the segregation of knowledge. Radio began to break down that segregation. Television goes much further. There are programs which cater to more elite audiences and are watched only by them, but insofar as television seeks the lowest common denominator and finds it, Americans as a group are introduced to the same themes in the same way. *Roots* and other "docudramas," as well as the six o'clock news, are watched by millions of Americans of all educational and social backgrounds, and they see the same pictures and receive the same information. [12]

Television breaks down regional boundaries as well – the same voices, the same accents, and the same lifestyles. As Meyrowitz points out, cultures in which knowledge is dependent on the ability to read require substantial preparation before one can penetrate many of the secrets of adult life. Television has broken that barrier. Children can and do watch television programs which tell them about the off-stage behavior of parents, and introduce them to themes which they would not have encountered until much later in life in the past. Young children are exposed to the news almost every day along with their parents. Most so-called family programs deal with concerns with which children would not have been familiar even twenty-five years ago, and millions of children are still awake at hours when more "mature" television programs are shown: "It is difficult for parents to control their children's viewing of television without limiting their own viewing as well. While a child has very limited access to the content of books and newspapers being read by adults in the same room, a television program being watched by adults is accessible to any child in the same space. Many children are exposed to adult news, for example, because their parents watch the news

during dinner. With book reading, a family can stay together in a single room and yet be divided into different households. In multiple-set television households, children and adults can be in different rooms and still be united into a single informational network.” [13]

*Roots, MASH, Dallas*, the Vietnam War and 1960s urban riots were seen by very large numbers of children under ten years old. All of this has played an important role in weakening traditional ties of church, ethnic group, and neighborhood. It has contributed to American social and geographic mobility as much as the revolution in transportation, in part because it has enabled Americans to feel almost equally at home in Oshkosh, New York, or Dallas. It has homogenized American culture and nationalized it. Working-class may continue to identify with those they know and with whom they work and live; but public reality is now such that we also know and develop intimate and intense relationships with public figures of all kinds, from anchormen to rock performers to politicians. [14]

The impact of television on the substance of politics has been at least as great as it has been on our personal lives. Seeing political events, the expressions on faces, and the use of hands or eyes during an interview adds a concrete dimension to political figures, even as it may reduce the discursive elements in the message conveyed. The camera can make a political figure look as if he or she is evading a question or stammering and confused, and materials which might never appear in print, or at least would not have the same impact routinely appear on television. [15]

Television has changed the very structure of political discourse. Political figures could once issue carefully written pronouncements to the newspapers. They now appear on television interviews with warts and stutters intact. Spoken communication, after all, is rarely as well structured as written discourse. We rely on all sorts of cues to get our message across, which work well in the lecture hall but not as part of a permanent television record.

The television revolution has affected newspapers and news magazines in a different number of ways. It has forced them to turn to in-depth reportage of the kind that television

handles much less effectively. On the other hand, it has encouraged them – partly for competitive reasons, and partly because television has created a new atmosphere – to seek out the same dramatic off-stage exposure that television can achieve. Vietnam and Watergate certainly contributed to the development of an adversarial press, but the changing assumptions of media personnel as to what constitutes news and how one deals with political figures were more important in the long run. It was television reportage, too, which gave journalists the sense that they could make the news as well as report it, though many of them continue to deny that they do so. [16]

On the other hand, other journalists argue that real changes have taken place in journalism in recent years: “Thirty years ago...nobody would have been attracted [to journalism] by the thought of becoming rich, or important, or powerful. Fame was not the spur. It is now. The new entrants have their eye on the target and they are frankly ambitious...those of us in the media have enjoyed an enormous surge in status and power in recent years...But while we have acquired confidence and self-assertiveness, there is no security. We are driven to keep moving forward, and in an adversary way. We are thus prone to that disease of the times – narcissism. The narcissism of the journalist, of course, is not mere conceit. It consists in the belief that because we describe events, we make them happen.” [17]

However, writers such as Meyrowitz, Epstein, Altheide and others are considered to be certainly correct in arguing that the very structure of the contemporary media is such as to produce some of the effects which they describe. However, it is also true that the personalities of those working in the media are such that they have been attuned to its nature and feel comfortable with it.

As a conclusion, media (broadly defined) is one factor which contributes to a large extent to the social changes which are taking place all over the world. Some of the factors which have produced changes in the influence of the media and in the kind of messages it transmits have resulted from a rapidly changing

technology. Television highly contributed to the growth of national media elite as well as to the kind of messages which are now communicated by media, to whom and with what effect. These changes have had a profound impact upon our society. In many ways, this has all been to the good. Our society is more humane today and, in a number of areas, more sophisticated than it was forty years ago. On the other hand, the contemporary liberal and cosmopolitan lifestyle of middle-class professionals depends on the orderly routine bourgeois behavior of millions of ordinary people. If they come to share the lifestyle of those who rely on their support, there is some question as to whether the foundations of the society will enable it to function in ways which permit the style to remain viable. Paradoxically, as Rousseau suggested about the impact of the philosophers of the French Enlightenment: those responsible for the creation and distribution of mass culture know enough to be skeptical, but not enough to seriously examine the possibility that skepticism can contribute to the decay of those very values and structures which enable them to live the lifestyle they so much enjoy.

[18]

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## POSTMODERNIST TRENDS AND ORIENTALISM

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**Abstract:** *The problem of social and cultural diversity has been a classic issue in the humanities and the social sciences throughout the period we refer to as the modern age. Therefore, the term and the concept of Orientalism were seen as a challenge and it refers to the aspects of Eastern cultures in the West by writers, designers and artists. These meanings were given a new twist by writers such as Akbar Ahmed in Postmodernism and Islam or Edward Said in his controversial 1978 book Orientalism, where he uses the term to describe a tradition, both academic and artistic, of hostile and deprecatory views of the East by the West. Said calls into question the underlying assumptions that form the foundation of Orientalist thinking. An “Orientalist” may be a person engaged in different activities, but is also the traditional term for any scholar of Oriental studies. The paper tackles also controversial issues referring to the problem of ‘other cultures’, or simply called ‘otherness’, which has always been a central problem of anthropology from Herodotus onwards and it has raised questions regarding the acceptance of new cultures.*

**Key words:** *Postmodernism, Orientalism, Islam, new cultures, anti-Orientalism, Occidentalism, globalization.*

With the rise of the world economy and cultural globalization, this question of cultural difference has become even more acute in contemporary politics. In the 1970s academics were interested in a specific feature of this intercultural problem, namely how Western societies have understood and interpreted oriental societies through the period of imperial expansion. The debate about Orientalism gave rise to a new approach to decolonization. [1]

It became clear in the 1980s that there were strong intellectual connections between the orientalist debate, subaltern studies and feminism which were all struggles for an authentic voice. Orientalism and colonial discourse studies are concerned, as it seems, to explore the problems of subjectivity and authenticity among social groups or cultures which are excluded from power. In the 1990s there is equally strong evidence to suggest a connection between anti-Orientalism and postmodernism as alternatives to modernist rationalism.

For Almond, for instance, Orientalism both in the classical Saidian sense of an imperial project of knowledge-power and forms of objectifying the oriental other in the present world share a basic insidious inability to ‘grasp the other’. The use of symbols and themes from the Islamic other that are deployed by postmodern thinkers to affect a critique of modernity can easily lapse into the distorted reification of the orient expressed in Orientalism. This new Orientalism, for Almond, represents a danger for postmodernism and for the world of Islam. In his book, the implications are clear: while we assume that Orientalism is a feature of the popular right-wing media and the fear, hysteria and paranoia of the post-9/11 world, it is often those, thought to be most sympathetic to the plight of the Muslim other, which may actually represent an equally disturbing development in their objectification. [2]

Juxtaposing Islam and postmodernism is not a new phenomenon. Akbar Ahmed in his book in the early 1990s examined the

relationship between the two concepts. Since then important contributions of Aziz al-Azmeh, Bobby Sayyid, and Ziaddin Sardar (to which list one should add Mohammed Arkoun) have drawn upon insights within postmodern theory to explain and understand the contemporary politics and intellectual history of the world of Islam. It is thus no surprise that Almond's book reflects the influences of these authors – in particular he singles out Sayyid's extended appropriation of postmodern thought that sees Islamists 'narrating' their politics through Islamic metaphors, considering Islam to be a 'master signifier' and 'nodal point' around point elements constitute and draw meaning, and examines the Prophet as a figure inaugurating a new 'discursive horizon'. [3]

*The New Orientalists* is divided into three sections. The first on the critique of modernity begins with the 'godfather' of postmodernism Nietzsche himself (and it is in this vein that Alasdair MacIntyre has labelled postmodernists as 'neo-Nietzscheans'), followed by a chapter on Foucault's engagement with the Iranian revolution and completed with a chapter on Derrida. The second section grapples with fiction in the 'standard sense' with chapters on Borges, Rushdie and Pamuk. The final section switches to the context of postmodern theory and imagining Europe and its others with considerations of Kristeva, Baudrillard and Zizek. Some concluding thoughts then try to piece together the argument. In each of these sections, one discerns a basic pattern and structure: Almond chooses a thinker from the classical postmodern tradition, another from the founding figures of the Rushdie/Cold War period, and culminates with a contemporary thinker of immediate significance. [4]

As the reader can notice while lecturing the book, Almond argues that its aim is to establish the genealogy of a gesture, of the use of foreign value-systems to elucidate, evaluate and re-present one's parent culture. Juxtaposing monolithic alterity with pluralisms and multiple identities seems fairly obvious; but does one need postmodern thought to recognize the basic fact of plurality in Islam? More perceptive is Almond's basic conclusion

that the study of perceptions of Islam in postmodernism tells us more about postmodernism. If one realizes the continuities of post-modernism with the 'Enlightenment project' it often critiques and recognizes the incestuous canonicity of the intertextuality in which postmodern thinkers indulge, should this really surprise us? Just as Almond ends with an important question about the ethics of representation (already raised in Said's *Orientalism*), one is minded to worry both about the Muslim apologist using postmodernism to critique Western modernity without realizing that he who deconstructs will be deconstructed (a clear warning to Akbar Ahmed among others) and the Muslim seeking a 'career in the West' through the acceptance and appropriation of the fashion of metropolitan academia (a salient critique that Aijaz Ahmad makes of many a postcolonial theorist). [5]

There are many the people who asked themselves questions such as, what does one mean by Islam? Can Muslims be transformed (and then only those engaged with metropolitan discourses) by postmodern thought but does that affect the doctrines, beliefs, and theology of a faith system such as Islam? What about being against Orientalism? It is assumed that a rejection of Orientalism entails a rejection of biological generalizations, cultural constructions, and racial and religious prejudices. It is a rejection of greed as a primary motivating factor in intellectual pursuit. It is an erasure of the line between 'the West' and 'the Other.' Said argues for the use of "narrative" rather than "vision" in interpreting the geographical landscape known as the Orient, meaning that a historian and a scholar would turn not to a panoramic view of half of the globe, but rather to a focused and complex type of history that allows space for the dynamic variety of human experience. Rejection of Orientalist thinking does not entail a denial of the differences between 'the West' and 'the Orient,' but rather an evaluation of such differences in a more critical and objective fashion. 'The Orient' cannot be studied in a non-Orientalist manner; rather, the scholar is obliged to study more focused and smaller culturally consistent

regions. The person who has until now been known as 'the Oriental' must be given a voice, as Akbar argues. [6]

Said argues that Orientalism can be found in current Western depictions of "Arab" cultures. The depictions of "the Arab" as irrational, menacing, untrustworthy, anti-Western, dishonest, and – perhaps most importantly – prototypical, are ideas into which Orientalist scholarship has evolved. These notions are trusted as foundations for both ideologies and policies developed by the Occident. Said writes: "The hold these instruments have on the mind is increased by the institutions built around them. For every Orientalist, quite literally, there is a support system of staggering power, considering the ephemerality of the myths that Orientalism propagates. The system now culminates into the very institutions of the state. To write about the Arab Oriental world, therefore, is to write with the authority of a nation, and not with the affirmation of a strident ideology but with the unquestioning certainty of absolute truth backed by absolute force." He continues, "One would find this kind of procedure less objectionable as political propaganda – which is what it is, of course – were it not accompanied by sermons on the objectivity, the fairness, the impartiality of a real historian, the implication always being that Muslims and Arabs cannot be objective but that Orientalists ... writing about Muslims are, by definition, by training, by the mere fact of their Westernness. This is the culmination of Orientalism as a dogma that not only degrades its subject matter but also blinds its practitioners." [7]

Although Said's writings have received much specific attention, different contemporaneous authors considered his work outdated though many of the problems raised by Said continue to exercise the minds, not only of Arabic researchers and Islamists, but of feminists and scholars working on alternative philosophies and methodologies. In the 1970s Said was considered enormously intellectually challenging; within the Anglo-Saxon world, he referred to Michel Foucault, whose work on historical discourses continues to influence research in the humanities and social sciences. At the time, Said presented us

with a very profound critique of liberalism by showing how power and knowledge are inevitably combined and how power relations produced through discourse a range of analytical objects which continue to impact on scholarship in a way which is largely unanticipated and unobserved. [8] In his argument with liberalism Said also provided us with a critique of what was a conventional view in American social science and epistemology, namely the alleged separation of facts and values and the neutrality of science. Said's work was significant in showing how discourses, values and patterns of knowledge actually constructed the 'facts' which scholars were attempting to study, apparently independently. Over the years this classical approach to Orientalism has largely shaped what people understand by the notion of 'Otherness', and the problem of the 'Other' in human cultures has been taken up first of all by feminism, by black studies and more recently by postmodernism. [9]

Coming back to the political conditions that have changed very profoundly since the 1970s is that Said's *Orientalism*, which appeared when communism was still a viable political option and for radical social scientists Marxism was still available as a vibrant and possible tradition in the universities. The early critique of Orientalism was associated with a process of decolonization which assumed that Marxism provided an alternative to capitalism in terms of theory and politics. Perhaps Islam, in the argument of Ernest Gellner, is the only global, credible political system. We are writing in a post-communist world and that fact ought to have profound implications for how we see the role of Islam or feminism or humanism or any other social movement as a plausible mode of thinking or living. Post-communism as an intellectual and political condition explains much of the current interest in Islam and postmodernism. [10]

Another criticism of the legacy of Said relates to the problem of Michel Foucault and politics. It is a controversial issue, but it is very difficult to derive a coherent political position from the work of Foucault. One is aware of the fact that Foucault's work does lend itself, for example, to critical

criminology. His writing on Soviet psychiatry and his analysis of French penal traditions provide a way of moving from his analytical working to a political position, but generally it has been rather difficult to derive systematic radical politics from Foucault's critical analysis. Foucault's critique of dominant paradigms of knowledge in conventional systems suggests at best a form of romantic anarchism. The same issue arises for Said because his own politics relating to Palestine cannot be derived easily from the epistemological position of his book *Orientalism*. That is, there is a hiatus between the philosophy and the practice which has proved very difficult to fill. If one reads Said's book *Covering Islam* (1978b) you will see that there he adopts what one might call a realist epistemology; that is, that he believes that the problem of covering Islam journalistically is simply that journalists are badly trained. They pop in and out of countries for a few days, talk to a few taxi drivers and then write a lead article about Arabic politics. In Turner's opinion, Said's criticisms here are perfectly reasonable and valid, but they are not related analytically or philosophically to his own work or to *Orientalism*. [11]

As a consequence of the debate about *Orientalism* one could mention the notion 'Occidentalism', which is seen as a rejection of everything to do with the West and an implicit rejection of the legacy of modernization. This antimodernist dimension of critical theory may explain some of the attraction of Heidegger's cultural elitism; some aspects of this rejection of the West obviously are justifiable in connection with the indigenization of knowledge which has occupied much anthropological debate about the growth and fostering of the social sciences in third-world society. More pertinent to this discussion is the so-called problem of the Islamization of knowledge. [12] One peculiar consequence of the legacy of Foucault and Said has been a defence of a fundamentalist reading of Islamic knowledge and tradition which involve an opposition to secularism and the disenchantment of modernization as conceptualized in Max Weber's *Sociology of Religion*. This involves a claim about the

authenticity of tradition over inherited, imported or alien knowledge. [13]

One of the problems of the Islamization of knowledge is that there is difficulty in deciding whether the fundamentalist claims about this Islamization of knowledge are modernist or anti-modernist. This leads to a problem about whether one can embrace Western technology without Western values. Sociology suggests that you cannot have modernization, technology, urbanization and bureaucratization without the cultural baggage that goes with it and this baggage is essentially a post-Enlightenment system of thought. [14]

Globalization is an extension of the emergence of world economic systems, but sociologists are more concerned with cultural globalization. There is a profound sense of globalism brought about by tourism, by world sport, world news, McDonaldization, AIDS, human rights and so on. Globalization and localization go together. Wherever you have the emergence of global consciousness, there will be a reaction which promotes an anti-global movement. Globalization is an important idea, but we have to be aware of the fact that the world religions have always claimed to be global and that part of the problem of trying to understand Islam and the Christian legacy is how to understand the concept of 'the world' in traditional cultures and how that relates to the concept of globalization in modern society. Here again the processes of globalization raise very interesting and important questions about the role of intellectuals as carriers of globalism. One criticism of globalization is that it is simply Westernization. However, there are profound cultural movements coming out of Japan and other strong economies in the Asian region which are shaping the globe to such an extent that one could equally talk about the orientalization of modern cultures. What has globalization got to do with the Islamization of knowledge and the legacy of Said? It is simply the case that globalization makes it very difficult to carry on talking about oriental and occidental cultures as separate, autonomous or independent cultural regimes. [15]

It is equally important to connect globalization with the debate about



postmodernity. Briefly, postmodernity refers to the extension of the processes of commodification to everyday life and the impact of mass consumer cultures on cultural systems, blurring the distinction, for example, between high and low culture. Postmodernism means the use of simulation in cultural production, and in stylistic terms it involves self-parody and irony. Now much of the postmodern debate has been concerned to assert the importance of difference and otherness, so there is a connection between a postmodern critique of universalistic categories and the process of indigenization. That is, both indigenization and postmodernism have a fascination for the textuality of knowledge; its local, embedded, contextual quality and the problems of universalizing or generalizing about 'religion' or 'human nature'. Postmodern methodologies are sensitive to the richness and complexity of local meanings of folk practices and beliefs, and particularly sensitive to ironic meaning and intention. The main threat to the Islamization of knowledge is not, however, cognitive. The main threat to religious faith is in fact the commodification of everyday life. People do not adopt or reject beliefs systems simply on the rationalistic grounds that they are not intellectually coherent. Beliefs are adopted or rejected because they are relevant or not relevant to everyday needs and concerns. What makes religious faith or religious commitment problematic in a globalized postmodern society is that everyday life has become part of a global system of exchange of commodities which are not easily influenced by political leaders, intellectuals or religious leaders. [16]

In *Postmodernism and Islam*, Ahmed's important and wide-ranging discussion of the place of Islam within the debate over postmodernism has to be understood against the background of the complex analysis of the cultural roots of modernity. In speculating about the origins of the modern (Western) world, social philosophers from David Hume onwards have been impressed by the impact of world religions in shaping modern cultural reality. However, the sociological problem has been to decide which of these world religions

has been most significant in determining the contours of modernity. Within the sociology of religion, the ascetic Protestant sects were regarded as fundamental in the push towards rational modernity. The inner-worldly asceticism of Calvinistic Protestantism transformed Western culture towards an antimagical, disciplined life-world. The alternatives to this Weberian thesis suggested that it was Jewish culture, according to Sombart (1962), which had provided the roots of modernist rationality, but this debate has remained fundamentally unresolved. [17]

There were two major issues within the argument concerning the Protestant ethic thesis. First, it tied the idea of instrumental rationality to modernity: to become modern, a society had to undergo and embrace the disciplines of goal-directed rational conduct. Second, the thesis gave a privileged position to north-western Europe as the cutting edge of this global process, and by casting the West in this role 'the Orient' became the Other. The rationalism of the West was fundamental to the teleological processes of world history. The consequence has been to place Islam in a problematic relationship to rationalist modernity and to the Christian West. [18]

Throughout much of the twentieth century, modernist apologists for Islam have argued that Islam as a religion was not in any essential manner anti-rational or incompatible with capitalism, nor was it culturally traditionalist. Orthodox Islam, as they call it, was in fact an anti-magical, radical, ascetic and disciplined culture; it could provide the same inner-worldly asceticism that one finds in Calvinism. In fact, Islamic monotheism was seen to be more rational than Christianity, within which there are polytheistic strains in the doctrines of the Trinity. The problem was to explain how this rationalist dynamic in Islam had been repressed. Several answers were available to explain this alleged historical retardation of the Islamic world, which included reference to the negative consequences of mystical Sufism, folk religiosity, the rigidity of Islamic law, or the closing of the gate of *ijtihad*, the effects of *Zakat* in relation to more profitable investments, and the absence of an

autonomous urban culture within civil society. [19]

In the 1970s and 1980s Western critics of orientalism and colonialism lived in a world where there appeared to be a viable alternative to Western capitalism, namely communism. In addition, there was a well-established tradition of scholarship which sought to explain, not only the origins of capitalist exploitation and colonialism, but also the historical stages by which the hegemony of Western capitalism would be brought to a final, brutal end. Two major changes have rendered this world obsolete: the fall of communism and the rise of postmodernity. These two changes are without doubt closely interconnected in cultural and social terms. The consequence has been that there is no significant political or economic alternative to organized socialism as the antagonist of Western capitalism, but it may be that this gap in the world system will be filled by either Islam or postmodernism. [20]

For many Western intellectuals, the enthusiasm for postmodern philosophies may be, at least covertly, a function of the demise of socialism as a credible anti-capitalist system. Following J.F. Lyotard in *La Condition postmoderne* (1979) we can define postmodernism simply as 'incredulity towards metanarratives'. [21] Postmodern philosophy offers a simultaneous condemnation of exploitative capitalism and bureaucratic socialism as 'grand narratives' which have imposed a barren sameness on the modern social world. Postmodernism, which has found important allies in feminism and anti-colonialism, condemns the uniform, patriarchal, rationalist and hierarchical structures of Western modernism. While many critics of postmodernism have mistakenly assumed that it has no political message, postmodernism suggests a new vision of justice which gives primacy to difference, to heterogeneity, to paradox and contradiction, and to local knowledge. [22]

These political and intellectual developments in postmodernism seem to challenge Orientalism. The collapse of Soviet communism (the consequent challenge to the intellectual authority of Marxism and the growing influence of postmodernism) make

the global position of Islam crucial but problematic. At one level it may be possible to argue that, given the history of the Islamic world since the French revolution, Islam can now function as the major alternative, perhaps even the only alternative to Western capitalist hegemony. For many writers, such as Ali Shari'ati in his *Marxism and Other Western Fallacies* (1980), Islam has been simultaneously opposed to the secularism of the communist world and to the consumerism of the Western world; hence, it can operate globally as an oppositional force. Furthermore, since postmodernism is also opposed to the instrumental rationalism of both capitalism and communism, there could be an alliance between Islam and postmodernism. At another level of analysis, however, Islam may be regarded as itself a 'grand narrative' of religious orthodoxy and uniformity, which has been fundamentally committed to ideas of universal rationalism, discipline and asceticism. [23]

These possibilities represent the 'predicament and promise' of Islam, and hence Ahmed's *Postmodernism and Islam* (1992) will assume a centrality to the contemporary analysis of the place of Islam in postmodernity. [24] The book implies that there can be a convergence between postmodernist criticism and the hegemony of the West and an Islamic critique of Western materialism, media hegemony, military power and global dominance. His thesis fails ultimately, because he wants, somewhat indirectly, to employ postmodernism to attack the traditional assumptions about Western supremacy and modernist rationality, but he does not fully face up to the critical implications of postmodernism for traditional Islam. [25]

However, what seems to be more problematic for the reader of *Postmodernism and Islam* is quite where the author himself stands in relation to postmodernism. At first sight his obvious understanding of and fascination with Madonna, Queen, 'Twin Peaks' and Batman suggest sympathy with postmodern culture, but still, his views on Islam and the West turn out to be quite traditional. Against the rampant consumerism

of the West, he suggests that Islam is by contrast a green movement which is deeply concerned with the politics of the environment. He notes that Islam's very colour is green and its concept of the good life, Paradise, is replete with gardens, orchards and rivers'. Ahmed rather inflates the idea of postmodern in order to suggest that the Kashmiri expression of independence is an example of Muslim postmodernism. He fears, however, that the combination of feminism and postmodernism will prove to be a lethal attack on manhood; his conclusion is that the West is morally bankrupt, because the 'lies, the hypocrisy and moral bankruptcy' of the 1980s have taken their toll. [26]

These arguments present a straightforwardly conservative critique of the vulgarities and corruption of the West, and of course the function of the book is to warn a rather complacent Muslim leadership that Islam is itself now challenged by postmodernism: 'The postmodernist age in the 1990s hammers at the doors of Muslim *ijtihad*; Muslims ignore the din at their peril' [27]

However, apart from the ambiguities of Ahmed's own stand towards postmodern consumerism, there is a more general problem about the precise nature of postmodernism. It seems that Ahmed wants to warn somehow the Muslim leaders about postmodernism, but it is not really clear what the nature of that threat is. Although he provides a reasonably full account of postmodernism, he fails to resolve an important question: is postmodernity after modernity or against modernity? Alternatively, is postmodernity in fact a form of high modernity? The academic community is sharply divided over the issue of whether postmodernity is a radically different alternative to modernity, of which Islam might be a part, or indeed of whether postmodernity exists. At least one step towards solving the first issue would be to make a distinction between postmodernism and postmodernity. By the former, we should mean the philosophical critique of grand narratives, and by the latter we should mean the postmodern social condition which is an effect of informational technologies, globalization, fragmentation of lifestyles, hyper-

consumerism, deregulation of financial markets and public utilities, the obsolescence of the nation-state, and social experimentation with the traditional life-course. Clearly both postmodernism and postmodernity are a significant challenge to the values and institutions which grew out of the Abrahamic faiths. Perhaps Christianity is already in a state of postreligion, but Islam has yet to experience the full impact of postmodernization. Secularization is certainly assumed to have brought about a condition of post-history, because there is no shared understanding of the meaning of history. The subterranean erosion of grand narratives by commercial TV, MTV, videos, head-sets and the global catwalk is a serious possibility. In this sense, Ahmed may be probably right: the threat to Islam is not the legacy of Jesus, but that of Madonna.

#### NOTES

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## BLOGGING FOR ESP

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**Abstract:** *The tremendous advent of technology in the 21<sup>st</sup> century has profoundly changed the face of the current ELT classroom. Nowadays, tapping the enormous resource pool available on the Internet has become common practice for language educators and learners alike. Language teachers can now easily access and exploit those materials (in audio, video, pictorial, textual formats) that allow them to supplement and enhance the information provided by traditional textbooks while language learners can use the Internet as the portal to a virtual world in which the target language (English in our case) is exercised in authentic, purposeful and meaningful ways. There are numerous learning platforms, tools and materials readily available on the Internet ranging from Webquests, podcasts, forums, chats, etc. This paper will look at web logs or blogs, as they are known today, and the benefits they could offer to teachers and learners of both general English and, most importantly for our context, English for Specific Purposes (ESP).*

**Keywords:** *blogging, technology, Internet, webquest.*

### INTRODUCTION

The tremendous advent of technology in the 21<sup>st</sup> century has profoundly changed the face of the current ELT classroom. Nowadays, tapping the enormous resource pool available on the Internet has become common practice for language educators and learners alike. Language teachers can now easily access and exploit those materials (in audio, video, pictorial, textual formats) that allow them to supplement and enhance the information provided by traditional textbooks while language learners can use the Internet as the portal to a virtual world in which the target language (English in our case) is exercised in authentic, purposeful and meaningful ways. There are numerous learning platforms, tools and materials readily available on the Internet ranging from Webquests, podcasts, forums, chats, etc. This paper will look at *web logs* or *blogs* as they are known today and the benefits they could offer to teachers and learners of both general English and, most importantly for our context, English for Specific Purposes (ESP).

### 1. WHAT IS A BLOG? DEFINITIONS

The term *weblog* was coined by Jorn Barger, an American blogger, in 1997, while editing one of the earliest known blogs *Robot Wisdom*. The short form, *blog* came later, being coined by Peter Merholz.

Before discussing the blog in an ELT context, it might prove useful to look at it in its initial, original context. The “Blogger” website (2004) [www.blogger.com](http://www.blogger.com), defines the blog as follows:

“A blog is a web page made up of usually short, frequently updated posts that are arranged chronologically — like a *what's new page* or a *journal*. The content and purposes of blogs vary greatly — from links and commentary about other web sites, to news about a company/person/idea, to diaries, photos, poetry, mini-essays, project updates, even fiction. Blog posts are like instant messages to the web.”

In the article “*Weblogs: A history and perspective*” (2000), Rebecca Blood, one of the scholars in the field, traced the history of this quite new medium for sharing ideas and

opinions. According to Blood, in 1998 there were only 23 weblogs on the entire Internet. In September 2000, there were ‘thousands,’ and with the numbers of users growing exponentially. Today, there are surely millions.

The speed and ease with which one can publish on the Internet by means of this particular software must be the key features which have transformed it into a popular tool, widely and diversely used for “e-self expression”. In brief, all basic document formatting, such as spacing, bold, italics, underline, and creating links, requires no knowledge of HTML or FTP (File Transfer Protocol), so that anyone who can type, copy, and paste can create and maintain a weblog. What is more, users can customize the layout of their blog and even add pictures, videos, audio clips, etc to enhance its attractiveness.

## 2. THE BLOG IN ELT

### 2.1 Why blogging? Advantages and disadvantages

The ELT community could not have possibly overlooked the benefits and possibilities for language learning and teaching that such a rich, interactive communication medium offered. Writing about the blog in connection to ELT, Aaron Campbell (2003) sees it as:

“an online journal that an individual can continuously update with his or her own words, ideas, and thoughts through software that enables one to easily do so. (...) Similar to an open journal, the accumulation of writings and other content creates both a record of learning and a resource for others. Furthermore, a weblog is interactive, in the sense that readers can respond to any given entry with a comment and even threaded discussions can take place depending on the software chosen.”

Seen as such, the benefits of the blog for English teaching and learning immediately become evident. The blog is conducive to purposeful language interactions in an

authentic context and therefore, is bound to enhance the students’ communicative skills. Moreover, the blog can provide students with opportunities for cooperative work within a framework of a learning community constituted as a result of using the same blog for the same purposes. The idea is supported by the “Blogger” website (2004) which points out that:

“Blogs are also excellent team/department/company/family communication tools. They help small groups communicate in a way that is simpler and easier to follow than email or discussion forums. Use a private blog on an intranet to allow team members to post related links, files, quotes, or commentary. Set up a family blog where relatives can share personal news. *A blog can help keep everyone in the loop, promote cohesiveness and group culture, and provide an informal "voice" of a project or department to outsiders.*” (emphasis ours)

Thus, besides offering the context for self-expression and communication, the blog helps learners create an identity as a group with shared goals, interests and features, consequently, contributing tremendously to enhancing learner motivation and personal involvement. Other benefits of using the blog in ELT might include:

- *Providing learners with a real audience for their writing activities.* When learners become aware of the fact that their writing can be read and responded to not only by their teacher but also by their colleagues, friends and possibly other people surfing the Internet, their writing endeavors become more purposeful while more care is given to both content and form. Moreover, the feedback received is less artificial (grammar mistakes, spelling, etc.) and more focused on the functional aspect of writing. Therefore, learners reach a point when they use the target language not merely to practice it but rather to actively communicate in it, accomplishing tasks which surpass language learning.
- *Providing learners with authentic reading practice.* The textual input

provided on a blog can originate in the teacher, the other learners, or regular Internet surfers posting comments. Thus, the input becomes at once diverse as far as register and level of difficulty, offering students a larger palette of possible responses and approaches to one particular topic.

- *Providing learners with a coherent, organized and targeted collection of materials.* Considering the immense amount of resources available on the Internet, learners might find it difficult and discouraging to navigate through the mass of information at hand. The blog can be created by the teacher and organized in such a way that the posted materials/links directly address the profile of the student in terms of needs, level, interests, etc.
- *Providing all learners with equal opportunities to express themselves in a non threatening environment.* Face-to-face interaction in the classroom certainly has numerous, undisputable benefits. However, it can also prove inhibiting for those learners who are more self-conscious and are afraid of making embarrassing mistakes in front of their peers and teacher. The blog can help the latter express themselves without the pressure of being on the spot. They can plan their answers, check them before posting them and allot themselves the necessary time to intervene constructively.
- *Constituting both an extension of and the basis for classroom discussions.* Learners can participate in values clarification activities which take place outside the classroom. Thus, work done in the classroom is extended beyond the regular study hours into the virtual realm of the blog. Moreover, discussions initiated on the blog can be continued in the classroom in the form of a speaking activity such as a debate.
- *Constituting a virtual portfolio of learners' work.* By saving the learners' postings online, the teacher

actually helps the learners create their own portfolios. Thus, the learners' work can be evaluated and feedback on progress made extended. What is more, learners can self-evaluate and decide on the road ahead.

- *It is a motivational factor in the process of learning.* Most learners are already avid and knowledgeable users of technology. If that technology is incorporated into a language learning situation, then learners are more likely to find it stimulating, interesting and fun.

No matter how wonderfully new and exciting the blog might prove for language learning, it may still pose some difficulties both to the teacher and the language learner:

- *Technical limitations and mishaps.* Not all students may have Internet access from home. Then, the teacher should work in some lab hours either within the language classes or after them. What is more, the Internet connection is bound to differ from one context to another, possibly impeding the students' posting their comments on the blog. Teacher should be prepared with a contingency plan and allow students to first type their comments and save them for later postings at more convenient times.
- *Lack of appropriate computer skills/knowledge on the part of the learners.* Although computer literacy is widely spread among younger learners, older ones are more likely to feel some anxiety and thus reluctance to using technology. The teacher should therefore plan for appropriate scaffolding in view to enabling the technophobes to reach a point when then can freely and constructively use the blog in their learning process.

## 2.2 Types of blogs used in ELT

Aaron Campbell (2003) has described three types of blogs which can be used in an ELT context:

- *The Tutor Blog* is basically a blog created and run by the teacher, who decides upon the content, the amount of information provided, its level of difficulty, the set-up of discussions, all in accordance with certain learning objectives. Students are invited to react to the teacher's posts by writing comments but they cannot alter the face, content and direction of the blog.
- *The Class Blog* is a medium for collaboration and extracurricular work and discussion, a space equally shared by students and their teacher. Within such a blog, students can be encouraged to reflect in more depth, in writing, on themes touched upon in class. They are obviously given a greater sense of freedom and involvement than with the tutor blog.
- *The Learner Blog* is actually each student's individual blog. It can be created by the teacher or the student and gives the latter total freedom of expression and manipulation. Students can use their individual blogs as personal diaries, they can post on each other's blogs thus self and peer-evaluating, ultimately taking ownership of their learning process.

The three types of ELT blogs outlined by Aaron Campbell can represent the starting point for a teacher to select, mix and match in order to create their own customized teaching tool, adapted to the particular needs of the class, the students and the course objectives.

### 3. THE BLOG IN ESP

Teaching and learning ESP is by no means different from teaching and learning general English. The same methodological considerations, approaches, choices of activities and resources that the teacher resorts to when teaching general English can easily be transferred to the ESP context. The only major difference resides in the specificity of the content. Therefore, this section will present the form and content of an ESP (military) blog in the hope that other teachers of military

English will be interested in what it has to offer and possibly become inspired to create their own, thus integrating more www technology into their classes.

The address of the blog is <http://ttseminar.blogspot.com/> and according to the moderator "[it] was created for teachers and students of military English in order to share links, addresses of useful websites and ideas on how to better exploit the Internet for learning and teaching English."

The blog consists of several sections:

#### 1. *Links for teachers of military English:*

- <http://www.britishcouncil.org/learn-english-peacekeepers>  
This interactive site was specially created with the personnel of peacekeeping missions in mind.
- <http://delaso.co.uk/>  
Free downloadable exercises and quizzes for students of Military English to practice language skills and develop military knowledge.
- <http://www.bbc.co.uk/history/interactive/>  
Games, battle maps, animated guides, interactive timelines and movies.
- <http://www.usafa.edu/isme/Cases/casesindex.html>  
Interesting military cases which lend themselves to be used in the language classroom to develop critical thinking, discussion skills etc.
- <http://www.english-to-go.com/wll/lessons.cfm>  
A bank of teaching resources to raise awareness of landmines and the dangers they cause.
- <http://onestopenglish.com/>  
One of the most popular resource sites for English language teachers. In the vocabulary section look for the theme of "war"!
- <http://www.campaignmilitaryenglish.com/>  
A three-level English language course from Macmillan, designed for multinational military and



peacekeeping forces on peacekeeping operations.

2. *Essentials*. Links to international organizations that military students should be acquainted with, and which provide a rich source both for information and for possible teaching and learning materials.

- <http://www.euforbih.org/eufor/>
- <http://www.nato.int>
- <http://www.un.org>

3. *Military news*

- <http://www.defensenews.com/>
- <http://www.iwpr.net/>

4. *Online military dictionaries*

- <http://www.yourdictionary.com/diction5.html#military>
- <http://www.milterms.com/index.php>

5. *STANAG topics (general and military)* providing students with a comprehensive list of thematic areas they should be able to deal with at different STANAG levels.

6. *Online practice for students* in military writing, military reading, general listening and reading.

## CONCLUSIONS

Such blogs can be created by each teacher of military English in accordance with the profile of his/her students and updated with each new class so that after a while it becomes both a repository of information and a platform for learning which can be accessed and enriched by each generation of students at its turn. Links can be created from one military blog to another within the branches of service or among them, creating a complex and beneficial network of learning resources and also a forum for sharing expertise, ideas and resources.

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### *II. Companies offering free blogging software and hosting without commercial advertising:*

<http://www.diaryland.com/> ,

<http://www.pitas.com/> ,

<http://www.upsaid.com/> ,

<http://www.webcrimson.com/>

**WHY INTERCOMPREHENSION? AN  
OVERVIEW OF CURRENT RESEARCH ON  
THE TOPIC  
AND ARGUMENTS IN FAVOR OF  
CONSIDERING IT WHEN TEACHING AND  
LEARNING LANGUAGES**

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**Abstract :** *A new approach towards “the capacity to understand and to be understood by means of different communicative modes or strategies – verbal and non-verbal” (Capucho, 2002:17) was done at the beginning of 1990s when the term Intercomprehension was first used. Not long ago, if one had tried to “google” the word Intercomprehension, not very many references would have been available. Nowadays, in less than 20 seconds, more than 6,400 entries are displayed at once. Books and articles have been written on the topic, conferences and workshops have been organized, projects have been run, web sites have been designed, all with the same purpose: to raise awareness that more attention should be given to “receptive competence rather than to oblige learners to develop a productive competence which mostly stays limited and is difficult to acquire and use” (Ollivier, 2005). Intercomprehension aims at facilitating access to languages and multilingualism in a more realistic way by concentrating on receptive competence. The aim of this paper is to provide a brief overview of the current state of research in the field of Intercomprehension and to bring into discussion several arguments in favor of seriously considering Intercomprehension when teaching and learning languages.*

**Keywords:** *intercomprehension, plurilingual competence, language awareness.*

## **INTRODUCTION**

The European Union has 27 Member States and 23 official languages. The knowledge of foreign languages varies considerably among the population of the member countries. The five most used, and spoken second or foreign languages in the EU are English, German, French, Russian and Spanish followed by Italian. According to the "Special Eurobarometer 243" of the European Commission with the title "Europeans and their Languages", published on February 2006 with research carried out in November and December 2005, English is by far the most spoken foreign language at over half (51%) of the population, with German and French

following. 56% of European citizens are able to engage in a conversation in a language other than their mother tongue. The EU encourages all its citizens to be multilingual; specifically, it encourages them to be able to speak two languages in addition to their mother tongue, in other words, plurilingualism is very much encouraged. In order to sustain the idea of plurilingualism, the Council of Europe has issued a handbook for language teachers and other language professionals, *The Common European Framework of Reference for Languages*, in which plurilingualism is defined as:

the ability to use languages for the purposes of communication and to take part in intercultural interaction, where a person, viewed

as a social agent, has proficiency of varying degrees, in several languages, and experience of several cultures. This is not seen as the superposition or juxtaposition of distinct competences, but rather as the existence of a complex or even composite competence on which the user may draw. (Council of Europe, 2001: 168)

However, there is a limitation of multilingualism (i.e. what linguists call plurilingualism) and this resides mainly in the amount of time and energy required to master each new language. Apart from this limitation, there are several questions that still have to be answered: does this policy solve the problem of international communication? How long does it take to learn a foreign language to such an extent that makes communication possible? How many languages can one learn and how does this guaranty the ability of communicating with people of different nationalities? And the list could continue. The beginning of '90s brought into attention both a new concept, *intercomprehension* and a new approach towards "the capacity to understand and to be understood by means of different communicative modes or strategies – verbal and non-verbal" (Capucho, 2002). *Intercomprehension* is considered by many practitioners as one of the most practical solutions in order to facilitate the international communication.

### 1. WHAT IS INTERCOMPREHENSION? DEFINITIONS

The term *intercomprehension* has been used by the European Union in order to identify a broader approach to language education, particularly the use of underlying language proficiency to enable access to other languages<sup>1</sup>.

<sup>1</sup> 1. [www.multilingual-matters.net/la/012/0247/la0120247.pdf](http://www.multilingual-matters.net/la/012/0247/la0120247.pdf)

English dictionaries do not include the word *intercomprehension*. "The term has been coined to describe the perspective which stresses the legitimacy of the universality of a language user's receptive proficiency. *Intercomprehension* is related to terms such as *interlanguage* suggested by Selinker (1972/1992), which in turn was adapted from *interlingual*, term used by Weinreich (1953). The term *intercomprehension* is associated also with the concepts of intercultural communication, inter-discourse communication, intercultural discourse, intercultural competence, and interpersonal communication across cultures, inter-group communication" (Pencheva, 2003).

*Intercomprehension* is a form of communication in which a person uses his or her own language and understands that of the other. It aims at facilitating the access to languages and multilingualism in a more realistic way by concentrating on receptive rather than productive competences. In other words, *intercomprehension* is nothing else but the use of linguistic and non-linguistic skills and knowledge in order to understand an 'unknown' language, depending on raising awareness of what a person already knows but does not realize, on the knowledge of how communication functions, or how interpersonal interaction develops.

### 2. WHY INTERCOMPREHENSION? ADVANTAGES

Several languages have played one by one the role of a *lingua franca* along the humankind history. Each proved to have a positive role at its time but none has become THE one able to make all people understand each other or gain enough ground in order to replace mother tongues and thus to become a universal means of communication. Moreover, there were some evident dangers of a global language that could not be ignored. Among them, according to Doye (2005) the most important ones are:

- the danger of linguistic imperialism;

- the disadvantage of a culture-free use of the *lingua franca*
- insufficient communication and potential depreciation of the mother tongue.

What does *intercomprehension* bring in response to these disadvantages? Why should we consider it a better alternative to a *lingua franca*? If *intercomprehension* is accepted as a positive attitude and thus it becomes a common means for global communication, don't we simply propose a replacement of a system with another one that eventually might prove to have the same short comes? Which are the advantages that make us embrace the new system? The first valid answer to these series of questions could be the fact that *intercomprehension* does not simply suggest a replacement of all languages with one considered by some as the only one capable of making people of different languages and cultures understand each other.

In our opinion, the main advantages of *intercomprehension* are:

- the ability to establish bridges between languages and cultures on the basis of linguistics and cultural competences already acquired;
- the establishment of an open attitude towards other languages, experiences, different ways of life, different learning and teaching situations;
- the communicative flexibility when facing unknown languages and cultures;
- the opportunity to benefit from the common features in human communication and languages;
- the ability to raise awareness of what one already knows but does not realize, the knowledge of how communication functions, how speakers interact among themselves.

The advantages mentioned so far along with other benefits noticed by all those interested in the topic of *intercomprehension* lead inevitably to the development of several projects and programs whose main topic is the

term under discussion and its implications in the learning/teaching process. Some of the finished projects are:

- **GALATEA**, which started in 1991 and finished in 1999, promoted the development of *intercomprehension* among speakers of Romance languages;
- **Eurom 4**, which is contemporary of Galatea and also aims at creating a specific methodology for the development of reading skills in French, Portuguese, Spanish and Italian;
- **Intercomprehension in Language Teacher Education (ILTE)**, which ended in 2001, aimed at creating a teacher-training module focused on the concept of *intercomprehension*;
- **IGLO** (1999 – 2003) promoted cross-linguistic comprehension among the Germanic languages, on the model of the Scandinavian situation, whereby speakers produce their own language but understand the other Scandinavian languages.
- **Galanet** (2001 – 2004) promoted *intercomprehension* among speakers of Romance languages and crated a web platform that is still being used;
- **Eu & I** (2003 – 2007) was the first project that promoted *intercomprehension* beyond the different families of languages;
- **Euromania** (2006 – 2008) developed materials for school children to develop *intercomprehension* skills in the Romance languages whilst learning other subjects (history, science, mathematics, etc.)

Other projects are still going on:

- **Intercom** (2007 – 2009) aims at developing reading skills in German, Portuguese, Bulgarian and Greek at A2 level;
- **Chain Stories** (2007 - 2009) creates chains of stories that are

written in cooperation by children using their mother tongue and understanding the languages of four other countries (Portuguese, Romanian, Spanish, Italian and French);

- **GALAPRO** (2008 – 2010) aims at training teacher trainers on the topic of *intercomprehension*;
- **EuroCom** is a project intended as a way towards European multilingualism. EuroComRom – The Seven Sieves is a multilingual gateway to the world of the Romance languages;
- **REDINTER – Rede Europeia de Intercompreensao** (2008 – 2011) is a thematic network which aims to develop *intercomprehension* and good practices in this domain, to identify the existing materials and experience and to publish a report of recommendations, as well as to organize a scientific colloquium at the end of the project in which all the research done will be discussed.

The main benefit of all these projects resides in the fact that the methodological principles of education to *intercomprehension* have been identified, analyzed and developed in order to accelerate the process of acquiring competences in reading and listening comprehension in several languages in any field of interest, be it general or specialized.

## CONCLUSIONS

Teaching foreign languages is and will remain of great interest all over the world. *Intercomprehension* does not come as an alternative whose intention would be to replace the process of teaching languages; on the contrary, it could be introduced as a guiding principle in any existing language course (Doye, 2005). Understanding foreign languages could be simplified by the guidelines provided through *intercomprehension* and thus, speaking in one's own language and being understood would be certainly an efficient way of

communication. The development of *intercomprehension* could be a powerful weapon to help the establishment of mutual understanding.

The role of the language teacher remains essential; nevertheless, his/her approach to teaching languages will shift from simply teaching a language to focusing on several languages at the same time. This could be realized by including while teaching features of other foreign languages, by exploiting the students' capacity for comprehending words, phrases and other linguistic and cultural elements in foreign languages at large, by awakening students' language awareness, by developing in students the capacity to reflect about how languages function, and not the least, by preparing students to live and work in a multilingual, multicultural and globalized world.

We would like to conclude with one of the definitions (Capucho, 2004) given to the term of *intercomprehension*, which might also serve as an example of the practice of *intercomprehension* for all the readers who have never learnt Portuguese.

A Intercompreensão é “o desenvolvimento da capacidade de co-construir o sentido, no contexto do encontro entre línguas diferentes, e de fazer uso pragmático dessa capacidade num situação comunicativa concreta”.

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## PECULIARITIES OF ESP

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***Abstract:** The paper analyses the peculiarities of English for Specific Purposes (ESP) to determine the way to obtain the maximum benefit from ESP courses. The four sections of the paper refer to the necessity to understand ESP, to the complexities of language and language learning, to the nature of ESP, finally stating the benefits of ESP courses and analyzing how to obtain maximum efficiency from teaching ESP. ESP is characterized by faster acquisition of required items because students learn what they need in content based context. Learning ESP is efficient as students make maximal use of their learning resources, and effective, as they are ready to use language appropriately in job related tasks.*

***Key words:** ESP, general English, ESP content, ESP methodology, needs analysis, placement test, progress test*

### 1. THE COMPLEXITIES OF LANGUAGE AND LANGUAGE LEARNING

In order to optimize the teaching and acquisition of ESP we have to grasp the full complexity of language and of language learning.

Language is multifaceted as a consequence of the variety of human activity. Each domain has its own language and cultural setting. We may divide these domains of life into two categories: those that are common to everybody and those that are concerned with specialised topics familiar only to a few.

Obviously, those domains of life which are common to many people are concerned with everyday existence. So, when one learns a language, one must be exposed to linguistic items relating to these universal topics. This is the task of a General English course.

On the other hand, when we reach the stage at which any topic constitutes an individual's profession, it becomes crucial that he should be proficient in the specialised language of his domain. Each topic will contain

certain tasks, specific to it, which an individual will need to accomplish.

In general, we may state that human life, and hence human language, is concerned with many and various topics. Each topic requires certain communicative tasks to be performed, and these tasks require mastery of certain task-based skills. Such skills are: reading and writing texts of various style, register and lengths, listening in various styles, accents and registers, speaking appropriately in a variety of contexts including socialising, negotiating, interviewing, presenting information and pronouncing material in a clear and culturally acceptable way. People who are engaged in different activities need to master different skills. In order to acquire the desired skills, a range of linguistic items specific to each skill must be mastered.

Each field will have vocabulary which is special to it. Some of the words may have meanings specific to the field, different from their meanings in everyday life. Within each field, there will be specific registers to be learned. Speaking and writing in different social and cultural contexts require language with different levels of formality and politeness.

Register is very complex and highly developed in English and includes not only certain forms of grammatical structure, but also specific kinds of vocabulary. Each field will have different linguistic functions which need to be performed. Each function may be performed in different registers.

Each language is so vast and complicated that it is literally impossible to master it completely. When native speakers learn their own language, they learn what they need, when they need it. Each of us grows up in a particular cultural and social environment within our own country. This environment will determine what kind of language we use in everyday life as we grow up. Consequently, people in different social groups will have their own vocabulary, register, functions and pronunciation. As we move to an individual level, we will find that everybody has a different vocabulary and style of speaking dependent upon his precise position in society. As people find themselves in different positions in society their activities change, so their linguistic needs change and they learn accordingly.

## **2. WHAT IS ENGLISH FOR SPECIFIC PURPOSES?**

Different human activities require different communication skills, which in turn require mastery of specific linguistic items. ESP is, basically, language learning which has its focus on all aspects of language specific to a particular field of human activity.

The most important difference lies in the learners and their purposes for learning English. ESP students are usually young adults or adults who already have some acquaintance with English and are learning the language in order to communicate a set of professional skills and to perform particular job-related functions. An ESP program is therefore built on an assessment of purposes and needs and the functions for which English is required.

ESP concentrates more on language in context than on teaching grammar and language structures. It covers subjects varying from accounting or computer science to tourism and business management. The ESP focal point is that English is not taught as a subject separated from the students' real world (or wishes); instead, it is integrated into a subject matter area important to the learners.

There are two areas of importance in ESP: content and methodology.

Content is concerned with how narrow or broad the scope of a particular course is, when compared with the totality of the language. The content of any ESP course should be determined by a comprehensive needs analysis, which will be composed of placement test, linguistic needs analysis and learning needs analysis. This will determine which language skills are most needed by the students, and the syllabus is designed accordingly. An ESP program, might, for example, emphasize the development of reading skills in students who are preparing for graduate work, or it might promote the development of spoken skills.

Learners in the ESP classes are generally aware of the purposes for which they will need to use English. Having already oriented their education toward a specific field, they see their English training as complementing this orientation. Knowledge of the subject area enables the students to identify a real context for the vocabulary and structures of the ESP classroom. In such way, the learners can take advantage of what they already know about the subject matter to learn English.

Methodology is also of crucial importance. Since ESP courses aim to develop linguistic skills relating to particular spheres of activity, the ways in which the linguistic items are introduced and how they are practised are highly significant. As a matter of fact, ESP combines subject matter and English language teaching. Such a combination is highly motivating because students are able to apply what they learn in their English classes to their



main field of study, whether it be accounting, business management, economics, computer science or tourism. Being able to use the vocabulary and structures that they learn in a meaningful context reinforces what is taught and how it is taught, and this increases their motivation.

The learning materials should be content-based and should focus on specific problems that people are likely to encounter in their everyday working lives in the ESP field. The result of this methodology is that learning has greater relevance to the current or future employment situation.

The content of an ESP course has to be determined based on the following:

1. Placement testing, which consists of administering tests that enable the teachers to determine the starting level of courses in the training program.
2. Linguistic needs analysis, which enables the teachers to determine the type, content and duration of courses, required skill development, linguistic structures, lexical items, functions and levels of formality.
3. Learning needs analysis enables the teachers to identify learners' needs of developing specific skills. Hence, they are able to develop courses and practice materials which use the learners' preferred methods and materials of learning.

In general, we may say that learning on ESP courses should take place in contexts which are as authentic as possible and content-based. The requirement of authenticity means that learning materials should use actual texts produced by people working in the ESP field under consideration. For instance, a class on how to write research reports should use good examples of reports produced by actual researchers.

The selection that the learning materials be content-based means that they should focus on specific problems that people are likely to be confronted with in their everyday work lives in

the ESP field. Within the context that learning materials should be authentic and content-based, many important linguistic items relevant to the ESP field may be introduced and practised.

The result of this methodology is that learning has greater relevance to the work situation and this means that students will have greater interest in the course and there will be better learning results.

The extent of the authenticity of the learning materials will vary depending upon two related factors: the language level of the students, and the degree of linguistic complexity of the skills presented and practised. The degree of authenticity will vary: if the language level is low, the degree of authenticity will also be low, but as the language level increases, the degree of authenticity becomes greater.

With respect to the degree of linguistic complexity of skills introduced and practised, the situation is more complex. At first, specific linguistic items are mastered in small simple activities. Real-life social interactions must be observed in order that the students may see what precise phrases people use to perform certain functions, and then the teacher should try to provide opportunities for practise in an authentic context. Such contexts are useful for introducing and practising specific linguistic items.

Once isolated linguistic items have been mastered in the context of such small scale activities, and the linguistic skills required become more complex, there emerges a need for more complex practice situations, based upon real-life situations. For this, case studies may be used in order to practise specific skills in reading, writing, listening and speaking and later, simulations based on real-life problem situations which require usage of a wide range of skills specific to the particular ESP context.

The skills and linguistic items learned will not be useful only in the ESP context. Some of them, for instance structures and register skills, can be transferable to other

contexts, where they can be applied successfully.

### **3. THE PECULIARITIES OF ENGLISH FOR SPECIFIC PURPOSES**

Firstly, there is learning speed. ESP results in faster acquisition of required linguistic items. This is because it follows the pattern of native speaker acquisition of language for specific purposes, in which speakers learn what they need, when they need it, in authentic, content-based contexts.

Secondly, there is learning efficiency. On an ESP course students make the maximal use of their learning resources, all of which are brought to bear on acquiring specific, pre-identified linguistic items and skills. Obviously, the needs analysis is of vital importance here, since it enables teachers to determine the specific requirements of students.

Thirdly, there is learning effectiveness. On completion of an ESP course, students are ready to use language appropriately and correctly in job related tasks, tasks which have been identified prior to the course by means of a needs analysis. The students' abilities in their subject-matter fields, in turn, improve their ability to acquire English. Subject-matter knowledge gives them the context they need to understand the English of the classroom. In the ESP class, students are shown how the subject-matter content is expressed in English. The teacher can make the most of the students' knowledge of the subject matter, thus helping them learn English faster.

The term "specific" in ESP refers to the specific purpose for learning English. Students approach the study of English through a field that is already known and that is relevant to them. This means that they are able to use what they learn in the ESP classroom right away in their work and studies. The ESP approach enhances the relevance of what the students are learning and enables them to use the English they know to learn even more English, since their interest in their field will motivate them to

interact with speakers and texts in that particular field.

ESP assesses needs and integrates motivation, subject matter and content for the teaching of relevant skills. The learners come to the ESP class with a specific interest for learning, subject matter knowledge, and well-built learning strategies. They are in charge of developing English language skills to reflect their native-language knowledge and skills.

People learn languages when they have opportunities to understand and work with language in a context that they comprehend and find interesting. In this view, ESP is a powerful means for such opportunities. Students will acquire English as they work with materials which they find interesting and relevant and which they can use in their professional work or further studies. The more learners pay attention to the meaning of the language they hear or read, the more they are successful; the more they have to focus on the linguistic input or isolated language structures, the less they are motivated to attend their classes.

The ESP student is particularly well disposed to focus on meaning in the subject-matter field. In ESP, English should be presented not as a subject to be learned in isolation from real use, nor as a mechanical skill or habit to be developed. On the contrary, English should be presented in authentic contexts to make the learners acquainted with the particular ways in which the language is used in functions that they will need to perform in their fields of specialty or jobs.

Adults must work harder than children in order to learn a new language, but the learning skills they bring to the task permit them to learn faster and more efficiently. The skills they have already developed in using their native languages will make learning English easier. Educated adults are continually learning new language behaviour in their native languages, since language learning continues naturally throughout our lives. They are constantly expanding vocabulary, becoming more fluent in their fields, and adjusting their

linguistic behaviour to new situations or new roles. ESP students can exploit these innate competencies in learning English

#### **4. HOW TO OBTAIN MAXIMUM EFFICIENCY FROM TEACHING ESP**

The central concept of ESP is that of providing students with what linguistic items they need, when they need them. Hence, in order for training in ESP to achieve optimal success, the teacher must permanently focus on the specific field of the students.

Firstly, the ESP supplier must conduct a comprehensive needs analysis and hold a detailed discussion of training requirements.

Secondly, by using the results of the needs analysis, the ESP supplier must be able to cater to the students' specific training requirements at various levels of detail: program design, course design and materials design. The teacher provides the conditions for learning in the classroom and sets long-term goals and short-term objectives for students' achievement. The knowledge of students' potential is central in designing a syllabus with realistic goals that takes into account the students' concern in the learning situation.

With respect to program design, a general structure should be developed which indicates what types of course will be offered, their duration and scheduling. Sketches of the content of each proposed course should be provided.

Each course designed should contain the following:

1. Course objectives
2. Analytical contents which provides the logical plan for the course. It contains such things as linguistic and non-linguistic study items (structures, vocabulary, functions, register and body language).
3. Schedule
4. Practice materials.
5. Placement and progress tests.

In general, in order to allow the greatest possible scope in using the course in training

specific groups, the courses should be modular. This means that they should contain a general course syllabus plus many practice activities for different skills, which students can use, depending upon the needs of particular groups of students. They should also contain practice materials which focus on problems in communicating encountered by the specific groups being trained.

Materials design is challenging, so, when they are both appropriate and of the required quality, published practice materials can be used. When this is not possible, original materials should be developed which are of higher quality than published materials and specifically designed for the students. These materials should take into account the linguistic needs, learner perceptions and learner needs identified during the needs analysis. They should also be content-based and contain authentic ESP material for assimilation and discussion. Such activities enable students to learn appropriate language in contexts which are related to their specific field and are stimulating.

The ESP course supplier conducts surveys to assess student needs and then, designs a program, courses and practice activities best suited to student requirements and also supports the students in their efforts, providing them with feedback on their progress.

The concept of preparation is of paramount importance. The quality of a language course must, of course, be determined by what happens in the classroom; but what happens in the classroom is determined by what happens before any training takes place. The better the preparation, the better the course, and good preparation takes much time and effort.

Thirdly and lastly, the process must be accountable. The course supplier should be able to assess the effectiveness of the training which it has carried out. To this end, the ESP supplier should ensure that the training program contains an adequate testing mechanism. Ideally, there should be a test at the beginning of each course, to determine each training starting level

concerning the skills under development, and one at the end, to determine the amount of progress made. Such tests have two functions. Taking the results as a whole, they can be used to assess the effectiveness of the training program. Taking the results of individuals, they can be used to determine individual progress.

Therefore an ESP teacher must play many roles: to organize courses, to set learning objectives, to establish a positive learning environment in the classroom, and to evaluate students' progress. The learning goals have to be transformed into an instructional program with the timing of activities.

The skills for communication and mediation of the teacher create the classroom atmosphere. Students acquire language when they have opportunities to use the language in interaction with other speakers. The teacher may sometimes be the only English speaking person available to students, and although the interaction time with any of the students is limited, effective communication skills in the classroom can be structured. Good language learners are also great risk-takers, since they must make many errors in order to succeed. However, in ESP classes, they are handicapped because they are unable to use their native language competence to present themselves as well-informed adults. That is why the teacher should create an atmosphere in the language classroom which supports the students. Learners must be self-confident in order to communicate, and the teacher has the responsibility to help build the learner's confidence.

An ESP teacher needs to dedicate much attention to vocabulary and its retention.

Language teaching, on the whole, and ESP, in particular, has always been characterized by the use of methods that enable learners to acquire a sufficient amount of vocabulary, a working vocabulary.

What should teachers do, in making a word pass from receptive to productive level and, at the same time, in fostering all other communicative language skills?

Undoubtedly, a certain amount of repetition is likely to be necessary before there is any definite hope of term retention, but simple repetition is not enough. Schonefeld proposes an approach for specialized word retention in ESP.

The essence of the proposed methodology is to recycle the same ESP lexical term/phrases in con-text in the interrelated Writing-Reading-Writing (WRW) stages.

The first step of the process is setting up a writing activity for students, either individually or in small groups. The teacher has to prepare a list of words beforehand. Students are asked to write a passage using a provided set of lexical items (six to ten) within a certain time limit. Initially those lexical items are discussed with the students in order to make them recall as many different semantic meanings of the given words as possible. As a rule, the students are able to identify General English meanings of the provided lexical items. Sometimes a 'pure' ESP term - with little or no reference to General English - could be included into the list of lexical items, with a definition clarified by a teacher or knowledgeable student.

While writing their creative passages students have to be aware of the contextual peculiarities of the word, its morphological modifications, if any, and its syntactical functions in a sentence. Though the shortcomings of such stories are universal for non-native students - simple sentence structure, avoidance of relative clauses, lack of phrasal verbs and naturally sounding expressions - some students may come up with written work beyond our expectations.

Having to concentrate on their individual task makes students particularly focused on and involved in the activity. Their creativity is challenged to put seemingly unassociated words or chunks into a coherent story, which is a characteristic feature of natural language use.

The second step involves peer-assessment of that written work: firstly, with

emphasis on appropriate and accurate usage of lexical phrases. This stage is extremely important as it aims at achieving adequate, accurate, brief and clear expression of ideas and events.

Adding affect makes both these aforementioned stages effective and fruitful. The role of affect is 'one of the best ways to facilitate language learning, it is to help the learner to respond to language experience as a whole person with emotions, opinions and ideas, to have positive attitudes towards the target language, to feel relaxed, confident and successful' (Nunan & Lamb, 1996).

Students not only become very involved in the activity, but they also find it enjoyable. The teacher's role is basically one of a facilitator, when teaching inquisitive adults, responsible for their own learning: to observe and, if necessary, to advise. This is when real learning takes place naturally, without apparent effort.

The follow-up or the third step includes reading. The important feature of this stage is that the passage contains the same key words that students had to use in their creative writing. The difference is that those words are used with ESP meanings or as an ESP term (studies into the nature of such terms clearly reveal the fact that very few terms have been coined, the majority having developed from general language words into specialized ones when specific professional groups highlighted a particular semantic meaning of an already existing word).

Students - with the joy of self-discovery which is very important - find for themselves that General English words can acquire quite new meanings in an ESP context.

Afterwards, students, usually in the same groups, are asked to read a specially selected authentic text and do the comprehension exercises. Such exercises include:

- a) matching ESP key words with their definition
- b) True/False choice

c) multiple choice

d) comprehension questions.

The final step consists of writing a summary of the same authentic passage. If time permits, this is done in the classroom; alternatively, it might be given as homework. As the focus in previous stages was on key-word-in-context words/phrases, the target ESP vocabulary is again being consolidated.

Written summaries should be analyzed in the same manner as students' creative writing.

**Conclusions**

The technique described above focuses on fostering students' writing and reading skills for ESP and recycling previously learnt lexical items. Learners' speaking skills are practiced in the discussion over their written work, i.e. creative writing and summarizing.

The advantages of proposed interrelated WRW technique are that it promotes:

1. language usage for improving ESP skills
2. builds up students' self-confidence and self-expression
3. reduces learners' anxiety
4. uses learners' intelligence, creativity and inventiveness
5. increases motivation
6. improves attitude to writing/reading process
7. develops accuracy and fluency in ESP
8. emphasizes patterns and collocations of lexical items

Shifting the emphasis towards effective ways of learning rather than effective ways of inputting language is the most important trend of contemporary ESP teaching.

## **CONCLUSIONS**

We have seen that language is an enormous and highly complex phenomenon, and that it is impossible for any individual to learn even his own language completely. The way in which native speakers maximize their learning resources to combat the problem of

achieving competency in their own language is simply to learn what aspects of language they need, when they need it.

ESP, the study of a particular aspect of language so as to be able to accomplish certain tasks, is an attempt to mimic the native speaker's way of learning so as to maximize learning resources. In the intensive, accelerated and subject specific learning contexts of ESP courses, students can increase their learning speed, efficiency and effectiveness.

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## FROM CORRUPTION TO KLEPTOCRACY

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**Abstract:** *Corruption is a phenomenon that affects, in different proportions, all states, no matter their doctrinary option, political social system or level of development and it becomes a factor of major dysfunctionality in all social domains. Its disappearance is improbable and almost impossible. Still, the possibilities belonging to decision factors domain are the adoption of immediate and efficient measures in order to diminish, prevent and control the area and level of corruption manifestation.*

**Keywords:** *corruption, kleptocracy, elite cartel corruption, oligarchic and clan corruption, official mogul style corruption*

### 1. CORRUPTION CONCEPT MEANING

Corruption, although always present in the history of human society, has become a social phenomenon that has recently got into the spotlight of thorough and extensive research which established a measure unit, a perception index of Transparency International organization (IPC) – a controverted conceptual reality within the scientific world.

G. Myrdal (in “Asian Drama”), referring to the ascension of this phenomenon, wrote: “corruption is a research taboo subject ... even western experts approach this only partially, subordinating scientific research to their target, while sociologists elude all embarrassing aspects no matter if wright or left-winged.” Furthermore, political corruption has been subject-matter within American political science faculties since the ‘70s.

M. Johnson backed up the appearance of “Corruption and its forms” by invoking arguments related to the nature of this phenomenon: a) corruption favors interest groups in spite of multitude; b) it exercises a negative economic development by distorting reality and rewarding the lack of efficiency and open contest; c) it crosses fundamental human rights and hijacks resources allocation, including international aids for general interest domains.

Corruption is defined by many forms: “public function or public resources abuse in achieving private goals” [1]; “dignitary behaviour that exceeds usual norms in order to fulfill private agenda ... the main target of politics turns from serving public interest to promoting personal one” [2]; “affairs between state interests and personal goals” (Elliot, Sefy, Rose-Ackerman); “abusing public or private power in order to satisfy personal or group interests” (Transparency International); “obtaining personal profit, direct or indirect, for him or herself or for anybody else within public or private sector and through power abuse” (ONU); “misusing authority for personal money or any other form of gain” [3]; “illegal or incorrect behaviour of a person that finds itself in an authority position” (BBC English Dictionary); “any departure from morality, honor and duty ... cheating, depravation” (J. A. Gardner); “using public function to obtain unworthy means and achieving personal agenda” [4]; “public agents misusing political, administrative and law power for personal unworthy advantages or gains (Spanish, German, Portuguese penal codes)”; “(...) the direct or indirect use of political or administrative power in their rightful fields in order to win money or assets that can also reward relatives or close-friends” [5]; “immoral, illicit and illegal activities

conducted not only by high-ranked public figures, but also by different public or private groups and organizations in order to gain material and moral advantages or even superior social status by using blackmail, fraud, intimidation, bribery.” [6]

In its essence, corruption implies direct or indirect use of political or administrative power beyond their legitimate space, having the goal of obtaining advantages (money or personal assets) or the loyalties of political clientel.

This phenomenon involves: a) power abuse (“negotiated authority”); b) mutual advantages (for both corruptor and corrupted); c) effects on both sides; d) transaction’s confidentiality; e) the clientel. Corruption targets individuals, groups, institutions, public or private organizations.

Political, cultural, educational and religious factors can be traced to the origins of this phenomenon. State’s authority erodation due to institutions’ lack of efficiency; political elite individual quality; personal and collective life-style degradation; the traditional value system becoming obsolete; moral principles being put away; the globalization of both economic progress and moral regress in the contemporaneous world; the lack of certain internationally correlated measures regarding fighting and punishing corruption acts; the absence of synchronization between institutional reforms (juridical and legislative) and the nowadays crime level growth; the abilitated organs’ lack of strength or their subordination to politics; mass-media’s and public’s opinion pressure in protecting or incriminating interest groups; the diminishing role played by religion within the contemporaneous society; the pragmatism of today’s world where God is synonym with money; the rivalry within this liberal and capitalist society; prosecutors’ incompetence; the excess of demagogy and oligarchy.

R. Klitgaard (in “Controlling Corruptions”), after identifying corruption causes, proposes a bureaucratic corruption formula: Corruption = monopoly + freedom of decision – responsibility. This way, the presence of monopolies and the absence of

responsibility are factors that support the act of corruption. [7]

The primary goals of corruption are profit and power. It affects: a) the efficiency of governmental programs; b) it sabotages social and economic development (corruption costs Romanian public property aprox. 1.5-2 billion dollars/year); c) society morality; d) society polarization. [8]

The phenomenon has its different ways of manifestation: bribery, fraud, dilapidation, personal use of resources that do not belong to a specified individual, sexual harassment, electoral corruption (influencing votes by offering money or by any other means) [9], using public funds at will, politics mix and influence within administration and economy, illegal donations for electoral campaigns, unauthorized use of confidential information in order to gain advantages, sharing public jobs with clientel (by ignoring any norms of professionalism and legality) – jobs paid from public money –, traffic of influence, allowing legal favors and subventions even where these acts are not required, study offices with the only purpose of cashing money from fake invoices, political parties’ leaders being paid for electoral goals by the municipality.

Corruption, on a global scale, affects, in different proportions, all world states – even the states of law. Fr. Revel warned us: “kleptocracy has replaced democracy” [10] and it becomes a threat to national security.

Given the context, there are two types of bribery: a) lubrication bribery (facilitates the usual run of beaurocratic mechanisms – obtaining visas, import-export licenses, certificates a.s.o. This type of corruption is also divided in two: the small corruption, at basic public employee level and the big corruption – the business one, within the highest-ranked public figures that receive sponsorships, bonuses or have double accountable evidences); b) the initiated delict (insider trading) – the misuse of confidential information in order to gain material advantages (Ivan Boesky scandal, 1968, David Levine).

Financial corruption goes hand in hand with other forms of immoral or illegal behaviour and tends to extend very fast on a



national and international level; the border between corruption and business still-legal behaviour is sometimes very hard to trace. [11]

Corruption taxonomical picture is extremely complex, according to the different criteria that can be used to describe it: a) daily manifestations of the phenomenon; b) political and economic assessments; c) main cause; d) type of political regime.

From the first category we can reveal: a) black corruption (an unwanted act that we wish to punish); b) grey corruption (only a part of the society wants to punish it); c) white corruption (public opinion and public figures do not support the punishment, the act being considered as tolerable); d) small corruption; e) big corruption; f) transactional corruption (mutual arrangement through that both giver and receiver gain unworthy profits); g) constraint corruption [12].

Regarding political and economic aspects, as well as the area of manifestation, M. Johnson identifies four types of corruption which are present in today's society: a) *influence market corruption* – centered around the access to important institutions and the advantages gained through these kind of high level positions; this phenomenon appears in atypical states: open economies, mature democracies, legitimate constitutional frames, free press, political competition, powerful civilian societies (USA, western states, Canada, Japan); “power-oriented corruption targets public functions and influences the people holding them”, it follows profit and aims for “government contracts” (the recent scandal involving American employees in Iraq; the ones from World Bank or the Elron case); b) *cartel corruption* – typical for countries with new, liberal or competitive economies (Italy, Korea, Botswana); the people involved maximize profit from a large range of opportunities: business, army, beurocracy, political parties, social, ethnical or regional links; corrupted elites link public domain to private one; in a paradoxal way, this kind of corruption has its stabilizing results; c) *oligarchic and clan corruption* (Russia, Mexico, Republic of the Philippines) – typical for the ongoing liberalization economies and politics; the dominant form is the violent fight

between competing elites that use their own resources in order to gain wealth and power; elites win their influence through government authority or through spending huge financial resources; we can distinguish symptoms like generalized corruption accompanied by momentary violent behaviour; the author includes Romania in this group made of 30 states; d) *official mogul corruption* (China, Indonesia, Kenya) is typical for the undemocratic states with weak institutions and having economies that tend to be liberal; business men from the top of the pyramid are also the most important politicians; dignitaries can become official moguls and this path can degenerate – according to S. Anderski (in "Kleptocracy: Or, Corruption as a System of Government") – into kleptocracy, a government of thieves; their credibility is based on political support and intimidation; political monopoly is used as an efficient enrichment tool. [13]

Regarding the ratio between the main cause and the area of manifestation, A. Aron remarks the following types: a) political institutions' corruption (supported by the malfunction of political parties – their competition leads to instability; the difference between constitutional rules and the party system); b) public spirit corruption (corruption of principles; the common wealth is sacrificed; the compromise doesn't succeed to offer a coherent and predictable political leadership; leaders and people trade places; discipline disappears); c) social infrastructure corruption (political power's impossibility to control society's development and give it a sense). [14]

Taking into account the type of regime, R. Aron believes that pluralist-constitutional regimes can be corrupted by either excessive oligarchies or excessive demagogy. Since antiquity, Plato remarked four forms of corrupted ideal: timocracy (political construction based on the honor principle), oligarchy (the rule of wealthy people, the poor being excluded from the act of government), democracy (the rule of the people, leaders being selected randomly) and tyranny (the despotic rule by an individual who is keeping people under control). [15] The transition from

a constitutional regime to another one can be made in three different ways: coup d'etat; legal and semi legal access to power, followed by revolutionary processes; the influence of external forces. [16]

Its area and volume are influenced by the degree of modernization, economic development, principles of society's resources distribution and redistribution, political maturity, culture and national religion.

## **2. CORRUPTION AND MODERNIZATION**

The relationship between these terms is seen by S. Huntington (in "The Political Order of Changing Societies") through the following three perspectives: a) the change that affects fundamental society values, the adoption of new criteria regarding the distinction between public and private interest, familial and state obligation; corruption becomes a product of modernization by inducing "the division between common wealth and personal interest"; b) the appearance or creation of new power and enrichment sources; the strong distinction between economy and politics fades out; new upcoming rich people can buy parliament entrance (the scandal involving Tony Blair's government who did offer noble titles and places in the House of Lords to business men supporting the party); the opposite phenomenon also happens; we can talk about wealthy corruption, but we can also discuss about poor corruption; the first negotiates political power for money, while the latter offers money for political power (Palermo's political men offered one shoe before voting, while giving the second shoe only after been sure of vote's result); in both cases, a personal gain was targeted; c) changes that emerge from political system decisions; endorsing government authority when a large network of institutions has to be reformed (commercial activities, customs, taxes, gambling, prostitution, alcohol); anti-corruption laws have the adverse effect by amplifying corruption possibilities. [17] Corruption index varies both ways: in low institutional level societies, corruption enlarges when climbing the bureaucratic

hierarchy tree; its level is higher on the upper floors; parliamentarians, ministers and chiefs of state are the most corrupted (Marcos, Nkrumah, Trujillo, Bokasa, Fujimori a.s.o.); in modern societies, corrupt behaviour is inversely proportional with the ascension or descent within bureaucratic hierarchy.

Corruption and reform can replace each other, can function simultaneously in order to support the political system or, even more, they can replace revolution. [18] A traditional society can accelerate its modernization through a low index of corruption, meanwhile a heavily corrupted society cannot evolve through an even bigger corruption.

## **3. CORRUPTION AND POLITICS**

F. Revel (in "Democracy at Large") remarked the gravity and amplitude of political corruption issue: "All over the world, the state – a huge money machine – steals from the people. It's a common practice among dictatorial, communist or fascist regimes, but it's even worse for the democratic countries where it weakens their mechanisms and is close to rob their reason to be, to exist" (France, Greece, Spain, Italy, Germany, Japan).

Political corruption has its own diverse forms of manifestation: a) private interest groups trying to obtain influential positions within state bureaucratic or legislative systems; b) electoral results fraud, through intimidation or illegal rewards sabotaging the electoral process; c) using position and state institutions' resources to manipulate citizens or to satisfy political clientel; d) illegal political party financing during electoral campaigns; e) giving public jobs on political criteria, "trying to gain political clientel loyalties"; parties are still in control over political selection processes; parliamentarians or public functions are still named by parties and even the so-called independents cannot rise without a proper political support; its ratio, on the western world scale, hits the unbelievable index of 75%.

Corruption finds itself in an inversely proportional relationship with the political organization; its level is higher within states

where political parties are inefficient or missing; here, individual, familial and clan interests are predominant, while in countries having powerful parties (USA, UK) their manifestation is diminished. H. J. Ford (in "The Rise and Growth of American Politics"), outlining the relationship between subjectivism and corruption, concluded: "Political party weakness favors corruption". [19] Edward Gibbon considers that the highest level of corruption is seen within authoritarian regimes, while W. Lippman writes that illicit activity is an industry of development, supports people's desirable actions which moral tradition holds from becoming legal. Corruption can undermine regimes' and leaders' legitimacy or the interpersonal level of trust; opposition inexistence maintains a high level of corruption, but when the imminent change threatens elite's safety, the society can be confronted with a hyper-corruption process; in the area where political competition is weak, there can be found severe cases of political corruption, the elite being too powerful and able to intimidate parties and buying people's votes. Since the development of communication technologies, in the commercials and public relations era, "people don't choose their leaders, but leaders succeed in being elected by the people", although "they do not have the capacity nor the legitimacy of exercising power". [20] Electoral marketing, a political marketing branch, targets offer's assistance and adaptation according to community's and time's political exigencies. [21] This practice has transformed electoral campaigns, the political fight, into a battlefield of professionals. Everything is made and sold in order to satisfy consumer's or audience's desires. R. G. Schwartzberg (in "The Show State. Essay About And Against Political Star-System") compares the political leader to a showbiz star, a celebrity from the political show arena, a desirable model build by persuasion and communication professionals; given different political markets or several ratios between what is offered and what can be bought, there can be many types of custom-build political leaders: "the fascinating leader" ("the prefabricated leader", a mass-media and political show invention); its appearance,

existence and evolution obey all commercial and publicity laws; "the regular-man leader" (a crowd psychology projection model, having certain attributes such as: common sense, national wisdom, inspiring safety, identity and conformity); "the father-leader" (model with biblical origins, can be taken as fuehrer, a ruler to which everybody must unconditionally bow). The candidate becomes a simple actor that learns and practices scripts and roles given by image creators. Political marketing has had a tremendous costly impact on all-levels electoral campaigns: local, parliamentary and presidential. A 30 seconds commercial can cost up to \$ 185 000.

Careful analyzer of native political life, D. Tudoran introduces some necessary distinctions between kleptomany and kleptocracy: a) kleptomany is based on individual's pathology, not on its status; b) the kleptomaniac doesn't care about objects' value, while the kleptocrat does; c) the first has individual manifestations, but the latter shows both individual and collective actions; d) the kleptomaniac lacks planning, meanwhile the kleptocrat is an outstanding organizer. [22]

Society's democratization process doesn't necessary reduce corruption index, in India, traditional corruption coexists with democracy and poverty; in Italy and Japan, generalized democracy mixes with generalized corruption. This phenomenon represents the lethal virus of democracy, being able to compromise its future; corruption hardens democracy installment and acts like a cavity where freedom is a reality. "Exactly in the moment when mankind needs the most an universal democracy, Revel used to say, ... this model starts being corrupt, getting away from its roots, becoming fake in its own center, right where it should conquer and lead all the people to democracy". Contemporaneous society evolution reveals a paradoxal phenomenon: "*Corruption is proportional with democracy's down path*", and where its presence is very low or not at all, corruption represents a major obstacle in returning to democracy, likewise, in open societies, corruption is the main tool for democracy undermine and violation, eroding legislative and law institutions. In order to survive, prosecutors and political

people become political power accomplices. [23]

#### 4. CORRUPTION AND ECONOMY

This link underlines a pronounced interdependence relationship. Its symptoms can be seen in different forms such as: a) political interference into economy domain; b) illegal parties and leaders funded by corporations and interest groups; c) favorable laws for certain companies; d) subventions and tax elimination for clientel corporations and companies; e) initiatic delict (illegal use of confidential stock information); f) frauded auctions; g) dubious business involving public institutions.

Political power interference in economy, above certain limit, develops corruption. Political control over economy fuels the temptation of using political power as an enrichment tool. As a consequence, the macroeconomic pyramid becomes a vast resource for worldwide corruption. Not different at all, the former communist countries and third world states have raised corruption to a status of raw model and scourge by expanding state's economic role. Furthermore, "when corruption, instead of being only a temporary state of individual actions, becomes a concentrated system conducted from within state's core, we can talk about an organic alteration (...) of democracy". Parties, F. Revel noted, "are crossing the line when becoming direct economic agents ... A business party has ceased to be a political one the moment it entered a foreign ground to its specific ... it is able, due to politics, to use occult means in order to fraud the economic game. (...) The party becomes, in this case, a source of economic corruption and not economic creation." [24] It equally bends democracy and economy. Low investments are found where business environment is corrupt, taxes and impositions being higher and the possibility of anticipating the rate of profit – diminished; *generalized corruption associates itself with generalized poverty; in these kind of countries, corruption stops the economic development; some states are poor because of corruption, or*

they live in a generalized corruption due to poverty; the prosperity index doesn't cancel the reality of corruption. An undeniable reality: "corruption from democratic countries accelerates the appearance and development of this phenomenon in underdeveloped states". This relation puts corruption from both kind of countries in a "complementary status". The resulted implications cannot be overlooked: "it makes democracy installment harder and corrodes it where this is already a reality". [25]

G. Myrdal warned about the complex effects induced by third world corruption: a) it facilitates totalitarian regimes' establishment; b) generates and maintains submission and fatalism in front of a so-called normal phenomenon promoted by "corruption folk".

#### 5. CORRUPTION, SOCIAL AND CULTURAL LIFE

Corruption can be a main factor for social differentiation. Its appearance may take multiple shapes: a) government officials' taking control over important economy sectors and getting away without charges; b) public resources dilapidation for rewarding temporary supporting people; c) the use of violence or its alternatives in order to gain resources access; d) nationalization culture (transforming arts' and literature's agents into executive power propaganda: the govern and the presidency).

#### 6. FIGHTING CORRUPTION

Transparency International, organization that has declared war on corruption, periodically prints world states' ratings, in which corruption level is evaluated on a scale from 1 to 10. No less than eight countries have received the highest "mark". Romania is seen as a highly corrupted state: place number 37 (1997), with a score of 3.44 (where 1 is the most corrupt and 10 is the least), place number 83 (2003), with a 2.8 score (from 133 countries); place number 85 (2005), from 158 states and with a score of 3.0, being next to Dominican Republic and Mongolia, place 69 (2007), scoring 3.7 out of 10, EU states having an average mark of 6.51. [26]

Fighting corruption involves: a) political pluralism; b) democratic control over administrative and governmental institutions; c) judicial independence [27]; d) updating and synchronizing internal and international legislation (the elaboration of civil convention on corruption by GRECO - Group of States Against Corruption, to which Romania participates thanks to the law number 107/2000); this convention targets: granting reparations to people that have been materially harmed by acts of corruption; participating countries' obligation of assuming state's responsibility for corruption acts conducted by its employees and also that of promoting protection measures for employees that reveal corruption deeds; international cooperation in civilian corruption cases, especially regarding procedures, papers' notification, probe gathering, verdict recognition and execution. [28]

### CONCLUSIONS

In our analysis, we've started from some axiomatical formulation that have been proven as true by today's reality: no matter its forms, corruption exists in all societies, totalitarian and democratic; corruption infiltrates human nature, political, economic, juridical, cultural and moral evolution; corruption finds itself in an inverse proportionality ratio with the political organization; it is higher within states where political parties are inefficient or missing and it is lower when confronted with strong political parties; corruption index rises in a proportional manner along the sinking democracy index; corruption associates itself with organized crime (banks' bankruptcy: Dacia Felix, Credit Bank, Columna, Bancorex, Bancop a.s.o.); corruption affects competition's spirit and public interest; its level is influenced by the manner in which state exercises authority and by juridical, institutional and legislative systems' vulnerabilities; corruption is diminished within a strong and functional state, while it grows in the background of judicial instability and public institutions weakness; depolitizing corruption constitutes the most efficient tool in fighting against the analyzed phenomenon. [29]

we cannot eradicate corruption, but we can diminish it and keep its level under control; the absence of control can lead to its degeneration into kleptocracy.

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## INTERNATIONAL RELATIONS PARADOXES

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**Abstract:** *We live within an anarchical international system that has converted its own logic into a real principle: competition is the rule and cooperation is the exception. In this context of turbulences, everything becomes complex and paradoxal. We are looking at an antinomic reality. Contradictory processes coexist and don't stop from challenging us: change and stagnation, peace and conflict, independence and obedience, rise and fall of hegemonies, world order and chaos. States' power, hegemony, security, world order or globalization bring in pervert phenomenons that are hard to anticipate and control.*

**Keywords:** *power, anxious power, hegemony, security, security dilemma, international order, globalization*

### 1. STATES' POWER PARADOX

States' international relations have been and will be relations of power, "power statements". K. Waltz commented that "Theory describes international politics as a competitive field". [1] The only concern that different countries have in this competitive and conflictual climate, no matter their doctrinary option or social-political system, is to augmentate their power and security, regarded as being the main factors for survival in a precarious world. The true issue of international relations remains the correct, intelligent and ethical management of power ("balance of power"), keeping it at reasonable levels without endangering humanity survival. Furthermore, this aspect should not disconsider "the balance of interests" (R. Schweller) and "the balance of threats" (S. Walt).

Power has multiple expressions and evaluation criteria. S. Strange (in "Political Economy and International Relations") insisted on the four fundamental structures: "the power to influence others' ideas" (knowledge structure); "the power to influence

credit access" (financial power); "the power to influence the future of their security" (security structure); "the power to influence their chance for a better life as producers and consumers" (production structure). K. Deutsch wrote about the capacity to "manipulate interdependencies", while T. Chopin and R. Bosch added other factors like: the potential for power, the place held within international relations structure, the prestige, the will to act and the built legitimacy. [2]

Not by chance, A. Toffler (in "Power on the move") remarked its contradictory utility: "Power (exercised or potential) can be used to punish, reward, convince and even transform. It can morph the enemy into an ally".

Between military power – power centers' definitory dimension (power, superpower and hyper power) – and its level or area of influence there is no absolute direct proportionality report. Military power itself, does no longer insure political control. Kissinger noted that "military muscles cannot guarantee political influence. Economic giants can be military weak, as well as military force cannot be able to hide its economic weakness. Countries can exercise political influence even

when they do not possess armed forces nor economic strength.” [3] This way, Hofmann showed that while USA has a huge military capability, it “remains a chained Gulliver, not a master with freedom of action” [4]. “Great powers are powerful not because of nuclear weapons, but due to their immense and vast resources that enable them to generate and keep power in all fields – the military and other strategical and tactical domains”. [5] In order to be powerful, a nation has to be strong from any point of view or criteria. [6]

Beyond certain limits, power degenerates in its opposite. In J. Hertz opinion, when we think of the highest level of force, absolute power equals absolute helplessness. Atomic weapons have never been anything else but discouraging tools; “the most performant weapon coming from the most advanced states has been the least utilized ... the strong are stopped by their own power; and even the weak do not become more powerful ... they are capable of acting like they would have gotten stronger”. [7] W. Ross Ashby completed the picture by formulating a systemic evolution law: “when a system is made of a number of sub-systems, the one that tends to dominate is the least stable one”. [8]

In a paradoxal manner, the nuclear threat has “saved” mankind from a devastating military conflict. Nuclear discouraging has been, since the bipolarity period, the key to world’s political stability. Unfortunately, this idea has made a career as a doctrinary principle in contemporaneous theoreticians’ creation – “(...) it is better to have a war-free nuclear world than a major conflict without atomic weapons” (M. Quinlan) –, and also as a fundamental statement in several countries’ security strategy (USA or Russia).

Force politics, in today’s international frame, is not only inadequate but also bankrupt. The former American president, Bill Clinton, said back in 1992 that: “in a world where freedom marches successfully and not tyranny, the cynical equation of force politics is really not working. It just doesn’t suit the new era.” This idea should make all great powers’ leaders meditate on the future of mankind.

Furthermore, between power and vulnerability there is a report of direct proportionality; it has been established that more power doesn’t necessary imply invulnerability; the most powerful countries are the most vulnerable. The events dating 11 September 2001 are proof enough regarding this matter.

## **2. HEGEMONY PARADOX**

K. Waltz admitted that within this ambiguous universe, in which there is no ordinating power for global politics, the supremacy of superpowers becomes a desirable solution, the only guarantee of world’s order and stability. Hegemony, both detested and accepted, uses its persuasive valences not because the weak admit the legitimacy of the powerful government, but because “it is not advantageous to battle them”. [9]

Hegemony cycles, according to R.G. Gilpin (in "War and Change in World Politics"), are being put in motion only if “the change of system brings profit. (...) If the anticipated gains excel involving costs”. International system transformation is achievable, by the implicated actor, through “territorial, political and economic expansion until the costs for another possible change” become “equal or bigger than anticipated advantages”. Their inexistence leads to maintaining status quo. Even more, being familiar with theories such as “rational option” or “power equilibrium”, the American author warns about the consequences which can be caused by unsolving international system lack of balance: “systemic change” and sudden restoration of a “new balance that reflects power redistribution”, or even “dominant powers identity change”. [10]

Today, famous theoreticians – H. Kissinger, Z. Berzezinski, G. Friedman, I. Walerstein, S. Huntington – sustain that USA has remained the only superpower that affirms its hegemony on a global scale, trying even to support and outline certain advantages of transatlantic leadership: “Long lasting American international supremacy is essential for the wealth and security of American people



and also for the future of freedom, democracy, open economy and world order” (S. Huntington). The acceptance of this idea offers the best possible solution for solving problems and challenges confronting today’s world. In time, the leader state uses less and less power or coercion. Everything is based on acceptance and submission. There are more and more voices asking for the recognition of the American leadership by all international actors in the name of stability. The role of world leader involves credibility, decision capability and having the proper means to solve present and future, national or international issues.

Hegemony – in Kindleberger and Keohane opinions – is associated with stability, a direct proportionality relationship being established between the two terms. R. Keohane wrote (in "The Theory of Hegemonic Stability and Changes and International Economic Regimes" and "The Demand for International Regime") that “hegemonic power structures, dominated by a single country, are the most efficient in developing a powerful international regime, whose rules are (...) precise and (...) respected”. The rise of hegemony determines a growth in world’s stability and its fall induces the twilight of generated economic systems, global economy development being penetrated by instability. Yet, the leader role is only momentary and affected by time-corrosion. American hegemony is discussed within a for and against environment. Not even the most optimistic scenarios grant this hyper power more than a century of existence, meanwhile Brzezinski is projecting a time interval of two decades. In “The Next 1000 Years: A Forecast for the 21st Century”, he extended US supremacy to almost one hundred years. The author wrote: “practically speaking, the process of exchanging positions has already begun”. [11] Arrogance, authoritarian domination, military solutions, cynicism, ignoring global public opinion, international right, regional and world security organizations, using leadership only in American interest has degenerated into rejection, mistrust, hostility and isolation from other states. This phenomenon is visible after the unfortunate plane crashes from 11<sup>th</sup> of

September or the crusades against terror from Iraq and Afghanistan.

Although the role of military power has diminished within international relations, especially US one, America remains a predominant military force of the moment. “Leadership should be based on power, but American economic and military power are not the same with the American leadership. This ... makes power to be exercised in the name of more general purposes and not for more particular interests ... belonging to only one nation. USA cannot lead alone. Cooperation between the main economic powers becomes mandatory, but yet, America does not want to share its leading role with anyone else (...)”. [12]

If isolation cannot be the key, then, the hegemonic powers’ dilemma remains the option between domination and leadership, and the problem of dominated states – the choice between a risky autonomy and accepting coordination and control from a protecting power. Hegemony generates its antidote and foresees the upcoming collapse.

### **3. INTERNATIONAL RELATIONS’ MISTRUST PARADOX**

No matter the social-political system affiliation, the political arguments or the ideas supported, the states, in today’s anarchic context that influences international relationships, cannot achieve their goals of momentary or eternal peace being in a permanent balance between security and prisoner’s dilemma.

The security problem offers a reasonable explanation for the weapon race, being based on the principle that any measure which improves one state’s security induces insecurity fear to the others. The prisoner issue originates in a game-type scenario in which, from all four possible situations, only one favors competing prisoners: mutual trust and hiding the adversary; in this case, both actors are free; yet, given the absence of information, of institutional credible mechanisms which can facilitate mutual trust and coordination, reality shows us, in most cases, contradictory situations where one of the participants

defects, risking an easy sanction instead of a hypothetical more severe one. [13] This behaviour rises suspicions and blocks cooperation. A typical case of A. Macedon syndrome where a neighbouring state is regarded as a potential rival or aggressor. This scenario has only one solution: aggression prophylactic treatment.

#### **4. ANXIOUS POWER PARADOX**

All super powers live in a state of permanent and persistent fear determined by the potential military aggressive danger of possible rivals; the probability of intensifying efforts towards security and preparing for war is proportional with the level of insecurity feeling; the more power a country achieves, the more fear induces to its adversaries which react by maximizing their own power, because no state can be sure that other competitors are not going to use their arsenal against it. [14]

J. J. Mearsheimer remarked that the level of fear responds to certain variables: nuclear potential (the level of fear between cold war superpowers would have been much higher if it wasn't for the atomic weapon; nuclear discouraging showed great efficiency during those times); natural boundaries (waters that usual represent uncrossable border lines; reality that explains why US and UK were never invaded since becoming superpowers); power distribution (a unipolar system is more permissive to conflicts than a bipolar one; "bipolarity is a configuration of power that produces the least level of fear between super powers; balanced-multipolarity generates less fear than an out-of-balance one, of monopole origins, but still more than bipolarity"; super powers show reluctance towards all states that have rising demographical and economic indexes, even though they didn't convert their wealth into military power). [15]

Bipolar systems are peaceful and out-of-balance multipolar systems are in a permanent danger of hosting severe conflicts; balanced multipolar structures are positioning themselves between two risk poles. [16]

War main causes have been identified by well known theoreticians – J. S. Levy, D. C. Copeland, S. V. Evera, K. Waltz – within a

complex structure of factors: human nature, political leaders, political ideologies, economic interdependencies, international system structure and the distribution of power. Starting from power distribution within the international system, K. Waltz, J. J. Mearsheimer and others, sustain the idea that bipolarity is less probable to degenerate into war than multipolarity is. Bipolarity is "the most peaceful and least lethal architectural type" for international relations. The two geopoliticians invoked the following arguments in order to support their claim: diminishing conflict opportunities (through the existence of only one possible dispute between the leading powers); balanced power distribution; discouraging calculus error; anxiety attenuation. Between 1945 and 1990, during post-war bipolarity, European continent has faced only one single conflict involving a super power and a minor one, the Russo-Hungarian war from 1956, situation that accounted 10 000 casualties.

J. J. Mearsheimer (in "Force Politics Tragedy") noted that the burst of armed conflicts within multipolar systems is also influenced by other causes: the existence of potential hegemonies, the multipolar system containing more opportunities and sources of conflicts; severe and permanent manifestation of unbalanced power (power asymmetries are more frequent in multipolar systems than in bipolar ones, multipolar systems leaning towards inequality, while bipolar ones – towards balance; the more actors, the more chances that wealth and demographic dimensions – the main ingredients for military power – are unevenly distributed); the possibility of misjudging that conquering a rival state will end in success (bipolarity favors certainty while multipolarity uses probability and makes room for errors); the presence of fear.

#### **5. INTERNATIONAL SECURITY PARADOX**

"Countries and individuals are to be found in an uncertainty state which is directly proportional with their own freedom". If

freedom is desirable, then, insecurity has to be accepted.

Organizations that enable authority and control relationships can augmentate security while diminishing freedom ... If force is the actor that has decision power, then, severe conflicts for this title can be much easier avoided.” [17] Between freedom and security there is an inverse proportionality report, states’ insecurity degree grows together with their affinity for freedom.

From this theoretical perspective, and considering the future of international political system, we believe that countries face the following alternatives: the anarchic model (which also implies actors’ freedom), the hegemonic model (an imposed world order) and the partial-hegemony option (centered around bipolarity); the last two alternatives cancel outskirts states’ freedom; the option depends on the way we want to coexist, free and in permanent danger by a virtual threat or, on the other side, we could lose our freedom in favor of a fake security, with a gregarious consciousness, living in discipline and led at will by the one that holds this power. Quoting Holmes, “only the weak care about international safety”.

## **6. WORLD ORDER PARADOX**

World order doesn’t originate in humanitarian cooperation, but it results from states’ desire to maximize their own status within the global power system; world order represents the selfish and spontaneous effect of super power competition. [18]

Great powers, in their actions towards a peaceful order, are led by two reasons: consensus improbability regarding a general peace formula and the fear of responsibility; super powers are not assuming this goal since these state aren’t sure on their success and are afraid of assuming failure; from this point of view, collective security treaties die before birth – First World War brought super powers cooperation, but this matter didn’t hold them from going to war one against the other. [19]

States cooperation happens on a competitive background, each actor trying to gain more advantages than its partners;

Germany and USSR have teamed in 1939 for splitting Poland; Serbia and Croatia united in conquering Bosnia; Germany worked together with Hungary and Austria during 1940 in spite of Romanian interests.

World order is cyclical. Unipolarity moments are followed by bipolarity and multipolarity ones. T. G. Ash warned us: “The unipolarity minute” has passed and “the multipolarity disorder” has been restored. American hegemony is part of past. Many factors have determined today’s international life: a) the ascension and development of BRIC states (China has \$ 200 billion in its treasury); b) nonstatal actors’ roles becoming more important; c) changes in the sphere of power structure; d) American economy fragility; e) the military and American centrism; f) public opinion pressure.

Power centers multiplication doesn’t insure a better, safer and more stable world. Analyzing the new geopolitical world status and taking into account the profound mutation from Asia, the rise of China, India and Russia, H. Kissinger compared this phenomenon with the 19<sup>th</sup> century Europe, “great super powers battling for supremacy and using war as a political extension. But it can be even worse ... with terrorists, corporations, international organizations and religious communities getting involved in this competition”. [20]

## **7. GLOBALIZATION PARADOX**

This process is highly favorable for the few and totally unfavorable for the others; it marginalizes and excludes two thirds of population from the main resources; wealth people are global, while poverty is local. Human Development report, presented by UN, reveals that cumulated assets belonging to world’s top 358 billionaires equal the income of 2.3 billion poor people (45% of mankind population); 22% of planet’s wealth belongs to 80% of population from the third world countries. Ricardo Petrella, from the Catholic University of Louvain wrote: “Globalization attracts economies towards volatility (mass products and services cuts) and poverty (temporary jobs, flexible and part time ones)”. [21] Uncontrollable effects appear from their

own nature; these side effects cannot be foreseen and for sure lack any bad will; we start global effects, but we do not possess planning means and tools for this kind of actions; Bauman defines the phenomenon as Jowitt's "new world disorder". In fact, we are facing Mandeville's paradox, a good action for a certain social segment means a bad action for others and likewise. In a paradoxal manner, "global economy produces planet's rupture between the three integrated poles (Northern America, Western Europe and Pacific Asia) and the rest of the countries (especially Africa) which are poorer and poorer and excluded from global trade and technological modernization".

Politics has become an instrument of economics. The two have exchanged their roles. "The market governs. The government administers. (...) The state is no longer a totalitarian one, but economy, in the era of mondialization, tends to become totalitarian". Totalitarian regimes from the '30s are now followed by a different type of totalitarianism, "the one of globalitarian regimes". [22]

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## STRESS AND LOCUS OF CONTROL IN THE ACADEMIC CONTEXT

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**Abstract:** *The main goal of this study is to verify whether locus of control moderates the relationship between stress and individual wellbeing. The instruments used in the investigation were: a factual data questionnaire (containing name, gender, age, length of time in work, length of time in teaching career, etc., susceptible to become research variables) which contained additional data about potential sources of academic stress (work satisfaction, promotion opportunities, social and professional relationships, etc.); the physiological reactions of stress questionnaire elaborated by Ebel et al.; IPAQ questionnaire (Multidimensional Locus of Control).*

*Data analyze consisted of calculation of means, standard deviations, minimum and maximum values for the stress dimensions and locus of control. The t value (T student Test) determined the significance of the differences identified between the investigated group's means. For establishing the relationship between study variables we have calculated the value for the simple Bravais – Pearson correlation coefficient.*

**Key words:** *occupational stress, locus of control, university teachers*

Although at the adult age no other human activity doesn't have a greater formative and consequent potential as work (a fundamental human necessity, corresponding to the need of accomplishment, performance, rewarded by the satisfaction of obtained results), it can also be a notably source of stress, with costs felt simultaneously by the individual and the organization he works in. Some of these costs are direct (absenteeism, leaving the job, work fluctuation and instability), while others are indirect (work dissatisfaction, poor work ethics), but they all generate short time effects, remediable and long time effects, chronically and hardly recoverable.

Kyriacou and Sutcliffe (1978) defined the academic stress as a response syndrome of negative affect (such as anger or depression) by a teacher usually accompanied by potentially pathogenic physiological and biochemical changes (such as increased heart rate or release of adrenocorticotrophic hormones into the blood stream) resulting

from aspects of the teacher's job and mediated by the perception that the demands made upon the teacher constitute a threat to his self-esteem or well-being and by coping mechanisms activated to reduce the perceived threat. This definition shows that the academic stress is a complex matter which implies an interaction of factors generating negative feelings associated with stress. Beside some aspects of the teaching profession, a major factor of stress is represented by individual's subjective perception of the work experience. A series of longitudinal studies emphasized that personality variable as neuroticism, Type A Personality, self-efficacy, locus of control, self-esteem, anxiety, resilience, etc., are able to modify the homeostasis of the stressed organism.

Locus of control is a concept introduced by J. Rotter (1966); the author demonstrates that the attitude and convictions regarding the relationship between behavior and its effect become a global and relative stable trait of personality. Internal locus of

control implies the belief that personal power and control influences the quality of work results and life events, while external locus of control refers at the belief that the personality force has a minimum effect upon life events, these being determined by chance or other people's power, factors which the individual cannot control.

Individual differences concerning locus of control gather way at three distinct levels: cognitive (the belief regarding the possibility of exerting the control over the events); motivational (the preference and the need of control); behavioral (the effort for gaining the control). Individual differences exist also regarding individual's reaction to stress. Individuals with internal locus of control are more active in getting measures against stress while those with external locus of control bear the stress and are less able to act against the source of stress. The last ones are predisposed at a variety of symptoms of stress which include: emotional sufferance, work complaint, extenuation and a low level of self-esteem (Kasl, 1989, apud Matthews et al., 2005). According to the reserches the differences between individuals concernin events control manifests at a cognitive, behavioral and motivational level.

A reserach upon teachers from secondary level identified a strong correlation between the reported level of stress and external locus of control, the externalist teachers experiencing higher levels of stress (Kyriacou și Sutcliffe, 1979). Hurrell and Murphy emphasized that those who manage efficiently the stressful situations are persons with internal locus of control, in contrast with the externalist individuals (1991, apud Chaplain, 2001). Still, Chaplain sustains, personal control can be a two edged sword, meaning that strong internals individuals could believe that they are responsible always and for everything, fact that could transform in work overload, tiredness or even depression.

The main goal of this research is to analyze if locus of control moderates the relationship between stress and the health of the working individual. According to this goal, we expect that in the academic environment, the length of time in teaching to exacerbate the

externality of attribution and to determine a decreasing self-efficacy state as a result of a more and more pronounced dissonance between age and the constraints imposed by the change adaptation. We also anticipate that demographic differences will influence the level of the perceived stress and the localization of control too.

Our subjects were 59 university teachers, the entire group being structured according to the next variables: gender, age, and marital status, length of time in teaching career, didactic degree, scientifically title, and specialization.

The instruments used in this investigation were: a factual data questionnaire (containing name, gender, age, length of time in work, length of time in teaching career, etc., susceptible to become research variables) which contained additional data about potential sources of academic stress (work satisfaction, promotion opportunities, social and professional relationships, etc.); the physiological reactions of stress questionnaire elaborated by Ebel et al., which consists of 39 symptoms, ranked on a Likert scale from 1 to 5, representing different levels generated by the stressful agents; IPAQ questionnaire (Multidimensional Locus of Control) which consists of 24 items ranked on a 6 gradation Likert scale. This instrument brings to the causal attribution an extra dimenssion: along with the internal dimenssion there are distinct items for the human factor – Other people scale – and Chance factor – the omonime scale.

The existing data analyze consisted of calculation of means, standard deviations, and minimum and maximum values for the stress dimensions and locus of control. The t value (from the T student Test) was calculated for determining the significance of the differences identified between the investigated group's means. For establishing the relationship between study variables we have calculated the value for the simple Bravais – Pearson correlation coefficient.

The results indicated average values for the variables which measured the sources and the level of stress, which represents the lack of a perceived stress for the actors involved. Also,

the university teachers obtained over the average scores for locus of control, which indicates the fact that teachers consider themselves capable of controlling the events from their life and from the organization they work in. Eloquent differences were obtained though when analyzing data according parameters like gender, age, length of time in teaching career or the teacher specialization. These results give us the right to place the locus of control issue in the design and implementation of stress management programs, in an organizational context.

So, it is known that persons with an internal locus of control perceive their job less stressful than the external attributors, no matter the length of time in work, managerial level or education. The externalists are more disposed to feel unhappy when dealing with stressors, so they develop and experience a higher level of stress. According to our study, women have a salient internal locus of control than their male colleagues.

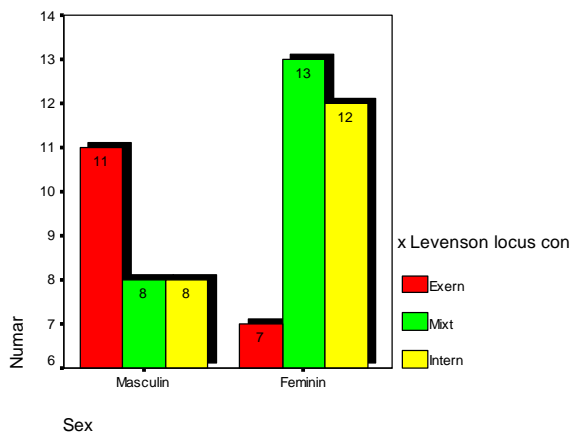


Fig. 1 Locus of control according to gender

A very important analyze criteria was the length of time in university teaching career, as an expression of perfecting the competences supposed by the performing of this profession. We identified significant differences from this point of view, concerning locus of control. So, along with progression in competence acquisition locus of control tends to externalize, teachers transferring the responsibility for their successes and their failures to other people or to the chance or destiny. The majority of the authors feel that

an internal locus of control is a foster factor for the sanity of the individual, while the external locus of control associates itself with large dissatisfaction and a predisposition to anxiety and depression. We try to explain the obtained results having in mind that in constitutive population locus of control has an individual evolution along with age (from internal to external locus of control). On the other hand there is an trans cultural variability of locus of control, which comes from cultural and social pressures specific to a certain society (for example, internal locus of control, expressed by early autonomy, independence, responsibility, and aggressive coping strategies are encouraged in modern, occidental societies, while external locus of control and passive strategies like “The bent had, the sword doesn’t cut” or “What is written for you is putted on your forehead”, are specific for traditional societies). If we accept the idea that the subjects from the over 15 years of length of time in teaching career category are the educational product of a traditional society, than we can explain the obtained differences. Another possible explanation could be that the external tendency is an organizational effect, generated by all type of constraints involved (material or psychological) by the academic environment. Next figures reveal the discussed issues:

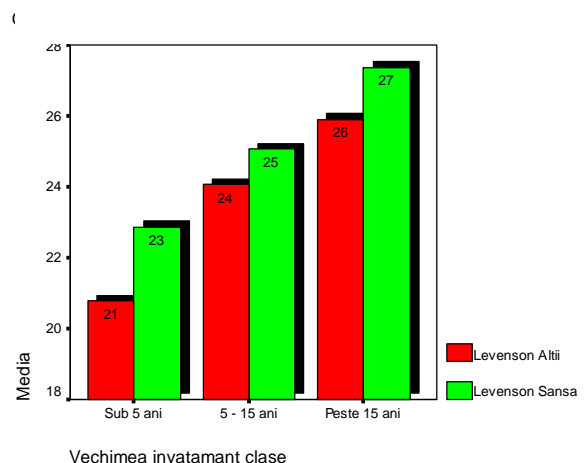


Fig. 2 External locus of control according to the length of time in teaching career

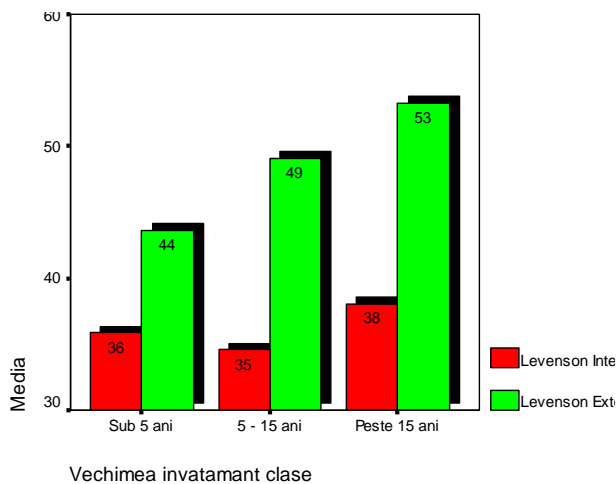


Fig. 3 Locus of control according to the length of time in teaching career

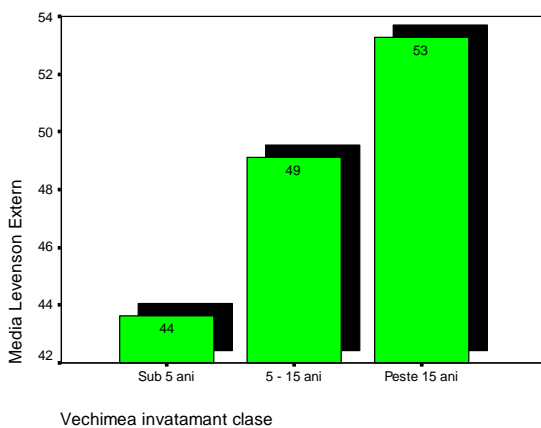


Fig. 4 External locus of control tendency

Regarding the subjects' specialization, there are necessary some clarifications. The faculties from which teachers come differ not only through the general profile (technical, or socio-human), but through aspects like the age of this faculties (the technical ones are traditional in the university while the others are relative young) or the didactic personal breakdown (men are the majority in the technical faculties, while more women work in socio-human faculties).

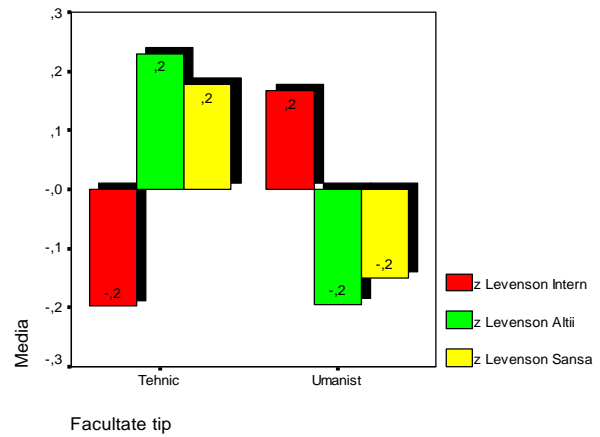


Fig. 5 Locus of control according to specialization 1

Our research identified differences between the two groups. Teachers from socio-human faculties are strongly internalized in comparison with their colleagues from the technical domain. Coming from socio-human faculties, teachers have a stronger sense of self perception. The above graphics illustrate this issue.

All the obtained data are relevant and give us the right to place the locus of control issue in the design and implementation of stress management programs, in an academic context.

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## THE INTEGRATION OF THE ROMA IN A MODERN, DEMOCRATIC SOCIETY

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**Abstract:** *To start with, this paper intends to describe the economic and socio-cultural situation of the Roma in Romania. Then it analyses the particular aspects and the complex social process of including the Roma in the Romanian society nowadays. We try to identify the main causes which led to this situation. How it was born, how it was maintained and how the economic and socio-cultural gap between the Roma and the main population deepened. Another main objective is to identify in Romanian society the main stereotypes, prejudices and forms of discrimination regarding the Roma. The conclusion is that in the Romanian society, the social inclusion of the Roma is a process that is far from being closed. A more firm and systematic mobilisation and accountability of all agencies of socialisation is needed in the elaboration and application of programs meant to fight prejudices and ethnic discrimination.*

**Key words:** *Social inclusion (of the Roma), stereotypes, prejudices, discrimination, democracy.*

### 1. INTRODUCTION

Motto: “In Romania, wherever you might be, you are 15 minutes walking distance, in any direction, from a community of poor gypsies. With the exception of a minority enriched at the limit of law, for more than two thirds of the approximately 1,5 million Romanian gypsies, the confusing years after the fall of the communist regime meant a transition towards hopeless poverty, delinquency and violence. They were among the first fired during the restructuring in the 90s and many of them haven’t managed to find another job. Almost 75% of the gypsies live on state welfare and occasional activities. 80% have no profession. Like in the village of Mocirla, where almost all poor gypsy communities are affected by the same problems concerning work, income, education, access to medical services, ID-s, property titles, poverty and overcrowded houses.” (Catalin Gruia, National Geographic magazine, November, 2006).

The present paper discusses the following issues: the economic and social situation of the Roma in present Romanian society; the causes of poor social inclusion; the identification of

the factors which contribute to the improvement of this situation and the role of the agencies of socialisation in a more efficient social inclusion process of the Roma. The paper focuses especially on the identification of the main causes which led to this situation.

*What is the relation between the paper and the already existent specialized literature?*

The paper turns to account the results of some renown sociological researches in Romania, done in the past 20 years, as well as the results of national investigations made within the ETNOBAROMETRU of CRDE program. We used also certain statistics from the Roma Inclusion Barometer as well as direct observation of the interethnic relations in the educational environment.

The subject we approach in this paper is of major importance in a well-functioning society, its democratic evolution, for growing cohesion, cooperation and social trust.

It was noticed that in the societies with a low level of social inclusion, the numbers of districts and areas where people live in miserable conditions is growing: the economic resources are at the limit of subsistence or even worst, the levels of education and social assistance are insufficient.

Such a life generates and deepens the frustrations, anger, “street culture” or the so-called “around the block subcultures”, at the same time leading to the rejection of projects, institutions, values and norms of the “marginalizing” society. Studies show that where the number of the people and marginalized groups is growing, democracy is in danger. Social exclusion is a failure both for society as well as the individual. Romanian society is also affected by this phenomenon. The Roma population is one of the most disadvantaged social categories – a well-known fact especially in the last decade. In other words, the social inclusion of the Roma is a real problem in Romania which should bring together all agents of socialisation involved. The study of the causes which brought about discrimination, of the factors which contribute to the improvement of the situation of the Roma in Romanian society could offer solutions for solving this problem.

## **2. THE ECONOMIC AND SOCIAL SITUATION OF THE ROMA**

The integration of the Roma is one of the important problems the present Romanian society is confronted with. Democracy is by definition a society for all, where every human being, meaning every social category – Roma also- must find their place and role, must enjoy equal chances and must turn to good account its aptitudes and talents. But, in comparison with the rest of the population, we notice that the Roma are lagging. The biggest part of the community continues to live, somewhere, at the outskirts of society, in poverty, with a minimum level of education and social security, or even under this level. Under these circumstances, sociological studies show that 2/3 of the Roma live in poverty and a quarter of them in extreme poverty, in improvised or abandoned houses, in small spaces, lacking sanitary facilities and heat.

Within this ethnic group, 24% of the people aged 10 or more do not go to school and 84% of the Roma aged 14 or more never worked with a workman’s pass, do not have secure income, health insurance, unemployment or retirement benefits.

Why are the Roma in this situation? What should society do to correct this situation? What should the Roma community do?

## **3. THE CAUSES OF POOR SOCIAL INCLUSION**

By analysing the following three social processes we might find the answers to the questions mentioned above: the historical discrimination of the Roma and its consequences; the attitude of the main population towards the Roma: stereotypes and prejudices; the attitude of the Roma towards the society that tries to integrate them: self-exclusion.

a) The Historical Discrimination and the Economic Backward State

Motto: „Ignorance feeds the fear and the fear feeds prejudices and intolerance. For centuries the Roma have been discriminated against because of their way of life and the attachment to their traditions. For centuries Europe has unjustly treated the Roma population thus missing the chance to understand and appreciate all its wealth, patrimony and cultural diversity. By learning, tolerating and respecting the Roma and their culture we could create the best Europe for everybody.”(Terry Davis – The Secretary General for the Council of Europe)

For many centuries from the moment they settled on Romanian territory until the XIXth century, the Roma had a marginal social status as being slaves. Because their social they were not treated as human beings, as persons but as working tools on the property of a master, an “instrument” which could have been sold, given or ill-treated. The masters had unlimited rights over the slaves on their property, but they could not take their lives. The marriage between two slaves was allowed only with permission from the master. If a free man would have married a slave, he or she would have become a slave too as well as the children resulting from that marriage.

Beginning with the XVIIIth century, there are new regulations improving the situation. The free husband could keep his free man status as well as the children resulting from that marriage. Regarding the selling of slaves,

it was forbidden to separate a legally constituted family as well as the parents from their children.

In the second half of the XVIIIrd century, during the reign of Maria Tereza and Joseph the Second, a set of values concerning the assimilation and the compulsory settling of the Roma population in the Empire was passed, thus the Roma from Transylvania were also affected. They had the following restrictions: free circulation, language, traditional costumes, traditional occupations, marriage etc.

Even when slavery was abolished (1864) and their status somehow improved, the centuries of tragic history left their mark on the economic and socio-cultural evolution of the Roma, and on the relations with the main population. Today, in Romania, it is officially acknowledge that, in relation to the main population, the Roma form a disadvantage marginalized social category.

The poor and very poor Roma are subject to a double social exclusion: an external one caused by the main population which does not show citizenship solidarity when it comes to the Roma, and an internal one caused by the corrupt "class" of the ethnic community. Lacking any kind of resources, the poor Roma are extremely vulnerable in front of the internal mafia, falling victim to prostitution, beggary, any type of exploitation.

b) The Attitude of the Majority Population towards the Roma: Stereotypes and Prejudices

Another factor which decisively contributes to the marginalization of the Roma is their negative portrayal made by the other communities, *the perpetuation and the consolidation of a strong set of stereotypes and prejudices regarding their behavioural characteristics*. Stereotypization consists of the undifferentiated treatment of the members of a group, the generalizing rigid simplifying ideas regarding a situation, an individual, a group. The belief that all Roma are lazy and dishonest is such a stereotype. Because of these stereotypes, prejudices are born: feelings, negative attitudes towards people and groups of people. The belief that the birth rate of the Roma should be controlled and the contempt towards this ethnic group are

eloquent examples of prejudices based on wrong and rigid generalisations.

Often, prejudices give birth to discrimination, negative, unjust behaviours for certain persons and/or groups. For instance, the refusal to hire Roma in a firm is a form of discrimination. Sociological studies show the fact that not always prejudices give birth to discriminatory behaviours.

People's behaviours depend not only on their beliefs but also on external circumstances, rules and laws which govern the society. If the laws forbid discrimination, even if a person has prejudices it will avoid openly manifesting them. On the other hand, even if the prejudice limited by law does not convert into behaviour (does not manifest itself) it still becomes a negative predisposition at any time ready to come out and manifest itself. According to the "theorem" of Thomas, the condition and the human behaviour depend not on the given situation but on the way it is defined by those who take part in it. A formulated definition becomes reality as soon as it is shared by a big number of people. The negative definitions given to some social groups (populations, ethnic groups etc.) are very dangerous and can lead not only to their isolation and subestimation but also to their annihilation.

R. Merton notices that in the 30s, the black people were portrayed as dishonest, lazy, strike breakers, thus the white people were avoiding them. This social defining reduces the employment possibilities of the black people on the labour market. A similar situation exists in Romanian society. The fact that the main population perceives the Roma as dirty, lazy, dishonest has negative effects on their professional chances, on their self-esteem and the capacity to overcome their condition. Even if a Rom has the same professional qualifications as a Romanian, usually the latter is preferred.

Studies indicate the fact that in comparison with the Romanians, the Roma carry on activities which are less paid but which require physical work, take place in toxic environments, which indicates on the one hand lack of education, and on the other hand a form of discrimination. Sociological research

shows that Romanians built up a quite rigid stereotype regarding the Roma community, its core part gravitating around the following four characteristics: dishonesty, laziness (the opposite of work), filth, uncivilized behaviour.

The main population has the tendency to delimit itself from the Roma, to avoid having relations with them: only 9% of the Romanians declare that they like talking or collaborating with the Roma, while 35% admit that they do it sometimes but have restraints, and 56% avoid doing it altogether. A big part of the Romanians (63%) dislike the idea of having Roma neighbours or of doing business with them. It is a paradox that although Romanians have a rather negative attitude towards the Roma, avoidance-rejection (78%) rather than acceptance-appreciation, they consider themselves tolerant and understanding towards them.

In other words, they do not admit, they are not aware that they are carrying prejudices towards the Roma. But it is a fact that you cannot get rid of prejudices if you don't even admit you have them.

So, the first step in our liberation from the preconceived ideas should be to find them by analysing ourselves, our attitudes, reactions, behaviour towards the other ethnic groups, and then followed by the awareness of the negative social effects that come along. Apparently, by doing this analysis, even the most democratic personalities will be surprised by themselves to notice that in certain circumstances they might do impermissible generalisations, having rigid, negative attitudes towards certain social groups.

Returning to the above-mentioned study, we notice that most of the main population is in abeyance regarding the Roma. The Romanians expect change to start from the Roma. They expect the Roma to prove they are honest, hard-working, civilized etc. In other words they don't see themselves as parts of this change. Their role is a passive one.

Under these circumstances, it is not possible to change the present situation of the relations between the Roma and the Romanians. Change needs active participation of both sides, even more of the main one that has to integrate the minority.

The above-mentioned study shows that most Romanians (80%) are distrustful of the improvement of the relations between them and the Roma. Only 20% of the people interviewed consider that, in time, these relations will improve.

Still, according to the Roma Inclusion Barometer, initiated by the Open Society Foundation, the intolerance of the Romanians towards the Roma was reduced by half in the last years. Even if Romanian society became more tolerant and the level of intolerance was reduced from 73% in 1993, to 36% last year, the Roma still feel discriminated when coming in contact with the town-halls, police and medical system employees. However, the school is the place where they feel less discriminated. According to the OSF study, 45% of the Roma from Romania declare themselves Romanianized Roma, educated in the spirit of the Romanian culture, approximately 15% are *rudari* and *vatrari*, categories relatively assimilated by the main culture, only 15% identify themselves with the more traditional relatives of the copper-smiths, gypsies and brick makers, while the remaining 25% consider themselves "only gypsy" or affiliate themselves to another group.

c) The Attitude of the Roma towards Society: Self-exclusion.

The long history of discrimination and marginalisation of the Roma put its mark on their mentalities and behaviour. The Roma enclosed inside a conservative cultural tradition, based on a moral of survival under unfavourable conditions, on practicing activities at the limit of legality, low interest in education, general norms of social convention. Their cultural tradition tended to develop a certain internal solidarity, simultaneously with the maintenance and even deepening the distance between them and the rest of the population.

Lacking resources and their fellow citizens appreciation, the Roma have isolated themselves even more from the rest of the society, self-expelling themselves socially. The situation of the Roma confirms once again the fact that the society which has disadvantaged some of its social groups is tempted to perpetuate – even involuntarily -

this situation, harming itself in this way. Marginalization is a social phenomenon hard to solve. It contains in itself a vicious circle: on the one hand, the disadvantaged population, constantly discriminated, lacking economic, educational, political resources cannot overcome the situation they are in; on the other hand, and consequently, it tends to stress the isolation, the inferior social statute, making their own values, norms, particular life styles, opposite to those preferred by society choosing a deviated identity instead of a normal identity. It is obvious that the solidarity of the disadvantaged around these values, deviated norms has no advantages for them, and even less for society, being obstacles in the way of social integration.

Returning to the Roma, we notice that their familial and ethnic solidarity was born out of the need to handle critical situations, to compensate poverty, discrimination, inferiorisation playing a modest role in the development of individual capacities, in the adaptation of the members of the society to the exigencies of modernity. They have shown little importance to education, professional training, identity cards or residence cards in this way maintaining the economic backward state and losing rights they are entitled to. Thus, statistics indicate that 3,1% of the Roma have no identity card, meaning that 47.000 persons are excluded from all the citizen rights in the Romania: education and free sanitary service for children, emergency help, other rights concerning social assistance and social insurance. They won't be able to get education, to work legally, won't be insured, cannot vote, cannot become members of any organisation, marry legally, make identity cards for their future children. And this is how a disadvantage entails many other disadvantages.

On the other hand, another factor which contributed to maintaining this disadvantage was the grown birth rate of the Roma. The big number of children per family, combined with the high level of poverty is another explanation of their incapacity to overcome on their own the state of social integration and economic backward.

#### **4. CONCLUSIONS REGARDING THE FACTORS CONTRIBUTING TO THE IMPROVEMENT OF THE ROMA STATUS IN A DEMOCRATIC SOCIETY**

Society as well as the representatives of the ethnic group and each member must contribute to overcoming this disadvantage. It is a process in which all involved must contribute for everybody's benefit. Some factors of the improvement are the duty of the main population, some are the duty of the minority, and others are the duty of both sides. In what follows we want to review these factors with the intention to develop the analysis during the next themes.

a) The formulation and the application of some social policies meant to increase the access of the Roma to decent life conditions;

b) The development of the skills of the Roma to contribute and to benefit from the economic, cultural and political development of the democratic society;

c) Increasing communication and intercultural, interethnic cooperation;

- fighting prejudices and any other form of interethnic discrimination;
- practicing and developing a culture and respecting the others;
- respecting and valuing the Roma culture;
- growing the mutual trust between the main population and the Roma community;
- changing the Roma perception on education and increasing their educational performances;
- improving their self-image. The conciliation of the identities: individual, ethnic, civic.

If we try to catch in one phrase the condition for improving the situation of the Roma, we could say that they should enrol in the trend of modernization. Modernisation is the great corrector of inequalities and discriminations. (Catalin Zamfir).

In a competitive system, such as the capitalist society, a minority which cannot cope with the competition no matter how much well-meaning support might get from the society, remains, in essence, marginalized. And modernisation implies first of all the increase of the educational, professional and civic performances.

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## THE ROLE OF INTERPERSONAL COMMUNICATION IN CAREER COUNSELING FOR STUDENTS

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**Abstract:** *The relationship between career counseling (C.C) and interpersonal communication (C.I.) represents a new conceptual attitude concerning the implementation of psycho-social strategies which can respond to certain commands of conjuncture.*

*Thus, professional accomplishment represents for student represent the sine qua non condition to report to society, proving his own capacities of adaptation and success, starting from the logistics of vocational career.*

*The intervention on time of counseling in career also supposes interpersonal communication, which facilitates the duality of success taking in consideration: the time, the goal and the cause.*

**Key words:** *student, career, communication, community, counseling, strategies, implication.*

If we start our incursion from E.Sabato's words: „We never manage to communicate properly. It's like shouting one at another from different islands” **then** we will easily discover that we have a serious **problem of communication** that **needs** to be solved immediately, both with ourselves and the people that surround us..What is the best solution? Laurențiu Fulga reacts to these quotes with a precise accusation regarding our ignorance ”Asking questions of high importance”, leading to an inevitable awakening of the nation.

Thus, in more practical terms we can evoke the existence of a relationship which is established within the context of implementing strategies to address psychosocial short order, namely the biunivoque sequence between **career counseling** (which will be noted as C.C. during this essay) and **interpersonal communication** (which we will note as C.I. in this essay). These two items

complete one another, resulting in this form:

C.C.  $\longleftrightarrow$  C.I.

decoding the conceptual and structural situation.

Starting from this point on we can establish that in specialized literature, Pasca M.D. and Tia T.(2007), **guidance** is a unique way of interpersonal communication based on mutual trust, honesty and willingness, born of the desire to assist another human being and it manages a transfer of experience and responsibility for the one in need, by providing a spontaneous and simulating pieces of advice.

In other words, **counseling** is a process of communication with interactive and permissive character, which provides guidance in matters that outrun the competence of the person to whom they are addressed.

When talking about **career guidance** (CC), Lemeni G. and Miclea

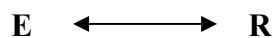
M. (2004) follow the development of skills as a possible solution to all career issues (indecision, anxiety related with career, academic insatisfaction, career planning etc..), which is considered to be the essence of psychological intervention.

We can decode the **C.C. strategy** (career counseling) through logistics:

- **Who** is involved and who provides expectations?
- **Where** does it take place (location)?
- **When** is it implemented?
- **How** is it structured in order to respond to the requested items?
- **What's** the purpose?
- **For how long** is it allocated?
- **What** is the motivation?

using the result as a tool for decoding positive / negative responses given by our client in a situation created as a result of our attitude.

Considering the relationship established between the emitter (**E**) and receiver (**R**)



as being the structural element of our **motivation**, we can conclude by saying that **interpersonal communication** (C.I.) is vital in **career guidance** because it triggers another report of cognitive features which intend to shape a new attitude and a more positive view when it comes to:

- the subject of labor and employment;
- professional involvement;
- the successful training of labor;
- personal satisfaction;
- cap, monotony;
- frustration;
- refusal / failure;
- dissatisfactions / instability;

the list could continue in order to separate the **reference group** and to influence its educational and psychological characteristics, knowing its age particularities.

But until then, it is necessary to determine the features of **communication** starting from N. Stanton (1995) which always seeks four main objectives:

- to be heard;
- to be understood;
- to be accepted;
- to cause a reaction (a change in behaviour or attitude).

In the structural limitations, E. La Monea (1994)- by Lupu I., Zanc I., Săndulescu C. (2004), which holds nine goals, whether alone or combined with each other, can be found in any process of communication like:

- to study, to transmit and receive knowledge;
- to influence people's behaviour;
- to express feelings;
- to explain and understand our own behaviour and others reaction;
- to maintain connections with the ones who surround you/to get integrated in the society;
- to clarify a problem;
- to achieve a goal;
- to reduce tensions and resolve conflict;
- to stimulate their interests or those around them;

Another feature of interpersonal communication (C.I.) is highlighted by Lemeni G. and M. Miclea (2004) who state that **communication** is defined as the process which transmits pieces of information from a transmitter to a receiver using a system based on signs and symbols. The same authors state that the **effectiveness** of communication depends on the existence of these skills:

- **active listening** = the ability to emphasize both the content of the message and emotions in order to ensure the most accurate understanding of the message;



- **the exact transmission of the message;**
- **identifying conflict sources** and using specific strategies to solve conflicts;

We will also stress out the **strategy of interpersonal communication(C.I.)** starting from the following questions:

- **Who** are those who communicate?
- **Who** is it addressed to?
- **Where** does communication take place?
- **Where** does communication take place?
- **Why** does this take place?
- **For how long** does communication last?
- **What** is the motivation?

noticing that the two entities have common features which simplify their interaction.

What implements interpersonal communication (CI) as a medium of knowledge, is the **stated communication (CA)**, Holdevici I. (2000) is an attitude and a way to act in those situations where we need to express our feelings, to claim our rights and say "no" when we are not willing to do a certain thing.

In connection with this idea we must relate the resultant of stated communication(CA),the **stated behaviour**, knowing that the author believes this holds the middle position between two extremes: aggression and submission, so it's really important for everybody to understand that we are entitled to ask what we wish, respecting their own rights as it does for those around them.

At this level:

- the issue is taken into consideration;
- your rights are sustained;
- you choose your own line of work;
- you have complete confidence in yourself;

- you recognise both your rights and others.

When discussing about stated behaviour(C.A.), Lemeni G. and Miclea M. (2004) underline that this:

- attends to the construction and development of personal and social identity and social,of efficient adapting (re)finding the mental,physical and emotional balance;
- promotes and maintains positive interpersonal relations by providing support for a constructive and amicable resolution of conflicts, practically **statements** facilitate solving tense interpersonal situations .

All of this have a strong effect upon the **solutions** of all **career problems** which have :

- **time**
  - **location**
  - **identity**
  - **shape**
- } ⇒ own

conceiving and applying **personalized strategies** helping **the subject** in these particular situations:

- 1)- at the end of primary school when he has to choose something(stimulated by his desire or by the people who surround him)- early teen age;
- 2)-at the end of secondary school when all **options** are already counted,and students take into consideration the demand and supply on the market when deciding upon a certain university;
- 3)-at the end of university when in order to gather **profesional fulfilment** one must attend different courses:postgraduate, master,doctoral as means of specialising in certain fields;

But,in order to use the benefic results of interpersonal communication (CI) in career counseling (DC) vs. career counseling (DC) and interpersonal communication (CI) it is absolutely necessary to know the **particular age of**

**the subject**, even his features, to act on future motivational characteristics of his **social identity**.

But before we look for all his age particularities it is compulsory to identify the **age** from these two points of view:

a)- **cronological** = considered a variable constant, relatively egalitarian, for those born on the same date (it mainly refers to the year);

b)- **psychological** = it doesn't concern only the complexity of personality in general but also the stratification and adaptive behaviour which allow adjustment forms and social contribution;

Șchiopu U. and Verza E. (1981) state that in order to analyse age particularities we have to consider the **criteria** that establish the different **stages of development** of personality:

- 1- dominant undertaken activity;
- 2- the socio-cultural relations;
- 3- specific mental structures.

The same authors established a hierarchy of **life cycles** in the form:

a)- the cycle of **growth and development** of the first 20 years of life, which in turn includes specific stages;

b)- **adult psychological cycle** which extends up to 65 years, marking the period in which human personality engages in social and professional responsibilities;

c)- **age regression cycle** (of old age), which extends from 65 years to death, which leads gradually to the final regression, also known as the terminal cycle.

We believe that in this case, along with the compartmenting above, Erikson E. (MD Pasca after 2007) surprises in a particular way life cycle, identifying particularities of life. So in this context, we will discuss upon :

1)- **teen age (identity - role confusion)** = stage that coincides with adolescence, ie the age frenetic, but very troubled when, at the end of all bio-psychological storms that cross, the young man wants

to know who became . That explains why at this stage, the crisis of identity and role confusion, it confuses him so frequently;

2)- **young adult (intimacy-isolation)** = this sequence is dominated by the need of the individual to make basic social relationships constantly, but at the same time, to find a genuine partner of the opposite sex to populate his intimacy .

Otherwise, he finds refuge in stressful situations without finding an optimal solution for the conflict that troubles him:

3)- **medium adult (career - the withdrawal itself)** = refers to the age when the individual has to choose between two alternatives, one of toil in the future (in the new generation) in a variety of activities or to center his interest upon himself. At this state, the evolution stops .

4)- **old age (integrity-despair)** = last ontogenetic stage is inevitably accompanied by an existential balance. When at the last inventory there are more achievements than failures, the individual seeks a happy sense of satisfaction and health. Conversely, if not, late regrets and the fear of death which becomes stronger , make people despair.

Thus, knowledge of bio-psychological identities of persons falling under the categories mentioned above, we can decode inter-relations between career communication (CC) and interpersonal communication (CI) at the strategies submitted to our attention.

The beneficial „cohabitation” between career advice (CC) and interpersonal communication (IC) is manifested especially in the university - where **students** included in the European system of education-Bologna, are forced, after the period of three years (in most situations) to continue their training courses in the form:

- a) - MA (2 years);
- b) - Postgraduate (6 months-1

year);

c) - Doctoral schools (4 years); which implies a new attitude towards lifelong learning / continuing included in adult education.

However, after the 1996 UNESCO report scored four foundations and directions for the XXI century to the students and the universities, namely:

a)- **learn to know** = to know the reality of the past, present or virtual, learning to teach permanently, to emphasize the cultural values that exist at a certain time;

b)-**learn to do** = to learn to deal reaching a pragmatic skill in a given horizon of activity, learning to cope with diverse and complex social situations in which you tend to integrate;

c)- **learn to live** together = to be permissive and care one for another, to be receptive and value your ideals, to achieve joint projects and be ready to manage any conflicts while respecting the values of pluralism, of the mutual understanding and peace;

d)- **learn to be** = to value your personality, to become capable of providing your own judgement, to create all along, to live through values, to spread and amplify them through through your own acts.

We can foresee the need of interpersonal communication (CI) in the career counseling (DC) as graduate students bound for **professional achievement** by a way of specialization required in some situations by the actual labor market, the society as a form of supply and demand:



transforming these words into :

- request = **to give, to offer;**
- supply = **to receive, to do;**

This is perhaps the point at which one form or another, the student needs to find a proper specialization, but also a way of achieving, to know whether the **situation** in which he lies is a **problem** or not and how it can be resolved, involving direct

interpersonal communication (CI). At this point, career advice (CC) should be involved modular, helping students in **resolving the issue** that really boils down to:

- **What** specialty should I choose?
- **How** would I know I did wrong? / I made the right choice?
- **Where** should I ask for clarification?

- **When** is the best time to know all about this?

- **Why** do I need information?

- **Who** can help / advise me? which competes in terms of the methodology with:

- defining clearly the student's problem;

- drawing up possible alternative solutions;

- choosing an alternative and practical implementation.

Thus, we are ensured with special assistance, through steps, Băban A. (2001) as following:

a)- **defining the problem** = settling the problem and its form;

b)- **describing the problems** = behavioral, cognitive and emotional problems;

c)- **identifying possible factors which develop the problem** = this is a necessary stage in its elimination;

d)- **identifying the factors responsible for maintaining and activating problems** = prevents the formation of appropriate attitudes and skills effectively;

e)- **the intervention plan** includes all ways of achieving the objectives of the intervention; plan formulation stages are :

- the formulation of long-term objectives;
- the formulation of goals;
- intervention strategies;

f)- **intervention assessment** = amends knowledge, attitudes and skill;

Considering our paper, the same author, Băban A. (by Pașca M.D. - 2007) constitutes the specific operations

involved in the process of solving problems ,namely:

a)- **finding alternatives**= the ability to generate alternative multiple solutions, overcoming stereotypes and rigid beliefs which state that a problem has an unique and ideal solution;

b)- **forward thinking**= the ability to anticipate the long and short term consequences of some situations;

c)- **planned approach**= the ability to plan ahead a series of specific actions to implement a certain solution causing a positive approach forcing students to see themselves as capable persons who can solve their problems and take responsibility for solving them.

Considering the problem under these auspices, the student will know to choose which master it meets both his material and spiritual needs, succeeding in a short time to be involved in community-by finding that role, and social position which he wanted, now being able to have it. But, there are situations in which in order to get here, the student needs **counseling and communication**, vanquishing in the end. In other words, he needs our **help**.

Very fit in this context, as a flexible way of understanding and accepting change we can invoke the therapeutic story-**Give him you hand**- Peseschkian N. (2005):

"A man had sunk in a swamp in the northern part of Persia. Only his head was out of the gutter. He was shouting for help. Soon a lot of people gathered at the around him. One decided to save the poor man. "Give me your hand, he screamed. I will get you out of the swamp. "But the one covered in mud just continued to call for help and refused to be helped. "Give me your hand," the man asked several times. But the answer was always just a pathetic cry for help. At a certain moment someone told the man:"He will never give you his hand. You **have to give him your**

**hand**. This is the only way you can save him".

And nothing will harm the personality of the graduate student, eager to achieve professionalism and why shouldn't we admit that if we stand by our students when they come to a crossroad it's like giving him out hand.

We started our incursion with **whether**, and now, when we have to end it, we come to realize how important it is to "see the closet and not the drawers" or "the forest and not the tree" meaning that, as Gary Sinise said "When I think about work, I think in particular about the possibility of having control over your own destiny and not wait for "faith's mercy" which shows that career advice (CC) and interpersonal communication (CI) have at one time, a **common route** finished with a role and a social position for each one of us.

And if Mihai Rales stated that "Each man has to have a time to listen to his soul" we can paraphrase him and say : "We all have our time for counseling and communication but it's important to find it, to hear it and especially to „listen” to it, and we can finally consider that our intercession has reached its purpose **if** turning into **then**.

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## WHAT IS WRITING?

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**Abstract:** *Writing is one of the most difficult skills that we learn to master. It involves not only a good command of language but also the ability to use just the right word to capture the meaning. It implies organized ideas and knowledge of the process. Of all aspects of studying, writing is probably the most challenging. That is because when you write down an account of your ideas for other people to read, you have to explain yourself particularly carefully. There is a difference between writing and speaking and we should be aware of it. Writing is not a simple process but with knowledge and practice we can master it. Our goal is to achieve basic competence first, then to reach the above-average competence, exceptional competence and, for the gifted ones, extraordinary competence. The process of writing and the principles of time managing share common ground: they require planning, organization and discipline. Writing forces you into a very deep and powerful kind of learning. When you write, you are really putting ideas to use. In my study I try to depict some basic aspects of writing which we should observe whenever we write as well as some of the items involved in each level of writing competence.*

**Key words:** *writing, process of writing, knowledge, writing competence*

Writing is a method of representing language in visual or tactile form. Writing systems use sets of symbols to represent the sounds of speech, and also have symbols for such things as punctuation and numerals.

Of all aspects of studying, writing is probably the most challenging. That is because when you write down an account of your ideas for other people to read, you have to explain yourself particularly carefully. You cannot make the mental leaps you do when you are in conversation with others or thinking about something for yourself. To make your meaning clear, using only words on a page, you have to work out exactly what you think about the subject. You come to understand it for *yourself* in the process of explaining it to others. So writing makes you really grapple with what you are studying. In other words, it forces you into a very deep and powerful kind of *learning*. That is what makes it so demanding. When you write you are really putting ideas to use.

In writing you have done previously, you may have ‘taken in’ ideas from books, articles, TV and so on. But it is only when you can *use* these ideas to say something for yourself that you have really ‘learned’ them. Ideas only become a properly functioning part of your thought-processes when you can call on them as you *communicate* with other people. It is very valuable to debate issues with other students in discussion groups. But an even more exacting way of using ideas in argument is to do it in writing.

A key part of using ideas effectively is to be able to write clearly and persuasively. Writing tends to be both the most demanding and the most rewarding part of any course of study. And, because it contributes so much to what you learn, you have to put a lot of your time and energy into it.

All writing systems use visible signs with the exception of the raised notation systems used by blind and visually impaired people,

such as *Braille* and *Moon*. Hence the need to include tactile signs in the above definition.

In *A History of Writing*, Steven Roger Fischer argues that *no one definition of writing can cover all the writing systems that exist and have ever existed*. Instead he states that a 'complete writing' system should fulfill all the following criteria:

- it must have as its purpose **communication**;
- it must consist of artificial graphic marks on a durable or electronic surface;
- it must use marks that relate conventionally to articulate speech (the systematic arrangement of significant vocal sounds) or electronic programming in such a way that communication is achieved;[1]

Writing systems are both **functional**, providing a visual way to represent language, and also **symbolic**, in that they represent cultures and peoples. In *The Writing Systems of the World*, Florian Coulmas describes them as follows:

As the most visible items of a language, scripts and orthographies are 'emotionally loaded', indicating as they do group loyalties and identities. Rather than being mere instruments of a practical nature, they are symbolic systems of great social significance which may, moreover, have profound effect on the social structure of a speech community. [2]

Theoreticians and practitioners alike agree that writing promotes both critical thinking and learning. Toby Fulwiler and Art Young explain it in their "Introduction" to *Language Connections: Writing and Reading across the Curriculum*:

Writing to communicate – or what James Britton calls "transactional writing" – means writing to accomplish something, to inform, instruct, or persuade. . . . Writing to

learn is different. We write to ourselves as well as talk with others to objectify our perceptions of reality; the primary function of this "expressive" language is not to communicate, but to order and represent experience to our own understanding. In this sense language provides us with a unique way of knowing and becomes a tool for discovering, for shaping meaning, and for reaching understanding. [3]

Writing systems can be divided into two main types: those that represent consonants and vowels (alphabets), and those which represent syllables (syllabaries), though some do both. There are a number of subdivisions of each type, and there are different classifications of writing systems in different sources.

Written and spoken languages differ in many ways. However some forms of writing are closer to speech than others, and vice versa. Below are some of the ways in which these two forms of language differ:

- Writing is usually permanent and written texts cannot usually be changed once they have been printed/written out.
- Speech is usually transient, unless recorded, and speakers can correct themselves and change their utterances as they go along.
- A written text can communicate across time and space for as long as the particular language and writing system is still understood.
- Speech is usually used for immediate interactions.
- Written language tends to be more complex and intricate than speech with longer sentences and many subordinate clauses. The punctuation and layout of written texts also have no spoken equivalent. However some forms of written language, such as instant messages and email, are closer to spoken language.

Spoken language tends to be full of repetitions, incomplete sentences, corrections and interruptions, with the exception of formal speeches and other scripted forms of speech, such as news reports and scripts for plays and films.

Writers receive no immediate feedback from their readers, whereas speech is usually a dynamic interaction between two or more people. Context and shared knowledge play a major role. Spoken language tends to be full of repetitions, incomplete sentences, corrections and interruptions, with the exception of formal speeches and other scripted forms of speech, such as news reports and scripts for plays and films.

Speech is usually used for immediate interactions. It is usually transient, unless recorded, and speakers can correct themselves and change their utterances as they go along.

When you are writing to someone, tone of voice, physical proximity and the possibility of quick interaction are not available but you have to communicate effectively without resorting to these features. This involves substituting for tone of voice, the physical presence of the listener, physical situation, and the possibility of interaction. Since you cannot look firm or sound firm in a letter, you have to convey firmness in a different way, perhaps by using an expression such as “I am absolutely determined that...” and, for example is no good referring to an object in a room as “the table over there” if the reader cannot see it. Striking the right balance between what to leave and what to put in, is sometimes a fine judgment which depends on whom one is writing for. In the military writing you can use these tips:

**Rifle:** Don’t simply say that a rifle can fire, say it is capable of firing or has the capability of firing.

**Soldiers/Troops:** Personnel, bodies, or individuals. Soldiers, squads, platoons never *fight*; they *operate*. *Headquarters* have become *echelons* and *methods* have become *techniques*.

Suffixes allow imagination. Simply add –**ize**. *Cannibalize, categorize, optimize, finalize, even dieselize and ruggedize.*

Or, add –**ry**. *Soldiery, riflery, weaponry, missilery, rocketry, weaponry.*

Or, add –**wise**. *Intelligencewise, weatherwise, weaponwise, healthwise, unitwise.*

Prefixes. **Debrief** for *briefing*, **unestablish** for *discontinue*, **non-greasy** for *not greasy*.

Other examples: *This semiautomatic, small caliber, shoulder-fired weapon, because of mechanical derangement, ceased to fire.* This means the “rifle jammed!”

While the writing process varies somewhat based on the task and the individual writer, the basic steps it includes are the same no matter what.

**First** is the initial brainstorming process. No actual writing takes place at this level although there may be some note taking or non-stop writing exercises. The more time you give yourself for this process then the easier the next step will be. You should experiment with various forms of brainstorming and prewriting to determine which works best for you and your various writing tasks. What may work in one type of writing may not work as well with another. The more you experiment, the more likely you will find the optimum brainstorming process for you.

**Second** is the drafting process. That first rough draft should be a quick and painless draft. Your main goal at this point is simply to capture the results of your brainstorming in one document. Keep on writing. Do not hold yourself back by rewriting, revising, or editing. Do not pause to worry about spelling, grammar, punctuation, or word choice. The important goal at this point is simply to capture your ideas in one place as quickly as possible. It does not have to be pretty and most probably it will not be pretty, but it will be done.

**Third** is the revision process. This should take more than one draft to accomplish. Again, do not spend time worrying about spelling, grammar, punctuation, revising or editing. Fix the obvious errors that are distracting to you as you rework but that is not your main goal. Your main goal with this part of the process is to look at the big picture. Is your thesis clear and well supported? Are your ideas well organized and fully developed? Are there any



gaps in the writing or logic? Do your ideas transition well from one to another?

**Fourth** is the editing process. Now is the time to worry about spelling, grammar, punctuation, and word choice. It is the time for you to focus on the sentences and paragraphs. This effort may take one or more drafts to polish your writing to the desired level. [4]

The most important part of creating your own individual writing process is to let it evolve. The more you refine and polish your process then the better the work you produce. The key to developing a successful writing process is to give yourself time – time to let your process evolve and time to let your writing develop.

Writing is a task that no two people do the same way. You should learn some basic aspects of writing to which you should attend whenever you write. You should make the attempt to write grammatically.

You should attend closely to the spelling of words. If a person presents work which is poorly spelled will at best be thought uneducated and at worse lazy; in addition meaning may be confused by poor spelling. You must attend to the use you make of punctuation-of full stops, capital letters, apostrophes, commas, speech marks and so on; punctuation should help you to clarify meaning but can easily lend itself to the unwitting clouding or distortion of what you want to say.

Finally you must follow conventions relating to the citation of sources by giving full references to everything that has influenced your work on the topic about which you are writing.

Style is one of the keys to great writing but it is not very simple to define style. In *The Elements of Style* E.B. White acknowledges the difficulty in defining style:

There is no satisfactory explanation, no infallible guide to good writing, no assurance that a person who thinks clearly will be able to write clearly, no key that unlocks the door, no inflexible rule by which the young writer may shape his course. [5]

Stephen Wilbers [6], urges us to consider our goals and assess our strengths and weaknesses. We should not make assumptions about ourselves and our skills that are self-limiting. He mentions four myths that can prevent us from realizing our potential as a writer:

Myth nr. 1: *Only people with natural ability can learn to write well.* The reality is that anyone with average intelligence and commitment can become competent in writing. As Marvin Bell, is fond of saying, “*talent is cheap. What counts is determination.*”

Myth nr. 2: *People who are good in math and science are inherently incapable of using language effectively.* The technically-minded people- can't-write myth can serve as a convenient excuse for inattention and lack of effort. Charles Darwin and Marie Curie are two of the numberless examples of talented and accomplished technical writers.

Myth nr. 3: *Achieving writing competence is a matter of learning to avoid errors.* Avoiding mistakes that interfere with precision or undermine credibility is crucial. If you fail to convey a basic group of language in your writing, nothing else really matters. At the same time, truly competent writing is more than a matter of correctness. In *Style; Two Lessons in Clarity and Grace*, Joseph Williams states that: “a writer who obsesses on usage can write in ways that are entirely correct but wholly unreadable.” One should put good usage “in its place-behind us- before we move on to more important matters.”

Myth nr. 4: *Learning to write well is easy if you just learn the right tricks.* Writing is not an easy task; it is a complicated, challenging endeavor. There are no simple principles and easy to learn techniques. Writing involves a feeling for language that comes from close association and familiarity.

The scholar thinks that our goal is to achieve basic competence first, then to reach the above-average competence, exceptional competence and for the gifted ones extraordinary competence. The items for each competence are as follows:

**Level 1: Basic Competence**

- to express the ideas clearly and concisely

- to write correctly
- to have confidence in your writing skills

### Level 2: Above-average Competence

- to write with emphasis and personality
- to produce text that is nearly error-free
- to be comfortable writing in various styles and formats for various audiences
- to look for occasions and seek out opportunities to express ideas in writing
- to publish an article in a newsletter, newspaper, magazine or journal

### Level 3: Exceptional Competence

- to command language with remarkable precision and nuance
- to be recognized in your group as a knowledgeable and reliable source of information on grammar, punctuation, usage and style
- to publish articles on a regular basis or to publish a book that is reviewed favorably by critics, or both

### Level 4: Extraordinary Competence

- to establish a national or international reputation as a talented and gifted writer
- to write with insight and beauty that people will be reading what you have written one hundred years from now.

To make significant improvement in our writing, we need to possess – or cultivate – the following attributes:

- **Confidence:** We need to believe that our efforts to improve your writing will make a difference and the time and energy spent will pay off in ways that are observable and significant.
- **Self-knowledge:** We need to have a realistic awareness of our strengths and weaknesses. We should go beyond generalities, to

assess our performance in specific areas such as expression, clarity of purpose, organization, support and correctness.

- **Attention/learning mode:** We need to open our mind to learning new information, place ourselves in an attentive, learning mode. We should become fully absorbed with task and the material at hand.
- **Commitment and determination:** You need to really need to improve. Nobody can teach you how to write if you do not help yourself.
- **Practice/follow-through:** You need to practice your newly learned skills to keep from losing or forgetting them. You need to drill, to work with each technique until it becomes second nature for you. You need to think long term rather than short term.

To read about writing and ways to improve it is one thing; to put it into practice is a tough process. Writing requires concentration and focus. In *Writing down the Bones*, Natalie Goldberg states: “Write clearly and with great honesty... Write. Trust yourself. Learn your own needs. ... Simply start writing and don’t stop.” [7]

The process of writing and the principles of time managing share common ground: they require *planning, organization and discipline*. [8] And we should not forget that if we want to perform with more precision we should stay in practice.

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## ELEMENTS OF CULTURE. AN INTERCULTURAL APPROACH

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**Abstract:** *The present paper lays emphasis upon culture moving across a broad number of elements, from values and beliefs to feelings and behaviors. Among the numerous elements of culture, not only beliefs, values, norms and symbols are included, but also broader categories such as: social structures, educational, religious, political and economic systems. The analysis relies both on sociological and historical perspectives that highlight the theoretical considerations regarding the notion of intercultural differences, the conceptual framework, the dynamics of relations and the way in which stereotypes are formed. The contemporary age is defined by rapidly increasing communication and contact with other cultures. In an ever-developing world, which emphasizes concepts such as globalization and internationalization, relations between countries belonging to diverse cultural backgrounds are likely to be hindered by cultural differences and the effects they may trigger upon people's mentalities and behaviour.*

**Key words:** *culture, intercultural differences, value, belief, worldview, social structure.*

### 1. INTRODUCTION

Culture can be defined in many ways: community, social class differences, minorities, social groups, nationalities, geo-political units, societies. According to C. H. Dodd, 'culture is the holistic summation and interrelationship of an identifiable group's beliefs, norms, activities, institutions, and communication patterns' [2].

This definition moves across a broad number of elements, from values and beliefs to feelings and behaviors. The behavior models for the norms of a culture are expected or prescribed or both expected and prescribed. The systemization of these norms and beliefs is obvious in the institutions of a certain culture. The use of verbal and non-verbal messages represents a feature of daily life, for culture is reflected in thought, speech, and action. Furthermore, cultural members are usually identifiable, often defining themselves. In a nutshell, people develop and come to expect ways of doing and thinking that significantly organize their world.

Among the numerous elements of culture, we can include not only beliefs, values, norms and sanctions, symbols and technology, but also broader categories such as social structures, educational, religious, political, economic and health systems.

### 2. CULTURAL WORLDVIEW, BELIEFS, VALUES. WAYS OF PROCESSING INFORMATION AND THOUGHT

Each culture has an interpretation of reality, or perceptual window, through which people see their own self and others. Moreover, cultures hold assumed truths (beliefs), concepts deemed as holding ultimate significance and of long-term importance (values), and worldview. Worldview is a specific belief system about the nature of the universe. More than just an outlook or a philosophy of life, worldview functions as a central construct related to how much control one believes is available.

The pattern of thought of a particular culture refers to the way in which a cultural group views such things as decision making,

the kind of logical system and evidence usage practiced, and cognitive pathways of thought. For instance, many people in the Western Hemisphere accept cause-effect reasoning. Solutions to problems are simply a matter of fact, they reason, of altering or controlling the causes to alter or control the desired effects. In contrast, some Eastern cultures reason that no one can know the causes of life events and that the events are part of a natural plan that humans should not try to understand completely but to accept. Thus, the intercultural difference in this example is the divergent approach the inter-actants have toward the use of evidence, the way the universe operates, and consequently, the most useful communication styles for discussing solutions to problems.

Furthermore, members of some cultures think in terms of linear-sequential, time-ordered patterns (1, 2, 3 or A, B, C). In contrast, members of configurational cultures think in terms of pictures or configurations. The individual with a configurational pattern of thought follows a different order of attention to stimulus items than the linear thinker. Here, the stimulus items may follow an attention pattern unique to that culture, for example 1, 16, 37, 2 or A, M, Z, B. The issue, which involves how a person collects and processes information, is being addressed by a number of theorists. According to them, methods of information processing appear to be culturally dependent as well as individually deprived, reminding us that perceiving culture requires an awareness of cognitive style and information processing differences.

### 3. SOCIAL INSTITUTIONS – THE FAMILY. INTERCULTURAL SIMILARITIES AND DIFFERENCES

The family, as a social institution, is universal; every known society has families. But the form the family takes and the functions it performs vary widely over time and among societies. These different arrangements seem as natural to the people who practice them as our family system does to us.

In traditional Navajo society, for example, a wife and a husband never live under the same roof. Rather, she lives with her mother, sisters, and their children; he lives in a communal men's house. Their conjugal relations are limited to discreet visits. The Maasai of East Africa consider it normal and proper for a man to ask permission to sleep with a good friend's wife. For either the husband or his wife to refuse *sexual hospitality* is considered rude. There are even societies where parents do not have final authority over their children. In Samoa, children are considered members of an extended family and wander from one relative's house to another, deciding for themselves where to live.

#### 3.1. FAMILY STRUCTURE

To most Westerners, the word *marriage* is synonymous with monogamy, marriage involving only one woman and one man. Although we recognize that such unions may not last, we assume that monogamy is the ideal in most societies. But that is not the case.

*'Monogamy is the preferred form of marriage in only 25 percent of the world's societies. In the other 75 percent of human societies, the preferred arrangement is polygamy – marriage involving more than one wife or husband at the same time. Most often this takes the form of polygamy, marriage of one man to two or more women'* [3].

Polygamy was practiced in ancient China, hardly a small, primitive society. It is part of the Judeo-Christian cultural history. The ancient Hebrews (including Kings David and Solomon) were polygamists. Up to 1890, so were the Mormons of Utah. And Islam, the second largest religion in the world today, allows a man four wives (providing he treats each wife equally). In contrast, only four societies have been reported in which polyandry – marriage of one woman to two or more men – is the norm.

Group marriage – marriage of two or more men to two or more women - is the rarest family type. Indeed, there has been some debate about whether this arrangement exists at all. Group marriage is most likely in a society where polyandry is the cultural ideal,

but if the first wife proves infertile, a second wife joins the marriage to provide children.

Most of the men in the societies that permit polygamy do not actually practice it, for the simple reason that there are not enough women to go around. Even if there were an excess of women, most men could not afford the cost of marrying and maintaining several wives. In practice, polygamy is a privilege that accompanies wealth, power, status, and, in most societies, old age. It turns out, then, that monogamy is the most commonly practiced form of marriage in the world.

Ironically, it may be more common for a person to have more than one spouse in the United States and other monogamous societies than in societies that permit polygamy. The only difference is that a person must divorce (or outlive) one spouse before acquiring another. More than half of first marriages in America end in divorce today. Most divorced couples remarry, however. Even when second marriages end in divorce, most of these people try marriage a third time. Thus, some Americans practice serial monogamy: one exclusive, legally sanctioned, but relatively short-lived marriage after another.

### 3.2. FAMILY FUNCTIONS

Family functions, like family structures, vary widely. In most traditional, pre-industrial societies, the family performs four central functions. The first is the regulation of sexual activity. No society leaves people free to engage in sexual behavior whenever they want, with whomever they want. Some societies place a strict ban on sexual intimacy before marriage; others require a woman to demonstrate that she is fertile by becoming pregnant before she marries. All societies place a taboo on incest, though which family members are included in this taboo varies.

The second function of the family is reproduction. The family bears primary responsibility for replacing members of society who have died or emigrated, thus keeping society alive from generation to generation.

The third function is the socialization of children. It is not enough simply to produce

children; they must be given physical care and trained for adult roles. The family bears primary responsibility for teaching children the language, values, norms, beliefs, technology, and skills of their culture.

The fourth function of the family is economic. The family bears primary responsibility for providing for the physical needs of both young and old members, including food, shelter, protection, and health care.

In modern, industrial societies, some of these traditional functions have either changed or been taken over in part by other institutions. For example, with modern birth control devices (especially the *pill*, which was more effective than earlier methods, in part because when used regularly it provides continuous protection) and safe, legal abortions, the regulation of sexual activity became less urgent. During the so-called sexual revolution of the 1960s and early 1970s, '*sex lost not only its biological connection to reproduction but also its normative connection to marriage*' [7].

It became an accepted – and expected – part of dating and premarital relationships. But although most Americans consider sex before marriage permissible, the great majority disapprove of it outside marriage (extramarital sex).

The family's role in socialization has changed significantly. In traditional societies, family members teach young people all they need to know for a life that will resemble their parents' life. The emphasis is on well-defined traditional social roles and skills. Education is continuous and largely informal, woven into the fabric of everyday life. In modern societies like our own, a child's future occupation is unpredictable.

Furthermore, technical skills and even knowledge quickly become obsolete. Schools (including colleges and universities) have taken over responsibility for preparing young people for occupational roles. Day care centers now expose children to *professional socialization* at a younger age than ever before.

Media also have a powerful impact on young people. Much of the debate over family values concerns whether the schools and the

media have usurped the family's authority over children.

Government also has taken over some of the family's former economic functions – for example, the care and financial support of the elderly through Medicare and Social Security. The medical establishment (physicians, hospitals, insurance companies) takes over when a family member becomes sick.

The overall trend is for functions that were previously matters of personal care within the family to be taken over by (1) professional experts, (2) large-scale markets, and/or (3) bureaucratic formal organizations.

While many of the family's functions have diminished, one that has become increasingly important is emotional gratification. Although schools teach children skills, the family still provides nurturant socialization or emotional support and caring. Children are not the only ones to receive emotional gratification from the family. For most of us, the family is the group we count on to satisfy personal needs on a continuing basis. We expect – or feel we have a right to expect – to find understanding, companionship, and affection at home. The more depersonalized our work and school lives become, the more we come to depend on the family. The modern family is an intimate environment, distinguished from other social groups by the erotic attachment between husband and wife and the affectionate attachment of parents and children. Ideally, the family is a safe, secure, nurturant *haven in a heartless world* [7] – the world of capitalism, careers, and competition.

#### 4. POLITICAL SYSTEMS

Universally, societies have some form of governing organization functioning on a formal level and an informal level. On the formal level, such governing organizations originate because of self-appointment, inherited rights, vote, consensus, or political takeover. A less obvious informal method of accruing perceived power, status, and leadership also exists. In various cultural groups, some leaders are assumed to have a certain degree of supernatural power. Many years ago, a group of South Sea islanders

considered the power of *mana* (special power or magic) to dwell in certain individuals. This impersonal power was believed to cause its recipients to possess the equivalent of what we might term *power*, since persons who were perceived to have high degrees of *mana* usually had greater financial prowess, inherent status, and attributed power. Individuals believed this power also resided because of some special charm or incantation formula. The term for this perceived power stuck – the word can still refer to a special leadership.

Aside from the concept of impersonal supernatural power residing in or near a person, traditional leadership in political organizations among traditional cultures seems closely linked with age and economic qualities. In Ghana, for example, village chieftainship and eldership appear to be related closely to father's role (inheritance factor), age, and economic ability. In the Sierra Quechua of Ecuador, village chieftainship is a function of economic ability, marital status (only married men are considered for the post of *prioste*, responsible for fiestas), and priestly appointment.

Most modern States are structured along either democratic or authoritarian lines. In a democracy, the government is controlled by the people. They govern in accordance with a constitution that guarantees basic human rights and sets forth the rules by which power is distributed.

Democracy originated in ancient Athens, where all citizens (meaning all free males; women and children were not considered citizens) participated in decision making, a system known as direct democracy. One reason the art of oratory was so highly valued in ancient Greece was that the ability to persuade was critical when decisions came to a vote. But Athens was a small city-State. In today's large modern democracies, such a system would be cumbersome. The most common form of democratic government today is through indirect democracy, or a republic. In a republic, citizens elect officials to represent their interests. The law establishes clear limits on what these representatives may do, however. When officials abuse their

authority, citizens have a right – even a duty – to vote them out of office.

Authoritarianism, which denies popular sovereignty and relies on force, is the opposite of democracy. The ruling party makes all decisions, and opposition to those decisions is considered intolerable. Those in power can and do act freely to crush any opposition to their rule. But rule by force alone would be almost impossible. Authoritarian governments control their citizens by specifying what the schools will teach, what the media can print and broadcast, and what religion (if any) people are allowed to practice; they also limit the right of people to travel and assemble in large groups.

An extreme form of authoritarian government is totalitarianism, which not only denies popular participation but also interferes extensively in people's lives. In China, for example, university graduates were not allowed, until recently, to choose where they wanted to live and what work to do; rather, the government assigned them to a post. Needless to say, this was one of the reasons why students rebelled. The slaughter of protesters in Tienanmen Square can be seen as their punishment for daring to criticize the government. The government of China even reaches into the family, decreeing that each family may have only one child. A couple must obtain an official permit to have a child. Those who refuse to comply may be fined, socially ostracized, driven from their home and job, even forced to undergo an abortion or sterilization. While Westerners might see population control as a worthy goal, most would see these tactics as an extreme violation of human rights.

Few States are purely democratic or purely authoritarian. In the 1950s, during the McCarthy era, thousands of Americans lost their jobs because they were accused of pro-Communist sympathies. In 1968, during the Democratic National Convention in Chicago, police used billy clubs, bayonets, and tear gas to clear the streets of students protesting against the war in Vietnam. Many Americans approved of these authoritarian actions. Democracy and authoritarianism are best seen

as opposite ends of a continuum, with most nations falling somewhere in between.

## **5. SYSTEMS OF SOCIAL CONTROL**

All cultures have methods of dealing with violations of norms (accepted modes of behavior) and laws. Societal punishment appears to be universal, although consequences vary from fines to banishment or death. For example, *'two visitors in an African country unknowingly walked through sacred African "ju-ju" ground, a religiously special place, and were fined the national equivalent of one's month wages'* [2].

Physical punishment also exemplifies differing cultural solutions to the universal need for order as caning in Singapore illustrates.

Like every other element of culture, social control develops from specific cultural contexts. A difficulty arises when we compare social control in one culture with its counterpart in another culture. Many international persons, for example, believe that the United States is far too lenient in its punishment for certain crimes; conversely, many U.S. citizens believe that some countries have enacted overly strict laws. Evaluation of cultural methods of social control depends on examining each culture from its own perspective.

## **6. EDUCATIONAL SYSTEMS**

Cultural educational systems differ widely. In the British educational system, for instance, students are either university or vocational bound, influenced by testing by about twelve or fourteen. Also, some European education is conducted bilingually.

Many foreign universities are structured differently from those in the United States. At some universities, subjects are studied a year at a time, not a semester or quarter unit credits.

The critical point for intercultural communication is recognizing diversity in educational systems and how those differences alter our perceptions and messages.



## 7. RELIGIOUS SYSTEMS

Religious systems involve beliefs, ceremonies, places of worship, norms of respect, and linguistic concepts that can cause great embarrassment for those who do not understand them. Many visitors to mosques and temples, for instance, neglect basic etiquette by failing to remove their shoes or observe other norms of respect. Recognizing the external elements of religiosity in a particular culture not only prevents cultural mistakes but also can affect insights into macrocultural patterns, cultural beliefs, and cultural values. For example, during the holy month for Muslims, fasting occurs from dawn to dusk. As told by a Thai participant, '*several Thai workers (mostly Buddhist) who worked side by side with Islamic workers failed to appreciate the significance of the period of time and the rituals associated with the fasting. Consequently, the organizational climate during that month was tense and negatively altered communication patterns, work productivity, and morale*' [2].

## 8. ECONOMIC SYSTEMS

Every culture has various mechanisms of dealing with economics and work, known as economic systems; these are defined as parts of the larger cultural system. A practice among farmers in certain parts of the United States is to swap out work, whereby one farmer helps another harvest crops and the second reciprocates. Money is seldom exchanged in this process, although a system of informal, mental record keeping develops so that both parties are fully aware of who owes whom. While monetary economic systems play a dominant role in most cultures today, this example reminds us that other methods of exchange exist according to unique situations. For instance, the highlanders of Papua New Guinea traditionally use the sweet potato as one unit of exchange. A missionary once described the mild surprise of foreign visitors to a church meeting where the indigenous church members contributed a large pile of sweet potatoes instead of money for a Sunday collection.

## 9. CONCLUSIONS

We live in an era defined by rapidly increasing communication and contact with other cultures. In an ever-developing world, which emphasizes concepts such as globalization and internationalization, relations between countries belonging to diverse cultural backgrounds are likely to be hindered by cultural differences and the effects they may trigger upon people's mentalities and behaviour.

It is a known fact that prejudices and stereotypes are formed due both to a lack of understanding of other cultural patterns and to misunderstandings that evolve throughout history.

The norms of communication greatly differ across cultures, causing lack of understanding, conflicts and perpetuating stereotypes and prejudices.

Rules that are considered to be valid in one culture, having proved their effectiveness over the years, will not necessarily be acknowledged by other cultural patterns, thus making it a tremendous challenge for foreigners to understand and adapt to other backgrounds.

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# NATIONAL SPECIFICITIES AND INTERCULTURAL COMMUNICATION IN THE UNITED STATES OF AMERICA AND FRANCE

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**Abstract:** *The present paper aims at precisely identifying the intercultural differences, the great range of connotations concerning time and space, the various ways of intercultural communication, the values, the social relationships, the national specificities of the United States of America and France. This study demonstrates that all the dissimilarities, all the misunderstandings between the two countries are, one way or another, related to culture. France has a very sophisticated and elaborate culture that is hundreds of years old, whereas America is a relatively young nation having established a new set of values – capitalism, consumerism and pop culture. The two countries have their own ways of perceiving the world, values and norms that are specific to each culture.*

**Key words:** *culture, intercultural communication, national specificity, time, space, value, belief, social relationship.*

## 1. INTRODUCTION

The norms of communication greatly differ across cultures, causing lack of understanding, conflicts and perpetuating stereotypes and prejudices. Rules that are considered to be valid in one culture, having proved their effectiveness over the years, will not necessarily be acknowledged by other cultural patterns, thus making it a tremendous challenge for foreigners to understand and adapt to other backgrounds.

The analysis that follows lays emphasis upon the differences between the American and French customs and ways of communication that individualize them as nations. This comparison is made according to Kluckhohn's approach [7].

## 2. TIME

Americans are governed by the principle *time is money* and are extremely to-the-point in everything they do; in fact, punctuality has a key-role in their society. Their attitude towards time is largely *monochronic*, i.e. they focus on one activity at a time. *Time*, for them, is like a

large ribbon of highway that can be sliced into segments. They believe that accomplishments and tasks should be performed during each segment. Americans are dissatisfied with dangling loose ends. As a result, their tolerance for ambiguity is not high. As uncertainty rises, *monochronics* tend to articulate solutions and to work toward resolution, whether in conflicts or ordinary, everyday decisions. Furthermore, the members of *monochronistic cultures* usually think in a linear fashion, processing information internally, in a sequential, segmented, orderly fashion [4].

Like many Western societies, the French are very conscious of time and somewhat punctual. As in the States, *time* seems to move more slowly in rural areas and more quickly in the cities. The public transportation system, best illustrated by the celebrated TGV generally runs on time. Meetings, dinners, and other functions start on time, too, and businesses open as scheduled. The importance of timeliness decreases as the situation becomes more casual.

Being late can be a function of status. For example, an upper level manager may keep a

lower level employee waiting longer than peers could keep each other waiting. Also, in service encounters, time does not appear to be as valuable to the French as to Americans, as speed is sacrificed in favor of multi-tasking in the form of talking to co-workers or performing other tasks. Americans might feel frustrated because they seldom receive the full attention of the person with whom they are interacting. The polychronistic aspect of time is a challenge for many Americans who may feel slighted in not receiving someone's full attention [8].

For the French, life is to be savored, thus business and socializing are often combined. Long, elaborate business meals and long, wine-filled lunches are common. One does not have a meeting without an *apéritif* of some sort. However, socializing occurs primarily between members of the same group, rather than across social classes or work ranks.

Although the French may linger over lunches and dinners and are less direct and non-sense than Americans, they do have a sense of the future and of the quantitative limitations of time. When raising children, parents believe they cannot waste a year by letting them fall behind in their schedule of development. Children in France can attend free public schools as early as the age of three at *écoles maternelles*, called schools rather than daycare. Thus, the French grow up with the pressure of schedules and timeliness.

The French still guard many of the daily traditions of other European countries, despite their appreciation of timeliness and future. The workday begins later, usually around nine, and the stores close for an hour or two at lunch, even in big cities. Dinner is served later, seven at the earliest, and often lasts three or four hours, with several courses. The workweek runs from Monday to Friday, and Sunday is a day of rest. Although much of France is no longer Catholic, or at least practicing Catholic, everything is closed on Sundays. The bakeries remain open until noon, so that one can buy food, but all other stores are closed. Paris, of course, is excluded because some stores in tourist areas keep more American-style hours.

The French celebrate birthdays and holidays much as the Americans do.

Traditional Catholic holidays such as Christmas are observed much in the commercial manner of American holidays. In addition to Mother's Day, Father's Day, and Worker's Day, the French celebrate the *Toussaint* (November 1<sup>st</sup>), a day to honor the dead, and *Bastille Day* (July 14<sup>th</sup>), the celebration of the storming of the Bastille during the French Revolution.

### 3. SPACE

As Americans are accustomed to wide open spaces, they tend to use much more space than nationals of other cultures. In the southwestern and western United States, a person can drive on a highway for miles and never see a sign of people. North Americans visiting a foreign country sometimes express surprise about the proximity of individual dwellings and the narrow roads.

Personal space is also culturally related. North Americans prefer greater distances between themselves and others than do Latin Americans, Arabs or French. When these proxemic expectations are violated, embarrassment can result. We can better understand why intercultural proxemics differences produce discomfort by describing the four zones of personal space.

According to Carley H. Dodd [4], the *intimate* zone encompasses touching and a distance of up to eighteen inches and, for North Americans, it is a zone reserved only for intimate relationships. The *personal* zone ranges from one and a half to three feet being used for confidentiality. The *social* zone is the normal conversational space for North Americans including space from about four to twelve feet. The *public* zone is used for talking across a room and for public speaking and it includes distances of twelve feet and larger. North Americans usually converse in the personal zones and social zones and stay at least sixteen inches away from each other.

A French person usually uses less space than an American. The French are more accustomed to sharing their limited space because of their small living quarters. On the subway, people sit down next to each other even if there is an empty row behind them.

French hotels often offer rooms with shared bathrooms. Eating elbow to elbow is not considered abnormal. Hall writes in *The Hidden Dimension* [6] that the numerous parks, smaller buildings, and smaller cars reflect the French desire to maintain the beauty of the environment and their proximity to it, whereas Americans distance themselves from it with their large cars and high-rise enclosed cities.

In France, rural highways often feature a third lane, in which either way of traffic can pass. Smaller country roads are often only big enough for one car at a time. The French believe that the traffic circle is more efficient than the four-way stop, thus traffic circles with gardens or even art displays in the center exist all over France. The most famous of these traffic circles is the *Arc de Triomphe* traffic circle in Paris, in which eight lanes of traffic move in and out to travel to the different boulevards of the French capital.

In *The Hidden Dimension* [6], Hall states that this star-system of infrastructure reflects France's system of centralization of branches radiating from a central core, as shown in everything from the national school curriculum to the Paris subway system.

#### 4. COMMUNICATION

Communication, be it oral, written or non-verbal, is at the root of many misunderstandings and conflicts that may occur between different cultures. Communication is culturally bound and its norms greatly differ across nations and civilizations. Thus, two interactants coming from different backgrounds may encounter problems when communicating because what is considered appropriate by one of them will not necessarily be accepted by the other.

##### 4.1. ORAL AND WRITTEN COMMUNICATION

The Americans are highly explicit and direct when communicating and prefer things to be concrete, whereas conversation is less direct in France and somewhat more of a dance of politeness and witticism. Playing

with language through puns is an appreciated art. The French are less action-oriented than Americans, and the art of conversation is more than simply delivering a message. In French films, conversation often dominates the movie instead of action. It is an adjustment for Americans to appreciate films where nothing really happens.

Face-to-face communication is valued. The French, whether out of politeness, stinginess, or tradition, are not fond of the telephone and use it primarily for making arrangements rather than chatting. In having a conversation, the French are more likely to discuss abstract ideas than talk about themselves, thus more response time is allowed in responding. The typical American pattern of responding without taking time to reflect is not appreciated. The French are willing to wait to hear the response and do not feel the need to come back quickly. In conversing, the French are rather polychronic, thus many conversations can occur at once. The American tendency towards monochronism can hinder communication between the members of these cultures.

Like many Europeans, the French prefer a more abstract style of thinking. As opposed to the Americans, who are highly deductive, they tend to use inductive reasoning, forming a general hypothesis, then applying it to individual situations. The way they reason relates to their speaking and writing styles. The French prefer discussing ideas about politics rather than biographical facts. In their writing, they use a zigzag style rather than the American direct style.

##### 4.2. NON-VERBAL COMMUNICATION

From posture to facial expressions, *non-verbal communication* differs significantly in France and America.

The French carry themselves differently than Americans; it is said that Americans bounce when they walk while the French glide. The French tend to have better posture and hold themselves erect.

The French face is very expressive and important in conversations. For example, raising an eyebrow means that one wants a

turn in a conversation. Although the French look into your eyes as Americans do in conversations, they may not make eye contact if they do not want to be interrupted. Other non-verbal conversation tools include the sounds a French person makes. Sounds such as *psstpsstpsst* to show disbelief or scorn or a certain holding of breath for emphasis before continuing a sentence get the listener's attention. Finally, the French *look*, a piercing stare, can make an American feel uncomfortable and disconcerted, although it is common knowledge that, for North Americans, eye-contact is very important as it conveys credibility.

The French touch more than Americans. For them, touching plays a role in acknowledging status or signaling beginnings and endings of meetings. The number of times one kisses someone in greeting indicates the intimacy of their relationship.

For both the Americans and the French, *politeness* plays an important role, although there are fewer constraints and rules to be obeyed in the American society. Etiquette and behavior presuppose a few norms that vary according to the formality or informality of the event. For instance, one rule would be not to speak one's own or another foreign language for more than a few sentences when several English-speaking persons are joining the conversation, or not talking during a concert or play.

In the French society, politeness is an important element, preserving status distinctions and showing that a person has been *raised well*. The first, most obvious symbol of politeness is the *tu vs. vous* distinction in France. Use varies with age, social class, and certainly from person to person. An unacceptable *tu* will generally generate at least a mean look, and a *vous* where not explicitly necessary puts the speaker in a lower position than the listener. The *tu vs. vous* distinction is a politeness convention, a symbol of group solidarity, and a distancing mechanism if one does not belong. In addition to the dual pronouns for *you*, the French have at their disposal a wider range of means of expressing politeness through the use of varying verb tenses.

In asking someone to close the door, a request might range from the extremely familiar *Ferme la porte!* to the conditional could or would *Pourriez-vous fermer la porte?* to the subjunctive *Veillez agréer, monsieur, de fermer la porte*. The subjunctive, of course, is more often used in letter writing because of its extreme formality. In a French cover letter for a curriculum vitae a person might write: *Please accept my most devoted sentiments and have the kindness to peruse my curriculum vitae*.

### 4.3. COMMON EXPRESSIONS

American language is permeated with French expressions that seem to express a more sophisticated or pretentious style of English writing. Expressions such as *joie de vivre*, a certain *je ne sais quoi*, and *savoir faire* express several characteristics important to the French personality. *Joie de vivre* reflects a person's spirit and *joy in living*, a personality trait valued among the French. The *je ne sais quoi* hints towards the mystique of an object or a person that makes them extraordinary. *Savoir faire* is related to having a high capacity for getting things done.

Many French idioms exist in English, such as *the early bird gets the worm*, *all's well that ends well*, and *cold hands, warm heart*. These common expressions reflect some of the common Western heritage and common values of the Americans and the French. Some shared values are expressed with different metaphors. For example, *C'est en forgeant qu'on devient forgeron* (*One becomes a blacksmith by blacksmithing*) is similar to *practice makes perfect*. *Don't count your chickens until they hatch* is *Don't sell the bear's skin before you've killed the bear* in French.

Other French expressions come from the thoughts of French writers and philosophers. France's rich literary tradition allows the French to draw upon admired writers such as Rousseau, Voltaire, Molière, and Hugo for inspiration. They seem to value poetry and literature more than the Americans, thus an ability to quote literary figures is important in France. Pascal's *Le coeur a ses raisons que la raison ne connaît point* (*The heart has its*

reasons that reason cannot know) is often cited in referring to affairs of the heart. Writers like La Rochefoucault and La Fontaine have supplied the French with multiple moral lessons, such as *One is never as unhappy as one thinks, nor as happy as one hopes*. Even St.-Exupéry's *The Little Prince* is quoted in French conversation with *On ne voit qu'avec le coeur (One sees best by looking with the heart)*, and *Il faut bien que je supporte deux ou trois chenilles si je veux connaître les papillons (I must put up with two or three caterpillars if I want to know butterflies.)*.

One of the most common French expressions and also one of the most difficult to translate is *système D* or *se débrouiller*. The French people went through many difficult times during the World Wars, and *Système D* and its accompanying verb *se débrouiller* refer to the resilient French spirit and the ability to get by in the face of adversity. Thus, today when a French person is faced with a bureaucratic problem and skirts the bureaucracy, when a French person fends for himself/herself in a situation in which skill, luck, or help is needed, he/she *se débrouille*, which loosely translated means *gets by*, but *se débrouiller* is more than getting by to the French and an important part of their character.

## 5. VALUES

Values refer to long-enduring judgments appraising the worth of an idea, object, person, place, or practice. Sometimes, our opinions and attitudes reflect deep-seated and fundamental values. While attitudes tend to change, values are long-lasting. Value differences affect intercultural communication. For example, a person may elevate the importance of extra effort and hard work, believing it produces success. But if this person were teamed with an individual who devalues hard work, believing that just getting by is enough and wanting to enjoy life, communication between them would be strained. An understanding of values, therefore, can pinpoint the differences between two individuals from separate cultures. It is worth to approach aspects such as: the value

attached to work, religion, heroes and the socialization of children in the U.S. and France.

### 5.1. HEROES

French political and military heroes range from the medieval Roland to Joan of Arc, from Louis XIV to Napoleon. Now that the French are securely in a democratic environment, they respect the glorious days of France under the Sun King and the sphere of influence Napoleon helped to establish. Twentieth century heroes include Jean Moulin, a Resistance leader killed during World War II, and Charles de Gaulle. Charles de Gaulle is more revered for his call to arms on June 18<sup>th</sup>, 1940, after France fell to the Germans, than for his accomplishments during his presidency. Thus, those who distinguished themselves for the glory of France are honored, while collaborators are viciously pursued even now.

The French value thinkers, artists and writers much more than the Americans. Their national currency features people such as Antoine de St.- Exupéry, writer of *The Little Prince* and war hero, and Delacroix, a famous painter, rather than politicians. The French are proud of their literary and artistic heritage, and intellect is generally placed at a higher value than sports achievements or movie stardom.

After the tragedy of September 11<sup>th</sup> 2001, all the brave people who have helped save so many lives are now genuine heroes for the American people. Apart from them, the Americans cherish Martin Luther King Jr., a fighter for human rights for all races and ethnicities; other important figures in American culture are Abraham Lincoln, Franklin Roosevelt, Colin Powell. Sports figures like Michael Jordan, Jesse Owens or Tiger Woods are particularly admired, and also scientists such as Thomas Edison or John Nash have their place in the American hall of fame. But since American values are known throughout the world, perhaps the most popular American heroes are Superman, Spiderman or other famous actors.

### 5.2. MANAGING THE SYSTEM

The French and the American also value success within their systems. The French both believe in their rules and systems of reward and try to avoid the bureaucracy they have created for themselves. The French educational system systematically eliminates children from future academic preparation. In American schools, one continually has the opportunity to redeem oneself and go to college, but the French are evaluated beginning at the end of middle school and sent to technical schools if they do not perform academically. Since a student cannot attend university unless he passes the *baccalauréat* for which high school is required, being banished to a vocational school prevents a child from pursuing more prestigious careers later in life. In France, the *baccalauréat*, given in June every year, is extremely important to the success of a young person. Each year heated discussions about the subjects of the *bac* and its questions are published in the newspapers for all the France to discuss. Not passing the *bac* is a great shame. The possibilities for political or business achievement are further restricted by the *grandes écoles*, the elite engineering and business schools, for which additional examinations and preparations are required.

### **5.3. SOCIALIZATION OF CHILDREN**

Children in America are becoming increasingly exposed to technology, which deeply affects their socialization process. As the brain of the young child is overstimulated by the new multimedia environment, with its sound effects and grabbing images, the attention span diminishes, causing problems for both children and parents who, in fact, only wanted to offer them the best start in life.

Another relatively new tendency related to the socialization of children in America is home-schooling, which could have a negative impact upon the child's social skills.

In France, children are highly valued, but they are not spoiled. The French believe that their children must learn early that life is not fun. They are disciplined by being shamed for their mistakes and by being rewarded for conforming. By the age of ten, they are

expected to know how to behave in every aspect of life. In the American society, one seeks to find what part of a child's environment caused him/her to act in a certain manner, but in the French society, they try to find the problem within a child's character.

In addition to the behavior training, and seemingly in contradiction to it, the French also teach their children how to evade the rules so that they can defend themselves in society. Not arming a child with this knowledge of *Système D* would cause him/her to be run over in the real world. The French invest a great deal of time in figuring out how to avoid the red tape or annoying nuisances they feel impede their own desires.

### **5.4. VALUE OF WORK**

Americans are renowned for being extremely practical and, over the years, have embraced a genuine cult for hard work. Employees are always willing to work overtime, including on Sundays, and gladly sacrifice their free time in order to be more competitive and efficient.

The French are much less likely to be enslaved by their jobs than the Americans. Although the French unemployment rate is high, the French demand high standards in their working conditions. The slightest dispute is likely to set off a strike. Striking is a nationally accepted tradition that is viewed as a worker's right, and it seems that someone is always on strike in France.

The French have more vacation time than the Americans. The French traditionally get at least four weeks of vacation time a year, while the American average is around two weeks. The workweek has recently been lowered to 35 hours in an attempt to provide more jobs. The French are not lazy, but they do value their leisure time and insist upon it.

### **5.5. MAN'S RELATION WITH NATURE**

As far as religion is concerned, the mentalities of the Americans and the French could not be more different. America is a very religious country and even if this nation adheres to the belief that man is the master of

his own destiny, they also think that everything that happens in the world is part of God's will. Thus, divinity is present in every aspect of their lives.

Although the French nation is Catholic in name, the number of devout practicing Catholics is small. There is separation of church and State, and liberal family policies and practices contradict the conservative Church.

The French, like the Americans, view nature as a force which must be civilized. Voltaire said that we guide nature, but we do not change it. They respect nature and believe that using it must be paid for, but do not consume it as much as the Americans. The outdoors and France's different geological features are highly valued.

## 6. SOCIAL RELATIONSHIPS

Social interaction and family life are aspects that are worth to be discussed within the framework of the American and French society. The spoken and unspoken rules governing everyday interaction pave the way for the more enduring connections called relationships. Relationships are the basic building blocks of social structure. Relationships take many forms. Some are multifaceted (e.g., two people living in the same neighborhood, working for the same company and having many friends). Others are single-purpose (co-workers who never get together outside work). Some relationships involve face-to-face interaction; others are indirect, but they all constitute a strong discriminator between the Americans and the French.

### 6.1. BELONGING

Despite the dissolution of nobility and peasant distinctions over two hundred years ago, the French society is still rather multi-layered. The French live within their social circles and do not move outside of them. They feel that they are bound by history to a certain circle, and that moving outside it is neither worthwhile nor feasible. While Americans like

to believe that everyone can be equal and get along, the French believe in their differences.

Because the French tend to exist primarily within their own circles, they can appear cold at first glance. But as one gets to know a French person, the intimacy of the friendship rivals the intimacy of American friendships. Their relationships are less casual and longer-lasting.

In America, the social class structure is not so rigid, and members of different categories find it easier to interact. Unlike most countries, except at the highest level, it is possible for an American to move up to a higher social class one step or one generation at a time. Immigrants from many countries have arrived by the millions, started at the bottom of the ladder, and within a generation or two have become part of the mainstream of American middle class life.

### 6.2. SOCIAL INTERACTION

In France, greetings are more formal than American greetings. Acquaintances do *la bise*, kissing on both of the cheeks when arriving and leaving. Closer friends may do more sets of kisses and a hug. In business, handshakes are frequent to signal the beginning and end of meetings.

The French generally discuss politics, art, literature, and music together. People are less likely to discuss what they do and do not like to reveal personal information about themselves. Opinions and ideas are more important than personal details. A conversation with a French person is likely to be remembered and appreciated; that is to say that most conversations to the French are meaningful rather than small talk.

Americans, on the other hand, shake hands firmly with each other when first introduced or when they meet again, but rarely when they part (a more European custom). Social kissing, as a greeting, is also sometimes acceptable between men and women who know each other well and between women. American men rarely embrace each other or kiss on both cheeks. Also, Americans can become fairly intimate in a conversation, though controversial subjects like sex, religion, and



politics are often best avoided, at least until one gets a good idea of the views of the people one interacts with.

It is permissible for an American to start a conversation with a stranger, but the conversation should be immediately ended if the person does not seem to want to talk. An accepted conversation starter is *What do you do?* meaning *What do you do for a living?*. *Do you have any brothers or sisters?* is also a safe question. Americans love to talk about their children, and another particularity is that they avoid the subject of death. Some Americans can spend a great deal of time in casual circumstances chit-chatting about astrology.

### 6.3. FAMILY LIFE AND CUSTOMS

As in many Western societies, the French family is changing. There are many broken homes. Domestic cohabitation is much more accepted in France than in the United States. The French are much less puritanical than the Americans and view many of their family values for things such as birth control, abortion, and marriage as outdated.

France does, however, wish to encourage young families, whether they are married or not. The birth rate of France is much lower than that of other Western countries. The World Wars caused an entire generation of low birth rates due to all the deaths of young men. Since 1941, France has offered family allowances in order to encourage the growth of larger families.

The traditional structure of the American family continues to prevail. Yet, over the past several decades, U.S. society has witnessed an evolution in family structure and daily life in many respects because of myriad factors. Single parenthood, adoptive households, step-parenting, stay-at-home fathers, grandparents raising children are but a few of the newer tiles in the mosaic.

## 7. CONCLUSIONS

The theoretical issues related to intercultural differences and communication are analyzed in detail in order to offer a broad and unbiased view of the cultural specificities of the United States of America and France giving possible explanations of the phenomenon that many people nowadays call a *conflict* or a *rivalry* between them.

France has a very sophisticated and elaborate culture that is hundreds of years old, whereas America is a relatively young nation having established a new set of values. The two countries have their own ways of perceiving the world, they sometimes have conflicting values and norms that are specific to each culture.

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## ABSURD SUFFERING FROM EXISTENTIALISM TO POSTMODERNISM

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*My paper treats the absurd suffering as one of the possible definitions for modern life and the theatre of the absurd as acknowledging this new reality. In my opinion, the theatre best defines human identity and the new realities in a fictional context. The Theatre of the Absurd is an expression of human impulses, a response to the cultural and social changes of our epoch. My research deals with reformulations of the absurd in the postmodern context. The main target of my paper is to prove that suffering under various forms is the prominent feature of the theatre of the absurd. Firstly, I deal with the concept of the absurd, the context that stimulated the appearance of the theatre of the absurd, its forerunners and followers. Moreover, I focus on the tragic-comic effects of the absurd. Secondly, I acknowledge different possible ways of interpreting the “absurd”. Thirdly, I demonstrate that suffering under various forms plays the main role in the absurd plays analysed, contemplating some futile ways of salvation from it. My paper also deals with the new forms and theatrical devices to express modern suffering in the theatre of the absurd. In addition, I stress the fact that language, as a way to escape from suffering has its own poetry. Finally, all the arguments lead to the conclusion that suffering characterises the theatre of the absurd and modern life in general.*

*absurd suffering, modernism, postmodernism, theatre of the absurd, tragic-comic, language.*

### 1. THE CONTEXT

In my opinion, the theatre best defines human identity, the new realities of modern life in a fictional context. The Theatre of the Absurd is an expression of human impulses, a response to the cultural and social changes of our epoch.

With respect to the main cause that stirred the appearance of the theatre of the absurd, I find it in the turmoil generated by the Second World War, which led to feelings of loss of hope and meaning. These coordinates are immediately reflected in plays such as those written by Ionesco, Adamov, Genet and Beckett, which present common themes.

Its roots can be traced back in the allegorical morality plays of the Middle Ages. Furthermore, instances of the absurd may be found in Lewis Carol's fantastic stories, the Swiftian novels, in Jarry's grotesque drama *Ubu Roi*. Beckett is part of the French tradition, picking up on the

Existentialism of Sartre, Camus, who established the absurd as literary norm with his *Myth of Sisyphus*. The Dada movement and Surrealism may be also considered the direct forerunners of the theatre of the absurd. In the alien modern world where the decline of religious belief has deprived man of his certainties, the human being becomes estranged from it, feeling isolated and limited. In this context, there is a split between I and the world, which leads to the resulting decomposition, term which prefigures a postmodern reality. In the same respect, Martin Esslin provides a clear definition of the absurd: “Absurd is that which is devoid of purpose. ...Cut off from his religious, metaphysical, and transcendental roots, man is lost; all his actions become senseless, absurd, useless”[1]

There are crucial paths of experiment open in an age when existence itself seems to be challenged and the human subject or identity put in doubt. In this context, Beckett chooses one of the paths namely the Theatre of the Absurd, being in the same time a modernist, Joyce's true heir and a forerunner of postmodernism.

To conclude, I underline that Beckett frees theatre of conventions and it opens the door towards the collective theatre, the theatre of the street and the happening, stirring the minds of spectators to improvise, prefiguring the postmodern theatre.

## **2. FORERUNNERS AND FOLLOWERS**

World War I and World War II caused deep destruction and the loss of human ultimate hopes and definitely brought about a world missing any coherence, a world senseless and disconnected with human life.

In post-war Europe, Dada overwhelmed the streets with Happenings.

In Paris, Dada evolved into surrealism, a development marked by the 1923 performance of Tristan Tzara's "Gas Heart". The Dada collages or montages formed from juxtaposed fragments of reality may be considered a spring for the new style in drama.

In the years immediately following the war, the trend of existentialism is also in fashion. Its philosophy is based on the idea that the universe contains no fixed set of moral codes and each individual is free to create his or her own morality.

The existentialists Jean-Paul Sartre and Albert Camus use the term "absurd" in the 1940s in recognition of their inability to find any rational explanation for human life. The term defines meaningless situations in a confusing, hostile, and indifferent world. Camus literally demonstrates it with the legendary ancient myth of Sisyphus. Camus underlines two aspects of the modern man: the absurd and the revolted man. The Absurd Man is embodied in Sisyphus. "The gods had condemned Sisyphus to ceaselessly rolling a

rock to the top of a mountain, whence the stone would fall back of its own weight"[2]. The playwrights grouped under the label of the absurd convey their sense of bewilderment and anxiety in the face of an inexplicable universe reflecting their emotional perception of an inner reality in their plays. They rely on poetic metaphors in order to trace outward their innermost thoughts. Hence, the images of the theatre of the absurd assume the quality of fantasy, dream, and nightmare, which may be considered a surrealistic heritage. Beckett did not express the problem of Absurdity in any form of philosophical theory his expression being exclusively the artistic language of drama. I may suggest that in "Waiting for Godot", Beckett uses philosophical references for the sake of derogatory purposes, but overall they fit with certain existentialist ideas. Vladimir, Beckett's character in "Waiting for Godot" is a parody of the revolted man, aware of his failure but happy for his apparent freedom. Another main idea of existentialism, which may be discovered in the play, is the limitation of reason. For the purpose of proving the absurd, I focus only on a few symbols which relate to the human perception of the absurd: the rope tied to Lucky's neck or the sand in Pozzo's bag, which visibly stand for the absurd of situation. Estragon's conscience still sleeps, there is no awareness of the absurd for him, only when it is revealed to him by Vladimir. The postmodernists take a position, which is a form of radical skepticism. They adopt relativism as their main doctrine instead of approaching it as a challenge to be answered. In this respect, I may trace this feature in the play *Waiting for Godot*, where from the very beginning space and time are questioned. They are aware that the strange place may not be the one where they are to meet Godot. In addition, tomorrow is uncertain, yesterday turns out to be a disillusionment and the only frail hope for the moment is the present: "Estragon: (despairingly). Ah! (pause.)/ You're sure it was here? / Vladimir: What?/ Estragon: That we were to wait./ Vladimir: He said by the tree. Do you see any others? /Vladimir The

point is- /Estragon Until he comes. /Estragon: You are sure it was this evening?/Vladimir: What?/Estragon: That we were to wait./Vladimir He said Saturday. (Pause.) I think./Estragon: (very insidious). But what Saturday?And is it Saturday? Is it not rather Sunday? (Pause) Or Monday? (Pause) Or Friday?/Vladimir: (looking wildly about him, as though the date was inscribed in the landscape). It's not possible!"[1]

Trying to establish a certain intertextuality in Beckett's play, another postmodern feature applied on "Waiting for Godot", there may be found some common points to Simone Weil's book "Attente de Dieu" and Balzac's "Le Faiseur", the American Clifford Odets' play "Waiting for Lefty", Ionesco's "The Bald Soprano". Martin Esslin traces back descendance for the tramps in Shakespeare's clowns, fools and ruffians.

Moreover, the Theatre of the Absurd had a considerable impact on post-war British fiction.

Beckett's play makes the transition from a more classical way of expressing the absurd, as in Ionesco's play to a postmodern one in Visniec's "The Last Godot". In addition, I may consider Beckett as a father of Postmodernism due to the invitation he makes to readers and spectators to have a creative personal interpretation and to give up any authorial power when experiencing the play.

### 3. TRAGI-COMIC POLARITY OF THE ABSURD SUFFERING

Beckett covered all the tragi-comic of human existence in one play "Waiting for Godot", focussing on the concept of the absurd, as an important dimension of modern life, proving its tragi-comic polarity. I define it showing that in an absurd world, man is estranged from his universe, because he no longer believes in any of the rational schemes that explain it. He is a puppet, a clown who acts ridiculously.

Although apparently the waiting has an object, namely waiting for Godot, it is an apparent purpose, whose tragism hides under the mask of an absurd situation. Two pathetic

clownish figures suffer through an endless wait for the enigmatic Godot amusing themselves with humourous games, religious allusions and clown tricks. Act One is repeated twice as if describing Vico's theory of *corsi e ricorsi storici*. Characters are all chained to each other. They seem trapped and even death is not allowed to them.

Beckett's "Waiting for Godot" may be considered one of the first great modern tragi-comic dramas, tragedy and comedy being mixed in a dramatic illustration of the human condition and absurdity of existence. A blend of seriousness and sarcasm emphasises the two dimensions of the play tragic and comic.

Although considered anti-heroes in comparison to the ancient tragedy, they still keep a heroic dimension that is undermined by the comic tones of the play.

Pozzo laughs to see that Estragon and Vladimir are of the same species as himself, "Made in God's image!"[1] Moreover, the final promise of salvation, Godot's coming is comically undercut by the dialogue about Estragon's fallen trousers.

The theme of ambiguity, another source of the modern tragism, seems to be the ruling motif of the play revealed in "nothing is certain when you are about" [1].

Vladimir and Estragon may be considered tragic characters because they assume in a way their fate. There is no sense in the world, but man should accept this nihilism and assume it trying to recreate the lost harmony of mankind.

Tragic instances are obvious in the play. The two tramps collapsing in a heap, incapable of rising seem to symbolize the fall of man if taking into consideration the biblical allusions that link the characters with the Christian doctrines of fall and redemption. The tragic comes out of their impossibility of rising, their impossibility to achieve redemption. The modern man seems to be best described by this reality, being the puppet, which has a tear on one cheek and a large smile on the other.

### 4. SUFFERING –PROMINENT FEATURE OF THE THEATRE OF THE ABSURD

In close connection to the concept of the absurd, I study the rather common subject of suffering. I try to define the concept taking into account the fact that the theatre of the absurd discloses completely this aspect of the human existence.

Suffering is the way in which man perceives his existence. It might be a remedy to our impurities, such as Baudelaire defined it in "Spleen et idéal". Or it defines the "dependent origination" according to some fundamental concepts of Buddhism regarding the origin and perpetuation of existence and suffering. It explains humanity's imprisonment in an endless cycle of lives, all of which entail pain.

In "The Genealogy of Morals", Nietzsche explains his understanding of suffering, that man was surrounded by a fearful void -he did not know how to justify, to affirm himself; [6] he suffered from the problem of his meaning. His problem was not suffering itself, but that there was no answer to the crying question, Why do I suffer? Man, the most accustomed to suffering does not repudiate suffering at such; he desires it, he even seeks it out, provided he is shown a meaning for it, a purpose of suffering. Nietzsche observes that the meaninglessness of suffering not suffering itself, was the curse that lay over mankind so far. Thus, the tremendous void seemed to have been filled with a fresh life-destructive suffering: it placed all suffering under the perspective of guilt.

Another possible representation of suffering is the absurd Sisyphusian struggle towards the heights. In his suffering, an absurd image of the Christian *via dolorosa* "One must imagine Sisyphus happy." [2]

Suffering plays the main role in "Waiting for Godot" and even if it wears different masks, it is overwhelming. As a proof, I examine the sources of both moral and physical suffering in the play "Waiting for Godot", such as: the hopelessness of living perceived by means of vain waiting, the timelessness and the characters' immobility, the split between the intellect and the body, the futile struggle to assert existence, identity and meaning, the

damnation and repentance for being born, man's persistent loneliness in a universe dominated by the loss of guiding light, the arbitrariness of human life and thinking, the awareness that makes their existence even more tragic. Some possible ways of avoiding suffering may be grasped, but all prove futile in the context of the play. I also question the nature of the mysterious Godot, suggesting that he is just another spring of suffering for the characters, in the same time their refused salvation and the only certainty in their life.

Beckett's hero is a Sisyphusian type of man waiting for the fulfilment of his fate, which seems to be eternal through his suffering and hoping. He is alienated from the world, which is unknown, remote, and indifferent, and from which he is isolated. Vladimir and Estragon are in an open empty road surrounded by the natural world, but unable to move on. "Estragon: It's not worth while now. (Silence.) Vladimir: No, it's not worth while now. (Silence.) Estragon: Well, shall we go? Vladimir: Yes, let's go. (They do not move.)" [1]

Beckett's characters are creatures grounded in Absurdity; there is no meaning in their existence, which is why their lives involve mere waiting for the end, for death. Their waiting is a never-ending fate having no purpose, but an unique aim -the end. But I may trace the whole greatness of Beckett's absurd man in his stubbornness, with which he continually fills up his precarious fate, and although his suffering increases as time stops he copes with his absurd life, without cursing or crying. The absurd man misses any hopes, plans, and troubles about his future. The only way to paralyse absurdity is to not ask for reasons. These moments of consciousness open up the world of the absurdity, the world of never-ending effort to go on, the world from which it is impossible to escape, the world of estrangement, loneliness, waiting, and continual endurance. "Estragon: Nothing to be done/Vladimir: I'm beginning to come round to that opinion. All my life I've tried to put it from me, saying, Vladimir, be reasonable, you haven't yet tried everything. And I resumed the struggle." [1]

The motif of time and waiting for is the absurd tragedy of Beckett's character in the play. Waiting is the absurd symbolical definition of existence. Beckett's characters are expelled from the stream of successive life events, which create the illusion of a flux of time, and stop in one single moment, which opens up the static world of absurdity.

### 5. THEATRICAL DEVICES EXPRESSING THE ABSURD SUFFERING

In "Waiting for Godot", the playwright violates the conventions of realism and breaks the coordinates of chronological time, coherent plot or setting. Firstly, I allege the modern innovations in Beckett's play: the structure of the play. In this respect, Beckett's play is a closed composition, characters finish in exactly the same positions as in the beginning. Nevertheless, Beckett's puppet-characters do not achieve an ending. This is reflected in the temporal setting and the lighting specified for the play, half tones, and rather a neutral state of non-darkness. In addition, there are some modern theatrical devices: the sound effects, the lights and the setting and the interesting metatheatrical technique. Furthermore, I try to explain the minimalism or the narrowing down of Beckett's *mises en scène*, the poor scenery that may be interpreted as a parody of a stage-set dramatic development. Beckett substitutes the image for action and that is why I notice a lack of visual images corresponding to scarce stage directions. Moreover, I express my opinion that Beckett put on the stage an internal psychological reality. Even if there is no direct interaction with the public, the way that the audience reacts after the first contact with a performance of one of Beckett's plays may be understood as a source for an inner dialogue.

The dialogue becomes external, namely a communication actor- spectator, which will be experienced later by the Happening Theatre.

### 6. FORM AND LANGUAGE- ATTEMPTS OF SALVATION FROM THE ABSURD SUFFERING

"Waiting for Godot" is such a complex play that it encloses a world in itself, a universe full of poetry, which uses this apparent common language in order to voice absolute truths.

As I consider that new realities, new definitions of suffering oblige to new forms, I express the personal view that the form of the theatre of the absurd best suits the awareness of suffering of the modern man. The play "Waiting for Godot" lacks plot and is devoid of narrative content. It does not tell a story and it explores a static situation. "Nothing happens, nobody comes, nobody goes, it's awful" [1]. The shape of the action contradicts the idea of shapelessness that bothers the characters. Everything tends to come in doubles giving the feeling that existence may be a void.

"Waiting for Godot" has a structure which never overpasses the simple factual assertions and haunting questions which it makes. It is like an initiation trip within this limited circle and in the same time limitless. Initiation is impossible because of the boundaries of human abilities to seize the unknown, but even the awareness of one's absurd repetitive suffering, reflected in the obsessive form may be understood as an initiation.

The New Theatre does not speak about human anxieties, but it shows them on the stage by means of décor, lightening, costumes and other technical devices, which have a communicative function, doubling the text. Vladimir and Estragon, like all human beings exist in a set of circles, circle of time, of space, of language. Within the cage of the circle their possibilities are limited: they are born, they live and die, but they resist these facts recreating and creating meaning. The

basic dramatic and human tension, the inner suffering is reflected in the décor. It presents only the bare boards, a desolate country mound and one tree, which is the only form of life in the landscape.

In my opinion, the whole stage seems to be the mirror reflecting the inner mental world of the characters, who organically belong to it. Moreover, the décor mirrors a universe of lonely people, as if they were the survivors of a cataclysm, which proves man's incapacity to stop in his rush in order to breathe, to feel the background where one lives.

First, I demonstrate that there may be poetry even in an absurd play, hidden in common disconnected sentences or fragmentary inconsequence. In addition, I show that there is a mixture of lyrical and prosaic tones in the play, which may render at the language level the opposition between form and chaos.

The referential and perceptual powers of language are subject to self-cancellation, questioning, destroying and deconstructing itself, in very postmodern terms. The "nothing with which to express"[1] may be understood as the incapacity of language to render the truth of being. Beckett attempts to create a new way of expression a new language of drama or rather a non-language, which refuses the conventional rules of both grammar and meaning. Beckett questions the nature of language, the status of the word, the basis of the fictional act itself, the status and powers of imagination to imagine. The first impression when reading the play is the simplicity and concreteness of language. This loss of normal language usage gives rise to the confusion, because the dialogue loses its function of information. It is a simulated dialogue, which proves the gap between human beings, wherefrom suffering arises. The dialogue does not say anything about the characters. It proves their inner void. It may be compared to the dialogue of deaf people. The boy, Godot's messenger communicates pure words without providing with complete facts. Language is useless in establishing contact but it gets the action down to zero. It is the counterpoint of action.

Characters' language is repeatable, interchangeable. It consists in the theatricalisation of language of a circus performance in order to stir new emotions.

Language masks the vacuum of life and it is a way of overcoming the silence refuge in order to forget the anxieties and sufferings.

## 7. CONCLUSION

"Waiting for Godot" is a play that captures the feeling of the absurd and characterizes it with archetypes that symbolize mankind and its reactions when faced with this reality of the modern world.

I may finally express my conviction that Beckett teaches his readers and spectators the lesson of the absurd of human existence when dealing with the position and the situation of the suffering Man in his surrounding world. He wants to prove the fact that even before being born, Man is the subject of a state of barrenness and of pain, subject of the agony and darkness of living, hardly surviving the feelings of entrapment and suffocation. As a conclusion, I may state that through their suffering, patience and often hilarious wit, Beckett's tramps transcend themselves to become a portrait of the suffering of mankind itself. They are memorable characters, who continue to live and breathe at the level of theatrical existence. There are many possible interpretations for the absurd suffering, but Beckett refuses them leaving everything open, a concept classicized by Umberto Eco's notion of *opera aperta*.

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## RELIGION – AXIS OF COMMUNICATION IN THE EUROPEAN SPACE

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**Abstract:** *The studying of religion in school is necessary because the history of the human civilization and culture stands under the sign of the supernatural. We are lead to this conclusion by the information offered by the literary and archeological sources. Even in modern and contemporary times religion does not disappear on the contrary it dissimulates in different forms. Religion in a pluralist society is subject to all kinds of aggressions, may induce a feeling of balance, security, and certainty in the communities, it can be the key to legalize some social-cultural structures, it can become the most efficient way of knowing “ the other one” and of cultural dialogue , but in the same extent , it can be a source of evil , if it is not kept in account the values of other ethno-cultural entities.*

**Key Words :** *religious education , education , attitudes , public schools , culture.*

We live in a world increasingly secular where religion can't find its place at a first glance and where questions as : “ *What can religion tell them? “ , “ Why those who think differently are damned ? “ “ Why does God accept evil in the world ? “ etc. are still frequently asked by the believers or not believers... At a time they talked about the disappearance of the sacred and by extension of the religion because of the progressive-rational of the human society in modernity and post-modernity, with visible effects on the capacity of the individual to adapt to a social order all the more complex<sup>1</sup>. The Answers that were given by the leaders of the diverse *iclesia* to these questions were not up to the expectations of the public opinion. They were received with reservation because they were made by persons belonging to different areas of etno-culture, each one of these generating a system of values, of own mental structures and forms belonging to some groups, communities .*

One thing, can't be contested, as long as in the discussion does not intervene the compulsion, the catechization and the proselytism . And forth the role of religion that

can generate, no matter the historical period, a dialogue between men, in order to integrate the individual persons in society and to build bridges between different cultures and civilizations . This fact is true even in the contemporary period when we see that the diverse forms of religiousness are understood as a manifestation of “*propensity of the human person for the village “* are more present<sup>2</sup> .

### Religion – Path to promote intercultural dialogue

As a social phenomenon, personal, and cultural, religion is characterized to be “*a necessity of human nature, because through the relevant truth man is by definition a religious being that finds it's existential condition only in a strong communicative relation with God. In other words, every human being has a religious predisposition, which is manifested and improved or on the contrary, it is ignored to the detriment and unhappiness of those involved*”<sup>3</sup>. If we accept this point of view, the religious education becomes a major component of the spiritual

<sup>1</sup> Elena Ghiorghiu, *Religiosity and Christianity in post-communist Romania, Romanian Sociology*, Vol I, nr 3/2003, p.105.

<sup>2</sup> *Ibidem*, p.106.

<sup>3</sup> <http://noinu.rdsj.ro/article.php?articleID=40>

formation of man, which requires the assimilation of a set of moral values and operating in the day by day life with notions that cling to the religious culture. Otherwise, this form of education can be considered a way to know the historic past and the cultural values made by religion, to promote human rights on the basis of the values and attitudes that this proposes<sup>4</sup>.

In some EU countries, the Church still enjoys some real prestige, owed, in part, to her major contribution to building European culture<sup>5</sup>, in spite of the fact that in text of the latest European constitution this fact was not stipulated<sup>6</sup>. Even in these conditions, nothing can stop the European institutions to appreciate and to want to value the cultural patrimony that each member state can bring into communion.

Europe is a space of universal values and multiculturalism<sup>7</sup>. In this time, Christianity, the dominant religion of the continent makes in a world marked by religious pluralism, which supposes the equal right of all religions to exist and to manifest, in the limit of the European community legislation. In other words on the basis of this principle of equality, Christianity becomes a religion like all others, obligated to billet specially in the sphere of private life, without

<sup>4</sup>Jane Erricker, *Reconstructing Religious, Spiritual and Moral Education*, Routledge, 2000, pp. 5-8; A. Wright, *Spirituality and Education*, Routledge, 2000, pp. 7-11; idem, *Religion, education and post-modernity*, Routledge, 2003, pp. 3-7; G. Rummery, *Catechesis & Religious Education in a Pluralist Society* (<http://203.10.46.30/mre/symp/rummery.pdf>).

<sup>5</sup> Cf. M. Merle, *Religion, étique et politique en Europe: essai de problématique*, en *Religions et transformations de l'Europe*, sous la direction de Gilbert Vincent et de Jean Paul-Willaime, Presses Universitaires de Strasbourg, 1993, pp. 58-65 (<http://orthodoxero.typepad.com/bor/2007/07/uniunea-europea.html>).

<sup>6</sup> <http://europaindirect.ecosv.ro/constitutia.htm>;

<sup>7</sup> N. Blake, P. Smeyers, R. D Smith, P. Standish, *The Blackwell Guide to the Philosophy of Education*, Blackwell Publishing, 2003, pp. 146-148; [http://www.uv.es/sfpv/congressos\\_textos/congres13.pdf#page=8](http://www.uv.es/sfpv/congressos_textos/congres13.pdf#page=8).

admitting its immense merit in respect to the definition of European identity<sup>8</sup>.

The study programs put a accent on multicultural aspect and on knowing the cultural dowry belonging to the etno-entities that populate the European space.

It is not surprising that within this social-political orientation that is being built in this period religion plays an important part. So, in almost all the EU countries she is a part of the curriculum<sup>9</sup>. How can this situation be explained? Simple. In front of the new challenges of the modern world, especially in front of fanaticism, racism<sup>10</sup>, terrorism<sup>11</sup> and religious extremists, the last one is induced by interference by the diverse *ethnos*, the European educational systems take into consideration new approaches, based on growing the role of religion in the life of the community.

### Religion as axis of communication and the formation of personality

Along with time the dialogue relationship between education and science has intrigued the interest of teachers, philosophers, theologians, men of culture, and in general all those interested about this problem, because both fields are interconnected: *in education religion is necessary for the multitude of contributions*

<sup>8</sup> Cf. T.Tia, *Elements of Pastoral Mission for a post-ideological, society*, Alba Iulia, Ed.Reintegration, 2003, pag.45-47.

<sup>9</sup> [http://www.amosnews.ro/PF\\_Daniel\\_Predarea\\_religiei\\_in\\_sistemul\\_de\\_invatamant\\_public\\_un\\_act\\_de\\_dreptate\\_si\\_o\\_necesitate\\_permanenta\\_-237626](http://www.amosnews.ro/PF_Daniel_Predarea_religiei_in_sistemul_de_invatamant_public_un_act_de_dreptate_si_o_necesitate_permanenta_-237626); *Digest of Strasbourg Case.Law relating to the European Convention on Human Rights*, vol. 5, Council of Europe, C. Heymanns Verlag K. G. Koln, Berlin, Munchen 1985 ([www.see-educoop.net/education\\_in/pdf/religija-javna-sola-rmn-t07.pdf](http://www.see-educoop.net/education_in/pdf/religija-javna-sola-rmn-t07.pdf)).

<sup>10</sup> M.Ventura i Oller, *Etnicitat i racisme*, *Revista d'etnologia de Catalunya*, 1994 Núm. 5, pp. 130-133

<sup>11</sup> D. L. Horowitz, *Ethnic groups in conflict*, University of California Press, 2001, p. 3; Sylvia Preuss-Laussinotte, *L'Union européenne et les technologies de sécurité* (<http://www.conflicts.org/index2142.html>).

that it brings to the formation of human personality, cultural initiation, and a good preparation for a good social insertion, and in religion education is necessary because faith is oriented in a explicit way towards formation<sup>12</sup> ‘ ‘ .

In this context we wish to underline the position adopted by the authorized institutions in regard to the presence of religion in the Curriculum, they have admitted the idea that an integral education presupposes besides the intellectual, moral, esthetic, technological, professional, physical, sexual, sides also a religious component, with the objective the general knowledge and appropriate use of the religious language and values, the consolidation of a moral-religious behavior and the assumption of a religious identity. On the basis that people report themselves to reality in a pragmatic way not only through reason, will , and action but also through faith is tracked the realization of some favorable social reports through the capitalization of the potential of all the members of the collectivity, accepting the fact that no educative system can't achieve plenitude, in such conditions as the marginalizing or the omission of one of the basic components. This is why it was permitted the utilization of some diverse methodologies in religious education, that will keep into account the particularities such as the pupils age and the necessity of choosing and adequate preparation of people in this domain.<sup>13</sup>

The formation of human personality is not only a long term and complex process, but an individual and social one, that implicates also the influences made by

culture<sup>14</sup> and society on each and every individual . Each society has a social-cultural model that in one way or the other influences the conduct of men. In these conditions, individuals obey either willingly or through force to some imposed cultural models that shape the way they think and the way they interact with the other members of the community. The sociological and anthropological literature show us that most times the space field of conduct is not given to the guy in the physical sense but in the cultural sense, on the grounds that his physical environment is entirely cultural in report to the society in which he belongs . As a consequence each guy adapts and manifests differently in the same physical environment<sup>15</sup>. During the discussion about how personality is formed we must not omit the social context that religion takes in some historical stages. We wish to highlight this problem knowing that religion has created that *forma mentis* that has made its mark on the everyday life of the members of the community .

The Historical evolution shows us that the traditional societies had some religious link that made a more close connection, even personal of homo religious with divinity while in the modern and post-modern societies we

<sup>14</sup> A. Prevosti, *Comparació de les estratègies de l'evolució biològica i l'evolució cultural*, Revista d'etnologia de Catalunya, 1994, Núm. 5, p. 29:“*La cultura és un patrimoni social - de grup - que porta informació en part codificada i en part no, en que el component que porta la informació codificada té un paper molt més passiu en l'evolució del sistema i està molt més laxament lligat als individus humans que en són usuaris, que no pas el genoma. Per això, el destí evolutiu de les cultures no està sempre lligat al dels grups biològics que en són usuaris en un moment determinat*”.

<sup>12</sup> [www.unibuc.ro/.../REZUMAT.teza\\_doctorat.pdf](http://www.unibuc.ro/.../REZUMAT.teza_doctorat.pdf).

<sup>13</sup> Ch. Haynes, *Finding Common Ground: A First Amendment Guide to Religion & Public Education*, Diane Publishing, 1997, p. 297; R. M. Hare, *Essays on religion and education*, Oxford University Press, 1998, p.V (Preface); W. A. Nord, *Religion and American Education: Rethinking a National Dilemma*, UNC Press, 1995, pp. 2-3, 16; W. Jeynes, *Religion, Education, and Academic Success*, IAP, 2003, p. 233.

<sup>15</sup> E. Durkheim, *Rules of the sociologic method* trad. rom. Dan Lungu, Iași, 2002, p. 31; Maria Jesús Buxó Rey, *Natura i cultura: els paisatges de la mundialització i l'etnicitat*, Revista d'etnologia de Catalunya, 1994 Núm. 5, pp. 78-87; R. Folch, *L'espècie humana: igual, però diferent*, Revista d'etnologia de Catalunya, 1994, Núm. 5, pp. 54-61.

see other religious patterns<sup>16</sup>. The result was that the religious impact on society was a gradual one, differently influencing not only politics, justice, the economy<sup>17</sup>, morals and culture but also the social behavior of men. So in the context of modernity the role of religion decreased and lead to a crisis of individual existence<sup>18</sup>. The solution to this grave problem would be in the opinion of some specialists the task of religion<sup>19</sup>. She would also have the task to prevent the appearance of conflicts through the intensification of dialogue between diverse ecclesia<sup>20</sup>. As to the matter of morality, the essential component of human personality we can say that it is manifested in the relations of a guy with the other members of the community. It can be modeled by religious education<sup>21</sup>, although “*thinking and the religious activity have not spread uniformly in the mass of believers*”<sup>22</sup>.

### Is religious education a mixture of the religious in the public space?

<sup>16</sup> Elena Iulia Gheorghiu, *op. cit.*, p. 104.

<sup>17</sup> See the differences between the economic development of Catholic, Protestant and Orthodox states etc.

<sup>18</sup> *Ibidem*, pag. 106

<sup>19</sup> *Ibidem*.

<sup>20</sup> For example the representative of the Russian Church pr. Vsevolod Ciaplin has stated that in order to keep interconfessional peace and in order to efficiently fight religious and ethnic extremism the citizens must enjoy a good religious education

(<http://www.ruvr.ru/main.php?lng=rom&q=1273&cid=298&p=01.02.2008>); Vezi și J. Fox, *Religion, Civilization, and Civil War: 1945 Through the New Millennium*, Lexington Books, 2005, pp.22-23; Monica Duffy Toft, *Religion, Civil War, and International Order* ([http://belfercenter.ksg.harvard.edu/files/toft\\_2006\\_03\\_updated\\_web.pdf](http://belfercenter.ksg.harvard.edu/files/toft_2006_03_updated_web.pdf)).

<sup>21</sup> Jane Erricker, *op. cit.*, pp. 10-11; Elena Iulia Gheorghiu, *op. cit.*, p. 108.

<sup>22</sup> E. Durkheim, *Elementary forms of religious life*, trad. rom. by Magda Jeanrenaud și Silviu Lupescu, with an introductory word by Gilles Ferreo, Iași, 1995, p. 18.

We can't talk about at this time about a unique European model on how to accomplish religious education. On the contrary, there is much concern about the identification of some common value models of approaching this kind of education (to learn religion – learning into religion; to learn about religion; to learn from religion – learning from religion), that will keep into account the openness towards multi culture, ecumenism and inter religiosity of the contemporary society<sup>23</sup>. After this introduction into context we wish to approach as follows the relationship between religion and education in the public school system, having as a milestone the separation of the State from the civil society. From the specialists that have examined the problem the study of Zdenko Kodelja, *Religion and education in public schools*. In his opinion the solutions proposed in the case of the relationship between religion and education in public schools gravitates around the existence of a balance between the State and the Church that will keep into account the historical evolution and contemporary social-political reality. He describes this link starting from the existence of certain models: 1 - a relationship of consonance (Italy, Austria, Germany); 2 - a relationship where the Church belongs to the State (Great Britain, Sweden, Norway) or confessional state (Greece); 3. A relationship where the State and Church are separate. Among the countries were the demarcation line between the Church and the civilian society, also known, as the civilians is understood as the neutrality of the state in problems of a religious nature (SUA, France, Slovenia)<sup>24</sup>. He has also undergone

<sup>23</sup> [www.unibuc.ro/.../REZUMAT.teza\\_doctorat.pdf](http://www.unibuc.ro/.../REZUMAT.teza_doctorat.pdf)

<sup>24</sup> [www.see-educoop.net/education\\_in/pdf/religiija-javna-sola-slo-rmn-t07.pdf](http://www.see-educoop.net/education_in/pdf/religiija-javna-sola-slo-rmn-t07.pdf). For more details also check W. A. Nord, Ch. C. Haynes, *Taking Religion Seriously Across the Curriculum*, ASCD, 1998, p. 6; [http://www.eua.be/eua/jsp/en/upload/Transatlantic\\_Dialogue\\_2003.1129208931860.pdf](http://www.eua.be/eua/jsp/en/upload/Transatlantic_Dialogue_2003.1129208931860.pdf); J. Boussinesq, *La laïcité française*, Seuil, Paris 1994, p. 128, 135-136; A. Boyer, *Le droit des religions en France*, Presses Universitaires de France, Paris 1993, p. 155; P. R. Hobson, J. S. Edwards, *Religious Education in a Pluralist Society*, Woburn Press, London 1999, p. 142.

the process of analysis a few elements with a large spiritual load present in some public schools ( icons, crosses, the star of David , the Islamic shall etc ) and he observed that the religious holydays are approached in a secular fashion, the religious marks can be used only has study material, their permanent exposure, of religious symbols can be or not constitutional, dramatic literature must be presented “*in a neutral and objective manor ( from a religious point of view), with the purpose of realizing the educational objectives*”, and the freedom of the teacher to show his religious membership is restricted in some countries by the liberty of conscience of the students and the rights of the parents of education on the children<sup>25</sup>.

In Romania, after the fall of the communist regime religion was introduced in the education plan after vivid talks<sup>26</sup>. It a decision of political education, that was not accompanied by preparatory measures. Nicolae Stoicescu Minister of the Cults ( January 1990) together with the members of Holy Synod of the Orthodox Church had the initiative of the studying of religion in public schools. It was agreed that at the beginning they will have into view the promovation of a system of optional classes in the pre-university cycles without the grading of pupils, and the school program had the gift of offering an alternative to the atheist humanism .

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C.Buonaiuti, *Chiese e Stati, La Nuova Italia Scientifica*, Roma, 1994, p. 86; J. Hitchcock, *The Supreme Court and Religion in American Life: From "Higher Law" to "Sectarian Scruples"*, Princeton University Press, 2004, pp. 142, 145. Jane Erricker, *op. cit.*, pp. 15-19.

<sup>25</sup> [www.see-educoop.net/education\\_in/pdf/religija-javna-sola-slo-rmn-t07.pdf](http://www.see-educoop.net/education_in/pdf/religija-javna-sola-slo-rmn-t07.pdf).

<sup>26</sup> On point 3 it is stated that „ moral and religious education- put an accent on the historical and cultural elements (...) Creating the teaching programs will be made in an irenic spirit and keeping into account the principles of common life in a modern state”, and on point 2 it is mentioned that religious-moral education is an object of study and has the stature of an optional discipline [http://www.proeuropa.ro/norme\\_si\\_practici2.html](http://www.proeuropa.ro/norme_si_practici2.html).

Religion was officially introduced in the school *Curriculum* , having the optional status, with an ecumenical content, through a Protocol signed at 11.09.1990 between The Science and Education Ministry and Secretary of State for cults<sup>27</sup>. Religion textbooks did not exist, specialists in the field, and religion classes had a pretty uncertain status, being held by the representatives of the clergy . The effects were seen immediately . Reactions from the civil society that had just appeared, from the Romanian Orthodox Church, and of other cults recognized by the Romanian State.

With time, significant progress was made in regard to religion classes, their position in the school program, the favorable attitude of the pupils towards religious education in schools etc. Most of the students agree about the current status of the Religion class: compulsory discipline in the education plan, part of the common trunk ,with the possibility of dispensation from the pupils, having the parental explicit accord . The pupils and the teachers agree that this status is the most adapt to the specific Romanian education system<sup>28</sup>.

Unfortunately, at this date, the religion class is being taught in some places by some teacher without pedagogical training, or worse, unqualified supplemented by the lack of elaborate textbooks for all the classes that want to respect the school program effectual and the inexistence of a document of political education to research the problem of religious education in public schools in Romania, from a capable manor to overtake the limits of a subjective and superficial approach, according to this is just a simple study object like other objects.<sup>29</sup>

The approach from a mono-confessional point of view of religious education has made that the accent to fall, especially, on the dogmatic contents, the formation of an own religious identity and

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<sup>27</sup> *Ibidem*

<sup>28</sup> [www.see-educoop.net/education\\_in/pdf/religija-javna-sola-slo-rmn-t07.pdf](http://www.see-educoop.net/education_in/pdf/religija-javna-sola-slo-rmn-t07.pdf).

<sup>29</sup> *ibidem*

through the values system promoted by every cult recognized by the Romanian State, protecting the problem that students shouldn't be formed in the spirit of tolerance towards those of another confession. It would be, ideal in the opinion of the specialists that pupils during the religion class they should auto-evaluate themselves in report to the Christian values. Otherwise said, the weight center should be moved from the simple information towards the practice by the pupils of what they studied in religion class.<sup>30</sup>

In recent years some complaints were registered in regard to the in-observance of the laic character of the Education in Romania, that come from a certain part of the civil society. Those that do not agree with the teaching of religion in public schools make a series of critics that target the danger of indoctrination, the tribulation implication of the religious in the sphere of the laic, and they put under a question mark the actuality of the religious values in this age<sup>31</sup>. It was kept in regard the magnitude that it took after 1989 the phenomenon of building some places of worship, that would effect in the opinion of some civilian associations, the liberty of conscious of Romanians<sup>32</sup>. Guilty for this situation would be the Romanian Orthodox Church. For example, The Association "Solidarity for the freedom of the conscience" say in a Raport (*The construction of places of worship after 1989 and its impact on the liberty of conscience and the secularization of the state*) that through the good collaboration with the Romanian state, "through the influence exercised on the local and central authorities, and through the penetration exclusively of some public institutions ROC threaten the liberty of faith and anole any claim of the authorities towards the inter confessional neutrality<sup>33</sup>.

According to their own estimates made by the association in the interval starting

1990 until 2004 there were built around 2000 churches, and 1000 being in construction. Among the cults officially recognized, The Pentecostal Church is touched by a building momentum. In this case the phenomenon is a normal one because the number of worshipers has grown, and the necessity of building of some new places of worship is acute. But what is troublesome in the vision of the society is the visibility of the Orthodox places of worship, whose religious identity can't go unobserved to which we can add the invasion of the few public spaces (Parks, playgrounds). The utilization of some exterior speakers makes, that on one hand the persons that wish not to take part at the religious manifestations to be bothered, and on the other hand the Orthodox message is promoted in inactive social environments from a religious point of view<sup>34</sup>. Another complaint of the Association "Solidarity for the freedom of conscience" targets the virtual monopoly of religious assistance held by the Romanian Orthodox Church in institutions such as the Penitentiary systems, army, hospitals, schools, high-schools, Universities, that would lead to the abandonment of some principals regarding the religious neutrality and the guarantee of the freedom of conscience of the persons guaranteed by the *Constitution*. To this is added another grave act. Which is the financing of these worship places from public funds, on the grounds that their own resources or the contribution of the worshipers would be insufficient. By far, the most important "income source was the giving of public space in free use for the building of places of worship, practice with a juridical status which Is controversial and whose beneficiary was ROC. Only in Bucharest the orthodox cult received 80.000 square meters of space, property of the mayor's office (1300000 square meters if we take into account the space given for the building of the Cathedral for the Redemption of the Kin). Even there where the authorities went the natural way of conceding of space instead of giving space in

<sup>30</sup> *ibidem*

<sup>31</sup> *ibidem*

<sup>32</sup> See the Report from 28 of march made by the The Association "Solidarity for the freedom of the conscience" (<http://www.humanism.ro>)

<sup>33</sup> *ibidem*

<sup>34</sup> *ibidem*

free utilization, the sums were in general very low”<sup>35</sup>.

Another Report belonging to the same Association was consecrated to the research of religious education in the schools of Romania (15 February 2006)<sup>36</sup>. From its contents results the following : 1. – from over 15.000 schools visited by the association at the beginning of the school year 2005-2006 , in over 90% religious services were held ; 2.- The optional factor of religious education was broken through a ministerial decision<sup>37</sup>; 3.-

<sup>35</sup> *ibidem*

<sup>36</sup> *ibidem*

<sup>37</sup> *Ibidem*. The relationship between religion and education was made through the Law number 84 from the 24 of July 1995 – The law of Education-modified and republished in 1999. See: “ art 9 (1) the school plans for the first grade to gymnasial , high-school, and professional include religion as a discipline in the common trunk. The pupil with his parents accord or its legal guardian can choose the study of religion and confession. (2) To the written request from the parent or the legal guardian the student may not attend religion class. In this case the school situation is closed without this subject. In a similar way is dealt with the students with objective reasons where not assured the conditions for them to attend this class.” It was published in the M.O nr 606 from the 10 of December 1999. In its original version from 1995 , in art. 9, par. (1), second sentence, religion was regulated as a compulsory subject for primary education, optional for secondary education and optional for secondary education and vocational training. " This version takes displeased some Romanian parliamentarians. On June 25 1995, 57 Members have asked the Constitutional Court on the unconstitutional provisions of articles of the Law on Education. Decision 72/1995 on the constitutionality of certain provisions of the Law on education, although mentioned in the law itself was stipulated very clearly that no religion should be understood as a compulsory subject. In order not to create confusion regarding the interpretation and application of this decision was that this discipline is binding only in its introduction into the plans of education, religion and confession remains to be chosen or not. Constitution Court decision was published in MO, no. 167 of July 31 1995. In the amended and re-education of Law in 1999, although they were eliminated provisions that would support the discipline required of religion and the status of the optional subjects, the discipline of religion remained unclear, it listed as mandatory (part of the common trunk art. 9, paragraph 1) but with the status of optional (student may not attend classes in religion, art. 9, paragraph 2). Also, no status optional subject for Religion, is not sufficiently clarified whereas "the option not to attend

Some abuses were made over pupils during the Orthodox religion class. 4.-the religion teachers had a ethno-nationalist attitude; 5- the presence of religious symbols in schools can't be ignored; 6.-the not knowing and the lack of interest shown by some public authorities that have a say in the matter of religious education is embarrassing; 7.- Some gestures were made in order to pressure, threaten and victimize : opposition to the research of the situation in the religious education in Romania<sup>38</sup>.

The conclusions made by the authors of the two reports have upset the Romanian Orthodox Church, believers, and some politicians. In a few years time professor Moise Cernea fought against the presence of religious symbols in public schools . His

this discipline is not subject to the discipline of choosing another package of optional subjects in the curricula, which can - according to art. 9, par. 2 - completion of the school without discipline, which gives the discipline and the optional ". To these are added and two acts of law which are proof of intention Minister of Education and Research to cancel the voluntary nature of religion. See Order no. 3670/17.04.2001cu on the implementation of the framework for school education in the school year 2001-2002 has the following: "(...) Taking into account the fact that education in Romania should contribute to the formation of the pupils of a personality, active and motivated creative, capable of choice and decision, the Minister of Education and Research provides: "(...) Art.5. According to art. 9 of the Education Act, "plans framework of primary, secondary, higher and vocational education include religion as a school, part of the common trunk . Learner, with the consent of parents or legal guardian established, choose to study religion and confession. At the written request a parent or legal guardian established, the student may not attend at religion. " In this last case, the student will choose, instead discipline Religion, an optional subject. "Order no. 5718/22.12.2005. by Article 14 lays down: "In accordance with art. 9 of the Education Act 84/1995, republished, with subsequent amendments, "(1) Plans framework of primary, secondary, higher and vocational education include religion as a school, part of the common trunk . Learner, with the consent of parents or legal guardian established, choose to study religion and confession. (2) At the written request of parents or legal guardian established, the child can not attend classes in religion. " In the latter case the student shall elect, in lieu of discipline Religion, an optional subject. " See also E. Moses, church-state relationship in terms of religious education in public schools in Australia, in JSRI • No.7 Spring 2004 pp 77-100.

<sup>38</sup> <http://www.humanism.ro>

gesture was condemned by most of the public opinion. The Politicians chose the side of the Romanian Orthodox Church for very simple reasons. The supreme argument was that from 1990 until today in all the polls that measure the people's trust the Church and the Army hold the first two places. In this context the historical tradition was invoked, respectively the good collaboration between the Church and the State.

From the sphere of European religious education Russia and Turkey can't be omitted. We start our analysis with Turkey, a country that hopes to enter the EU. There is no secret to nobody that Turkey is the only country in the Middle East that has very powerfully affirmed its laic character. The constitutional reforms from 1928 and 1937 have changed the balance of power between the State and Religion, by affirming the absolute laic character of the state, while the Islamic religion was given a private zone. Therefore she was "subordinate to the exigencies of modernization and the affirmation of Turkish identity"<sup>39</sup>. An involution towards the kemalist reforms is represented by the passing of some measures that contravene the laic. We must remember the religious source present on ID's, the payment of religious personal from public funds, the management of their assets by the public administration, the introduction of the study of the Koran (1949), the founding of a Islamic Theology Faculty (Ankara), the reintroduction of mandatory religious education for schools stipulated by a constitutional act (1982)<sup>40</sup>. The obvious approach between the State and Islam lead to the elude of some provisions of the Lausanne Treaty that ensured a special status for the three minorities officially recognized by Turkey (Greek, Armenian and Hebrew). For example Christians are considered an ethnic minority and not a religious community like they are seen by the rest of the Muslim countries. This means that they are marginalized by the Stat and rejected by the

Turkish people. But the most grave is that they are being hit in their cultural specific ( in Greek and Armenian schools the use of the Turkish language is protected by law while the possibility of using foreign languages is very limited)<sup>41</sup>.

The controversial discussion between the Kemalist and the religious groups about the presence in the project for the constitution<sup>42</sup> of some provisions that wanted to reduce the influence of the army over the civil society, through the right to conscience objection, of the freedom of speech, and through the creation of a replacing civil service, the introduction of the Islamic shall in laic space<sup>43</sup>, the declaration of pluralism, of the optional character of religious education, the possibility that any person can change their religion without the fear of a sanction, and others show how divided is the Turkish society and how hard is the integration road to the European community. Those who oppose Turkey's entrance in the EU invoke the braking of human rights that recognize the freedom of thinking, of conscience, and the protection of the ethno-cultural identity of persons and ethnic communities. Toward the growing number of aggressions against Christians from Turkey, and other parts of the world The European Parliament was obligated to vote a *Resolution* in which all the abuses and forms of discrimination were condemned<sup>44</sup>. Sadly the message remained

<sup>41</sup> *Ibidem*

<sup>42</sup> Final version was to be passed by Parliament in the spring of 2008, then approved by referendum.

<sup>43</sup> On February 9 2008 Turkish Parliament voted to introduce a wave of Islamic universities.

<sup>44</sup> See European Parliament resolution of 15 November 2007 on serious events which compromise the existence of Christian communities and other religious communities which condemns unequivocally in Article 2 "all forms of discrimination and intolerance based on religion and faith, and acts of violence against all religious communities, urges states concerned to ensure that their constitutional and legal guarantees granted effective and appropriate exercise of religious freedom and faith, and effective remedies for victims whose right to freedom of religion or the faith has been violated. " Article 3 is evidence "that the right to freedom of thought, conscience and religion is an essential human right, guaranteed by various international legal instruments, recalls the same time, its attachment to the

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[www.bredafrancoise.ro/index.php?option=com\\_content&task=view&id=271&Itemid=67&josclean=1...-86k](http://www.bredafrancoise.ro/index.php?option=com_content&task=view&id=271&Itemid=67&josclean=1...-86k)

<sup>40</sup> *Ibidem*



without an echo and the aggression of Christians continues even today. On the other side there is Russia, multi-confessional state, that after decades of ideological atheism has introduced religion in the Curriculum. It is undoubtedly a big piece of evidence of the opening towards democracy of a country which has known throughout its history only strong handed regimes and has avoided confessional wars. The influence of the Russian Orthodox Church is very big in the Russian society and political leaders prefer to have a strong ally that can assure power, assure popularity and facilitate their implications in the life of the community. From this favorable conjuncture the Church also profits<sup>45</sup>. During the last years the better and better collaboration with the secular power lead to the building of a big number of places of worship and the introduction of religious education in public space.

In 2007 the introduction of a new discipline, with mandatory character in the Education Plan, *The Basis of Orthodox Culture*. Against this measure a part of the Russian Academy protested saying that Russia is a Federal State, and on its territory there are other religions and confessions, a reason that they would be discriminated. They asked the president not to allow the mixture of the Church in the affairs of the State, avoiding a breach of the Constitution<sup>46</sup>. But the decision was already made. The electoral stake was way to high and the politicians knew they can't afford the luxury to defy the dominant

Church. In these conditions the 2007-2008 school year started under the sign of novelty. The school program made by the Ministry tries to define the cultural identity of the Russian people after the fall of the Soviet Union and the importance of religious values in the contemporary society. The number of hours given to the studying of religion reflects the influence of the Russian Orthodox Church in the State<sup>47</sup>.

### Instead of conclusion

In a semi-secular Europe an important role in keeping the ethno –cultural specific of the nations that compose it and in the sustaining of inter-cultural dialogue is given to religion. This dimension of human existence, along with family, is the one that can give a sense of the meaning of life to a guy in a world dominated by globalization, modernism, and diversity. Everywhere religious problems from the contemporary age have a distinct place in public life and the religious conflicts that we hear about today through the media are the most dangerous. Starting from this reality the European states have seen the importance of religious education in the forming of personality and behavior of the modern man. This means that all the tries from one or the other to get God out of history have failed, because they did not offer something in exchange. But let us not be fooled by the ideal of getting to the most wanted spiritual unity, forgetting that religion not only brings us together but it also devises people. Religious pluralism comes with many offers of salvation that multiplies on a religious market without constraint, where syncretism blooms together with mysticism, superstition and fraud. From this generous offer each person takes what they can or what is suited for his personality.

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<sup>45</sup> Marina Gaskova, *The Role of the Russian Orthodox Church in Shaping the Political Culture of Russia*, JSRI, no.7, Spring 2004, pp. 111-122; D. A. Golovushkin, *On The Issue Of Religious Tolerance In Modern Russia: National Identity And Religion*, în J.S.R.I., no. 7, spring 2004, pp. 101-110.

<sup>46</sup> V. Ernu, *Russian Orthodox Church - between education and the Kremlin*, in Romania Libera, Saturday, 04 August 2007 (<http://www.romanialibera.ro/a102727/biserica-ortodoxa-rusa-intre-educatie-si-kremlin.html>).

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<sup>47</sup> <http://ortodoxism.wordpress.com/2007/09/05russia-introduces-the-orthodox-religion-in-the-school-curricular/>

## POWER OF THE WORD IN PSYCHOANALYSIS

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**Abstract:** *Psychoanalysis exploits the thaumaturgic power of the word. The therapeutic utility of Freudian construction is being conditioned by admitting three assumptions: the overwhelming of thoughts, the existence of unconscious psychic contents, to the pleasure principle. Psychoanalysis expresses itself through the voice of the patient, as per Jaques Lacan. There cannot be talking without a response. This characteristic of speech is placed in the core of its analytical function. Lacan shows that psychoanalysis is based on speech and language. In psychoanalysis, words act, their effects are real. The reverse of the Freudian reductionism is giving value to subjectivity in speech and granting the word with healing power.*

**Key words:** *psychoanalysis, unconscious, speech, language, verbalization*

### 1. TELEOLOGICAL SPECIFICATIONS

Giovanni Papini [1] placed psychoanalysis under the sign of the attempts programatically oriented towards the destabilization of the systems of values underlying Christian Europe. „Everyone of us is convinced of being, as a whole, a normal and moral being: there comes a Jew from Freiburg, in Moravia, Sigmund Freud and discovers that within the most virtuous and the most distinguished gentleman there lies hidden an incestuous, an assassin to become.” [1, p. 69], he writes.

Freud is, of course, deemed one of the great masters of doubt, beside Nietzsche and Marx. Their approaches are similar in the direction of signalling the hidden motivations of human behaviour and may be deemed reductionist. The approaches associate, at the same time, liberating discourses.

Psychoanalysis exploits the thaumaturgical power of the word. The present work, signalling the articulations of the Freudian therapy and the role of the verbalization in its economy, enhances the implicit edifying dimension of Freud’s thinking.

### 2. SUPPOSITIONS OF THE PSYCHOANALYTICAL THERAPY

The therapeutic utility of the Freudian construction is conditioned by admitting three suppositions.

The first of these, formulated relatively late as the *almightiness of the ideas* (in *Totem and taboo*), had been imposed upon Freud ever since the experimentation of the cathartic method, crystallizing once with the necessity of admitting the fantastic character of the infantile scenes of seduction, following the self-analysis. The Viennese neurologist compares the neurotic symptoms, especially the obsessional ones, with the animist reference to the world. The almightiness of the ideas is the functional principle of magic, specifically animist technique. The neurotics reactivate this principle, „these neurotics’ primary obsessional acts are, to speak truth, of magical nature.” [2, p. 95].

The second supposition of the psychoanalytical therapy aims at admitting the *existence of the unconscious psychic structures*. Freud considers that the post-hypnotic suggestibility, the failed acts, the dream and not in the least the success of the psycho-analytical practise confirm the

existence of the unconsciousness. However, the assertion of the antecedent from the existence of the consequent constitutes a logical error. The psycho-analytical practise cannot confirm the hypothesis of the unconscious psychic. It may, at most, in popperian terminology, corroborate it. This state of fact does not diminish nevertheless its therapeutic utility. The unconscious psychic does care neither about the external reality, nor, Freud considers, of the kantian constraints of the categories.

The third supposition for the therapeutic use of psychoanalysis refers to the operability of the *principle of pleasure* in the field of the psychic processes. The function of the psychic apparatus consists in maintaining the internal energy of the body on a minimum level. The apparition of an unpleasant tension orients the psychic towards its diminution and, implicitly, towards the avoidance of the displeasure. The psychic energy is called by Freud *libido*. „Taken in this relative sense, the only in which it seems feasible, happiness is a problem of individual libidinal economy.” [2, p. 308] considers the founder of psychoanalysis.

The three basic suppositions of psychoanalysis are operational in the context of the universal deciphering of the psychic functioning in sexual key. The importance that Freud grants to sexuality is suggested and sustained by clinical observations. The apparitions and the development of speech were to a high extent connected to sexual needs and events. [3]. Sexual issues rouse children’s intelligence and „Non only in the case of the research instinct, but in many other cases of particularly strong instincts, we dared come to the conclusion they are enhanced by the sexual instinct.” [4, p. 92] Freud writes. The spectacular corollary of the clinical meaning of sexuality is infantile sexuality. Its stages, denominated by Freud *oral*, *anal* and *phallic*, impress on the normal and neurotic adult’s sexuality. Oedipus’ complex, Freud considers, stands for the climax of the infantile sex life and at the same time for the central nucleus of

neuroses. The appetite for incest and filial hostility are generally human features, he claims [5].

At the basis of every hysteria, there lay one or several precocious sexual events. When psychoanalysis identifies non-sexual traumatic experiences, behind them there have to be sought desires driven back ever since childhood.

### 3. FREUDIAN REPRESENTATION OF NEUROSIS

Neurotic malady stands for a substitutive modality for satisfying the erotic needs non-fulfilled in the surrounding world. Hysteria is a malady of the psychic, despite its spectacular somatic manifestations. The reference of hysteria to sexuality has been known within Western culture ever since Plato, the parent of psycho-analysis emphasizes [6]. Hysteria originates in precocious sexual experiences. Hysteric manifestations are remnants, symbols of psychic traumatism, like the monuments. Result of the excessive sexual driving back, in the name of the sense of decency, of disgust, or of the rigid moral conceptions, hysteria crystallizes dually, in out-flowing sexual need and exaggerated sexual aversion.

In hysteria, the driving back of the intolerable desire fails, the subsisting desire searching for opportunities of activation in substitutive formations. Hysteric symptoms, keeping a remnant of analogy with the driven back desire, stand for such formations. Psychoanalysis, therapeutic method invented for hysteric persons, moreover in some visions, by the hysteric persons, has to retrospectively decode these symptoms. Neurosis entails the regressive fixation to an infantile and non-privative previous phase of sexual life. Involution occurs in two registers, chronologic and formal: libido comes back to the stages already gone through and its manifestations use primitive means of expression.

Lacking a specific defining content, neurosis stands for the surrender to the challenges that the normal individuals

undertakes. The suppression of virility to little girls and the shift of the erogenous centre of interest, at entering the phase of adult sexuality, predispose women to neuroses and particularly to hysteria, Freud states, in his characteristic line of differentiated approach of the masculine and feminine sexual issue.

Neurosis is one of the pathological ways out of infantile sexuality. The other way out is represented by the perversions. Result of the early driving back of the perverse drives, neurosis is the negative of perversion, definable as exaggeration of the sexual instinct [7].

Sexual instinct may sublimate, shifting towards a non-sexual object, highly spiritual. Sublimation is the extraordinary modality of discharge of infantile sexuality, as an alternative to the common modalities, normality and pathologic. „Freud thought the suppression of the unsatisfied libido is responsible for the production of the entire art and literature.” [8, p. 109] states Anthony Storr. From the psychoanalytical perspective, nevertheless, the interest will be focused on the ideatic content and not on the form of the work of art.

#### 4. STATUS OF THE DREAM IN PSYCHOANALYTICAL PERSPECTIVE

The frequency of the neurotics' references to their own dreams during psychotherapy suggested to Freud, according to his very saying, [5], the psychoanalytical signification of the dream world (oniric).

The reason for the sleep is the relaxation of the organism through putting off the interest for the external world. The sleep is the condition for the dream and the latter protects the sleep. The dream is a reaction of the psychic to the excitations it confronts during the sleep. It is the modality for avoiding the awakening, through the prism of the principle of reducing the psychic tensions on a minimum level. The simultaneous assimilation of all excitations, somatic and psychic, does not modify the essence of the dream. The fulfilment of the desires is the

purpose of the dreaming activity. The desires which require to be realized during the dream are most of the time shocking, unfamiliar to the consciousness. They supply the energy necessary for the production of the dream, using to this purpose the daytime impressions. The content of the dream constitutes the fulfilment of the censored desire. Sigmund Freud talks about a *manifest content* and about a *latent content* of the dream. The manifest content constitutes the dreaming narration, embroidered upon the daytime happenings (sometimes of the days) preceding the dream. It is a deformed substitute of the unconsciousness contents. The latent content fulfils the unnatural desire, being antisocial, immoral, intensely affective and egoistic [3]. „These censored desires which receive during the dream a deformed expression, are, before all, manifestations of an endless and unscrupulous egoism. In fact, there is no dream in which the Ego of the dream author should not play the leading role, although he knows very well to dissimulate in the manifest content.” [9, p. 152] states the founder of psychoanalysis. The passage from the latent content to the manifest dream is done through mechanisms of oniric elaboration. There occurs this way the transformation of the ideas into images, the condensation and the shift or the overturning of the dream elements. To these mechanisms there is added the secondary processing.

The interpretation of the dream should take into consideration this secondary elaboration, too, as part of the dreaming process. There is significant from the psychoanalytical perspective the oblivion of the dream, considered tendentious. As priority in the psychoanalytical construction, the founder of psychoanalysis emphasizes, there have to be considered the explanations supplied by the author of the dream. Through their enhancement, the one who is dreaming, recalls increasingly remote events from the past. The dream builds a bridge between the contemporary event and a happening with significant consequences from childhood. It stands for a revival of the individual

childhood and a glimpse upon the phylogenetic childhood. [5]. The interpretation of the dream means exceeding the infantile amnesia.

Not all dreams need interpretation. Small children's dreams are fulfilments of the plain, explicit desires. In their case, the manifest content and the latent ideas coincide. This proves, Freud considers, that the deformation is no natural characteristic of the dreaming process, but is secondary, acquired. The adults have themselves plain dreams, of circumstance, of trauma, of anguish, of orgasm. There also are typical dreams, of all of us, such as those referring to the embarrassing nudity, to the death of a dear person or to defending exams. There are however not these simple dreams which interest the psychoanalyst.

The dream is, like the neurotic behaviour, a solution of compromise between censorship and direct expression. Censorship impedes the manifestation of the scandalous desire in its rough form, however it cannot impede any manifestation subtly connected to this one. People, healthy or ill, will dream. „The interpretation of the dreams is *Via regia* which leads to the knowledge of the unconsciousness as system of the psychic life.” [5, p. 464] Freud appreciates. The dream approaches the pathologic and the normal, making the distances relative and making out of the psychoanalysis a general theory of the psychic.

## 5. RESISTANCE, DRIVING BACK, TRANSFER AND COUNTER-TRANSFER

The operationality of psychoanalysis is conditioned by the outline of the concepts *resistance* and *driving back* and by the control exercised by the analyst upon the phenomena of transfer and counter-transfer.

Between the territories of what awareness of and the unconsciousness, Freud places a *driving back barrier*. The drives non-concordant with the exigencies of the human placement in the world are this way censored and likewise, the desires not to be desired from the perspective of the Ego

are pushed beyond the consciousness. Placed together under the sign of the principle of maintaining the psychical tensions to the minimum, the driving back and the resistance function complementarily in the driving back barrier. The driving back, considered by the founder of psychoanalysis as the angular stone in comprehending neuroses, stands for a defensive primary mechanism which ensures the removal from the consciousness of the undesirable perturbing drives. The reason for the activation of the driving back protection mechanism consists in identifying desires incompatible with the expectations of the Ego. The resistance impedes the individual's accessing his/her unconsciousness and implicitly, the driven back desires. It manifests in psychotherapy when the analyst tries to bring forth to the patient's consciousness the significant unconscious desires. Between the current modalities of manifestation of the resistance, there may be mentioned: silence, void of any emotion in the discourse, logorrhoea, lie, absence from the therapeutic meetings, constantly rigid attitude. Another form of manifestation of the resistance, with serious consequences in the unfolding of the analytical labours, is represented by the patient's erotisation of the analytical situation. Sigmund Freud tried initially to infringe the resistance during the therapy, through suggestion or persuasion, Later on he perceived its significant therapeutic utility, proving its existence through artificial rise and exploiting the effects produced upon the analyzed one by the unveiling of its methods and modalities of expression.

Psychoanalysis stands in fact for the discovery of the driving back and its way out. The psychoanalytical labours stand for the process through which the psychoanalyzed one undertakes the interpretation of the psychoanalyst and overcomes the resistances it arouses. The resistances to interpretation make the driving back barrier objective. The existence of the driving back contents is proved by the very manifestation of the resistances.

The phenomenon of transfer consists in orienting the impulses originated in the imagination of the patient under treatment towards the psychoanalyst. The latter temporarily collects the affects liberated in the therapeutic process. Initially cataloguing the transfer as devaluating, as undesired erotic attachment and as artificial neurosis, Freud admitted afterwards, in the case of the resistance to analysis, the therapeutic importance of the phenomenon. The transfer may be positive or negative. An essentially negative transfer undermines the healing, but the positive or moderately negative transfer constitute themselves in favourable frame to the psychoanalytical cure. This favours or induces a transfer neurosis with the significance of re-experiencing it in homeopathic dose of the infantile neurosis. The manipulation of the transfer constitutes itself in the most difficult task for the therapist. The transfer makes possible the patient's persuasion with respect to his/her unconscious sexual desires and, once exposed, may spectacularly influence the psychoanalysis unfolding.

The psychoanalytical practise also unveiled the existence of a phenomenon completely complementary to the one of transfer. The counter-transfer addresses to the patient the therapist's psychoanalyzable affects. „I did not know to lay mastery upon counter-transfer at the right time" the founder of psychoanalysis appreciates, quoted by Jean-Pierre Chartier [10, p. 101], in the context of evaluating the transfer and the counter-transfer in *Case Dora*. At the beginning, Freud thought the issue of the counter-transfer might be solved through self-analysis. Later on, he was compelled to admit the necessity of a didactic analysis, in the expert's specialized training, under the guidance of another psychoanalyst.

In the same class with the transfer and with the counter-transfer, there may be integrated the projective phenomenon. In fact, the transfer and the counter-transfer are particular cases, with specified destination, of projection. In a generally human approach, the individual projects outwardly the affects considered undesirable. In this

comprehensive vision, the enhancement of the projective phenomenon is less usable in therapy than its particularizations in transfer and counter-transfer.

## 6. PSYCHOANALYSIS AND LANGUAGE

The patient's speech constitutes the environment of psychoanalysis Jacques Lacan shows[11]. There is no speech without answer and this state of affairs is in the middle of the analytical function of speech. Even silence, as void speech, is an answer. Signalling the resistances, it orients the therapist's interest towards what the patient does not say. The analyst rediscovers, in this case, the speech as free association. Anamnesis, as full speech, discovers, through symbolical interpretation, the traumatic pathogen event. This one is admitted as cause of the symptom as its verbalization suppresses the symptom. Lacan emphasizes the importance of verbalization, not of awareness, in the therapeutic approach. During the first psychoanalytical therapies, the verbal formulation of the trauma was done under hypnosis. Therapeutically efficient was the expression, not awareness upon the driven back memory.

Verbalization is, simultaneously, reproduction of the past and spoken representation. As spoken representation, it implies an answer, which is the presence of at least another person. The verbalization does not raise the issue of reality, Lacan shows, but that of the truth. The psychoanalytical approach rearranges past happenings through the prism of the future necessities. Speech is the instrument of psychoanalysis. The subject's discourse is its field and its representative operation is the surge of the truth within the reality. The psychoanalytical method implies interlocution, which is inter-subjectivity. Its expected result is the restitution of continuity in the subject's motivations. In order to obtain this result, the therapeutic approach has to operate with the unconsciousness, as absent part of the discourse. Silence or lie, signal the unconscious articulations. The therapists

rebuilds the discourse, working with the hysteric symptom, with the archive of the patient's childhood, with his/her lifestyle and with the traditions he/she assumed.

Lacan enhances the supposition of intersubjectivity within psychoanalysis. The dream is always for Freud the expression of a desire. However, Lacan shows, desire acquires its sense through the other's desire, implicitly acknowledging its existence. In the therapeutic approach, after the instauration of the transfer, every dream is confession and challenge, which means element of the dialogue. Any failed act is in psychoanalysis a succeeded discourse for the one who has eyes and ears. And the approach of the symptom through language analysis signals the structuring of the symptom as language. The joke requires, according to Freud, a third auditor.

The bases of the psychoanalytical experience are the speech and the language, Lacan shows. Their relation is of antinomy. An increasingly functional language becomes improper to the speech. A too specific language loses its function of language. For this reason, the value of speech of a language will be measured through the inter-subjectivity it allows. In speech, there is always sought for the other's answer.

Speech is a gift of language. In speech, words act, they have effects and suffer symbolic lesions. Psychoanalysis aims at the instauration of a true speech as premise of the patient's undertaking his/her own history. Interpreting the symbol and making this way the symbol disappear, the analyst asserts himself/herself magically, thaumaturgical. The reality of psychoanalysis effects is tributary to the gift of speech, Lacan considers.

## 7. CONCLUSIONS

The reality of the psychoanalysis effects is tributary to the act of speech. The reverse of the freudian reductionism is constituted by the enhancement of the meeting with the other in speech and by the accrediting of the word with healing power.

Jacques Lacan spectacularly surprises the optimistic anthropologic dimension of

psychoanalysis. Originating its therapeutic efficiency in the speech that is shared language, Lacan signals the intersubjectivity of psychoanalysis.

The therapy has colloquial character, the patient needs the analyst as receiver of the verbalized psychic contents. The therapeutic meeting is sitting together with the other, efficient and generous carrier of the transfer.

Freud places in a determinist manner at the basis of the entire human behaviour the events of infantile sexuality, however he/she implicitly recognizes for the speech, as gift of the language, the healing power. The need for the other in the therapy and the word that acts, healing, outline a representation of psychoanalysis closer, paradoxically, to Christian theology, than to modern mechanicism.

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## SYMBOLIZATION, SYMBOL AND PSYCHIC ENERGY AT S. FREUD AND C. G. JUNG

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*Abstract:* Paul Ricoeur identifies an archeological and an eschatological hermeneutics. Gilbert Durand considers that eschatology rules over the archeological. Freudian therapy assumes and exploits the preference for symbol and symbolizing, a general characteristic of human psyche. Therapy builds and accesses symbolic links. The symbol is the best possible method for something relatively unknown, as per Jung in agreement with G. Durand. Symbols are created unconscious and spontaneous by man. Symbols are the only access way to archetypes and owe their appearance to such. Symbolizing is both in the middle of psychoanalyses and of analytical psychology. Besides acknowledging the importance of symbols, the two directions operate therapeutically with different versions of the symbol.

**Key words:** hermeneutics, symbol, therapy, archetypes, psychoanalyses, analytical psychology

### 1. TELEOLOGICAL SPECIFICATIONS

Paul Ricoeur identified an archaeological hermeneutics, of denouncing the mask and of demythification, respectively, an eschatological hermeneutics, of unveiling of the essence and of remythification. The two manners of reading a symbol are, Ricoeur deemed, in equal measure, legitimate, in virtue of the necessarily double character of the symbol. Gilbert Durand considers however that the eschatological has the precedence upon the archaeological. Symbolic imagination is oriented towards turning into euphemism, towards the amelioration of the human being's situation in the world. It is, once more, denial of the death and of the lapse of time.

Contemporary Occident is marked, as Durand shows [1], by the alienating breakage from the symbolical, traditional vocation of human knowledge. Western iconoclasm has three stages. The first stage is of the Byzantine iconoclasm. The second stage is of the mediaeval aristotelianism, turned into official

philosophy of Christianity. The third stage, the clearest one, is of the scientism of Cartesian origin. According to its representatives, imagination is the main source of error, and the only credible source for augmenting the knowledge consists in reducing the searched fact to analytical records. Reductive hermeneutics tend to do this. In Freudian psychopathology and in ethnology, the images are approached in a reductionist manner, the symbolized being refused the mystery. In Freud's teaching, the symbol is reduced to driven back libido and the latter to sexual drive. Within restoring hermeneutics, however, Durand shows, the symbol sends to something without reducing itself to that something. At Jung, the symbol reacquires the mediating role. In the symbol, there meet the contraries, the symbol is their union. It is constitutive to the individuating process, illuminating the libido through the sense it confers. The present work enhances the hermeneutic reductive dimension and respectively, the hermeneutic restoring dimension in Freud's and Jung's references to symbol, symbolization and libido.



## 2. SYMBOL AND SYMBOLIZATION AT S. FREUD

Freudian therapy necessarily assumes and exploits the appetite for symbol and symbolization, general characteristic of the human psychic. This characteristic is easily noticeable in neurosis and dream.

Symbolism connects cognitively distinct entities. The essence of symbolization is a comparison. In Freudian vision, the symbolized, one of the terms of the comparison, is driven back, existing in the unconsciousness. Mnestic symbols, frequent in neuroses, are symptoms, which express through the intermediary of the somatic, driven back representations charged with drives. Oniric thinking, ontogenetically and phylogenetically primitive, resorts to symbols [2].

What is currently symbolically connected, in immemorial times was verbally and conceptually identical. The universality of the symbolism of the language and the human's appetite for symbolization confirm this. „I dare say, we are authorized to consider as phylogenetic heritage the symbolization, which the individual himself/herself has never learnt.” [2, p. 192] further states the founder of psychoanalysis. Numerous symbols, come from different areas of activity or human situation, easily adapt to the few groups of symbolized contents: body, parents, relatives, birth, death, nudity and, especially, sexuality. The symbols are multivalent, acquiring their signification from the context.

Beyond its defensive role in the good functioning of the psychic, the symbolic relationship has to be considered an environment for the psychoanalysis development. Therapy builds and accesses symbolic connections. The healing approach unfolds around the symbol as symptom.

## 3. PSYCHOANALYTICAL SITUS OF INTERPRETATION

Becoming aware of the source of the pathological representations leads to its annulment and to the liberation of the sick

person from the afferent constraints of the drives. Awareness implies the accepted and undertaken interpretation of the symptoms. Psychoanalysis is operational for the maladies with traumatic etiology, in which the Ego does not consider itself modified. The interpretation is efficient when the distance between the driven back material and the conscience is reduced enough, and the installed positive transfer is capable of avoiding the interruption of the cure. Indices for the fulfillment of these conditions are the patient's failed acts, the lapsus-es and the concordance between his associations and what the psychoanalyst feels. Non-dogmatic, Freud also admits the sporadic efficacy of the *wild interpretation*, imposed on the patient before the satisfaction of the mentioned condition. Usually, nevertheless, when the interpretation is not possible in a first phase, the psychoanalyst arbitrarily reconstitutes part of the patient's childhood. For the latter, the therapist's assumptions turn into constraints and, this way, the possibly inexact constructions, are operational. Freud pleads for the inoffensive character of these latter ones, showing that, in case they do not reach tensional nuclei, they do not leave traces in the patient's psychic. Favoring the patient's return to the field of his childhood, and authenticating the real traumatisms, the *vicariant* interpretation [3] is useful for the subjects who cannot affiliate for themselves to the symbolic order.

Psychoanalysis is, in fact, interpretation confirmed through the infringement of the resistances. There is necessary re-experiencing the driven back events in the transfer neurosis, Freud appreciates. [4]. There is essential for a fruitful therapy, the psychoanalyst's and patient's placement in an analytical, interpersonal relation, focused on the controlled regression to childhood.

The communication of the interpretation stands for a turning point in the evolution of the therapy. The compulsory vehicle in elaborating the interpretation is constituted by the associations of the analyzed one. The privileged modality for exploring the unconsciousness is the free association,

connected or not to the dream analysis and exploitable against the background of the characteristic objection to reproducing the driven back material.

Freud renounced relatively soon to hypnosis, which he considered dangerous, antipathic and mystic, of selective use and with short term effects. „Freud was not particularly endowed and interested in hypnosis.” [3, p. 37] Jean-Pierre Chartier appreciates. The use of the cathartic method independently of the hypnotic technique materializes in the method of the free associations. In the psychoanalytical therapy, the method of the free association aims at expressing with no discernment all thoughts which pass through the mind of the analyzed one. Nothing of what the analyzed one says is independent of what the analytical approach aims at. The things that the patient considers inexact, foreign to the problem, absurd or disgusting lead, through interpretation, to the driven back complexes. The analyst is neuter, he/she has to avoid the religious, moral and social valorizations and the privilege conferred to a certain type of significations. At the same time loved and loathed by the patients, in the ambivalence of the transfer, he/she has to dispose of floating attention, suspending his conscious motivations and ensuring, this way, a supplementary opening towards his/her own psychic apparatus and towards the communication from the unconsciousness to the consciousness.

The treatment is considered closed once with the disappearance of the symptoms or once with their rendering compatible with the regular existence, and likewise, once with undertaking the driving back, through overcoming the resistances. „The triumphs of psychoanalysis are rare and only the patients who haven't been warned expect a magical healing.” [3, p. 53] Jean-Pierre Chartier appreciates. In psychoanalysis, the doctor is the catalyst, not the healer. He might possibly favor the healing and may promise, at most, to try to help the patient through a method that has likewise been of help to others „on condition

the patient should try to help himself / herself” [5, p. 317].

#### **4. SYMBOL AND SYMBOLIC THINKING AT C. G. JUNG**

Symbol is the best formulation possible for something relatively unknown [6], Jung shows, in accordance with G. Durand. The essence of the symbol lies in the fact it does not stand for a completely intelligible content. The symbol only suggests the sense of the respective content. The symbol is a psychological reality which does not correspond to any cognoscible physical reality. Therefore, the symbol has a double character, it is real and unreal. [6]. It is an expression, a bridge, an indication for a fact that cannot be overtly expressed. The symbol implies the vague, the unknown, the absconded. Symbols are necessary as there are multifarious things beyond the limits of comprehension.

Man unconsciously and spontaneously creates symbols. Their formation is a natural process, consequence of the existence of an afferent psychic function. This inborn psychic function allows the individual to transfer his/her instinctual energy into symbolic acts, recoverable as sense. The symbol may unite the consciousness with the unconsciousness. With its help, the unconsciousness transfers and transforms the libidinal energy from an inferior form into a superior form. The force of the symbol comes from instinctual processes. As sexuality stands for one of the strongest instincts, most symbols owe their existence to the existence of sexuality, Jung shows, which cannot contest all Freud's therapeutic experience, although he does not share his opinion referring to the omnipresence of the sexual instinct.

Beyond the conscience, there is an unconscious disposition for the production of identical or similar symbols. This inborn disposition gives the collective dimension of unconsciousness. [7]. Imagination is the „privileged instrument of the supreme knowledge” [8, p. 48]. However the symbol is not exclusively a product of imagination. Symbols contain under condensed form

existential themes. [9]. The modality of revelation of the individual's psychic life, the symbol is not his/her willful creation, but the spontaneous expression of some universal and atemporal contents.

The symbols are the only way of access to the archetypes and they owe their apparition to the archetypes. Symbolic thinking is the vehicle of unconsciousness. The fundament of the symbol is the archetype and the phenomenal dimension of the symbol is given by the acquisitions of conscience. [10]. An endless reality can be lived only symbolically and likewise, the non-personal and collective dimension of the psychic can be revealed only symbolically.

Symbolic images are the manifestation, the expression of the libido. They acquire numinous character as they transport libidinal energy. They are convincing, operating on a common human level, and they are captivating. For all these reasons, religions resort to the symbolic language and express themselves in images. For the same reasons, the symbol, rooted at the same time in the conscience and in the unconsciousness, may unify these ones, too [11]. Their harmonization is the result of a vital process, which expresses itself symbolically, too. The unification of the contraries, with the generation in unification of several new states of consciousness, stands for the transcendent function of the symbol.

The symbols are indispensable for healing and individuation. Human being is, out of soteriological reasons, a concocter of symbols. The Parents of the Christian Church were still thinking symbolically, Jung shows [10]. In the dogmatic truths of Christianity, there is „contained almost insurmountable knowledge of the soul secrets, expressed in great symbolic images” [12, p. 152].

A symbol is alive as long as it is saturated with signification. Something turns into a symbol for the one who adopts a symbolizing attitude, endowing the event with a deeper signification than that of its phenomenal reality. A symbol may be alive for someone and lacking life for somebody else. The symbol loses its efficiency when the individuating process acquires nuances it can no longer express. When this thing happens,

there appear new symbols. A new symbol is the result of an imperious individuating need, which the existing symbols no longer satisfy.

The symbolic manner of expression is proper to the primitive spirit, before the language turning abstract. This spirit operates with analogies. The comprehension of the symbols implies the knowledge of mythology and, for the therapist, Jung shows [13], the knowledge of the symbols is compulsory. An efficient therapeutic relation activates the transcendent function of the symbols.

## 5. THE CONCEPT OF LIBIDO IN PSYCHOANALYSIS AND ANALYTICAL PSYCHOLOGY

“Freud had always thought that one of the principles that dominate psychic life is the need of the organism to reach quietness through completely discharging all tensions (later on called Nirvana principle).” [14, p. 26] Anthony Storr states. The function of the psychic apparatus consists in maintaining the internal energy of the organism on a minimum level. The apparition of an unpleasant tension orients the psychic towards its diminution, and implicitly, towards the avoidance of the displeasure. Ever since their period of collaboration, Breuer and Freud had made the distinction between free psychic energy, non-bound, and the bound energy. Free energy appears in the primary processes, searching for rapid and efficient discharges. Bound energy appears in the secondary processes and admits put off energies, under control. The maintenance of psychic excitation on a minimum level is the result of psychic labors for transforming the free energy into bound energy, of motion and condensation. The excitant psychic energy is called by Freud *libido*. „Taken in this relative sense, the only in which it seems feasible, happiness is a problem of individual libidinal economy.” [15, p. 308] the founder of psychoanalysis considers.

*Libido* is of erotic nature. Its reservoir is the Ego. Libido may be channeled towards the Ego (Narcissist libido) or towards the others (objectual libido). The primary,

infantile stage, Freud boldly maintains, of the fixation of the libido is narcissist, sexual drives being auto-erotically satisfied. Narcissism, as love for oneself, is normal to a certain degree. The driving back may be explained through the opposition between the narcissist libido and the objectual libido. The libidinal dissatisfaction generates neuroses. Freud attributes the subtle variations of sexual drives during the individual's development to the specific conflicting positions in which he places himself/herself during the various stages of the mental development and in the various psychic disorders.

The concept of *libido* is for Jung an argumentative necessity. The referent of the term is constituted by the vital energy, species of the universal energy and as less accessible empirically in a direct manner as physical energy. Libido is a basal upsurge very much alike to the Bergsonian vital buoyancy, but with more psychological charge. Libido may be known only through its manifestations and real effects —instincts, desires, will memories, affects, labor force, or potentials— states, aptitudes, attitudes, being impossible to rein under normal instances. As energetic value, indifferent in itself, libido may charge any field of the human quality, from hunger passing through power, hatred sexuality, up to religion. [10]. Therefore it is not exclusively sexual. „The sexual theory of the sexual automatisms is a prejudice which cannot be supported any longer.” [10, p. 133], the Swiss psychologist states, in declared disagreement now with Sigmund Freud. Sexuality is one of the most important and dangerous forms of expression of the libido [88], however it is not the only possible instinctual basis of the affects.

Libido is natural energy, with priority orientation towards the fulfillment of the targets of life. Culture is the result of the energy in excess. [16]. The mobility of psychic energy is the secret of cultural evolution [10]. The movements of the libido bind the consciousness to the unconsciousness. As psychic energy, libido is partly at the disposition of the Ego and has partly an autonomous behavior in relation to this one,

putting it in undesired critical situations or further supporting it with energy.

The retirement of the libido out of the object determines its sinking into the unconsciousness and pushing the phantasmatic material therein upwards, towards the consciousness. The archetypal images and motives are libidinally charged. Introversion and regression of libido produce the constellation of several archetypes and, through their enrichment with the substance of the individual memories, the possibility of the perception in awareness. [10]. The attributes of light and fire from the symbols of the libido mark its very individuating efficiency. Libido is represented in guise of Sun or solar hero. However, it also appears as tree, snake and phallus. [10]. The referent of these last symbols is not the sexual organ or act, Jung shows, but the vital energy.

## 6. CONCLUSIONS

Symbolization is at the same time in the core of psychoanalysis and of analytical psychology. Freud deems symbolization as phylogenetic heritage. He furthermore deems that oniric thinking, primitive and so useful to the psychoanalytical approach, works with symbols. Jung considers that man spontaneously creates symbols, converting instinctual energy. There is in the nature of the human an afferent function to this conversion. Moreover, there is a universally human unconscious disposition for producing identical or similar symbols, starting from similar instinctual charges. This disposition gives the collective dimension of unconsciousness. Symbolic thinking is its vehicle. And Jung deems the symbolic expression proper to the primitives, inferring hence the analyst's obligation to be acquainted with the mythology in order to therapeutically interpret the symbols. Beyond the common recognition of the importance of symbolization, the two orientations therapeutically operate with different visions of the symbol.

Psychoanalysis unfolds its healing approach around the symbol as symptom. Neurotic symptoms somatically formulate

driven back representations. Their decoding unveils the sources of the psychic tensions within the unconsciousness. There are only a few symbolized contents, Freud shows, among these the sexuality being of priority.

In analytical psychology, the symbols are indispensable for healing and individuation. Owing their existence to the archetypes, they are at the same time the only path for accessing them. The symbol is the spontaneous expression of several universal and atemporal contents. It has numinous character, as it transports libidinal energy and loses its efficiency when it no longer accompanies in its articulations the individuating process.

In psycho-analyst vision, human psychic is oriented towards silence and towards a discharge as efficient as possible, implying minimum effort, of the tensions. To this reductionist vision, there opposes Jung's conception about the constructive, restoring orientation of the psychic. This one instinctively undertakes the traumatic confrontations with the archetypes, advancing with considerable effort towards self-accomplishment. The Freudian Libido is guided towards avoiding the displeasure. In analytical psychology, libido acts towards the direction of fulfilling the purpose of life.

Both psychotherapeutic orientations connote determinism. In the case of psychoanalysis, there is about a mechanistic determinism, centered upon the meaning of infantile sexuality. In the case of analytical psychology, there is about a restoring determinism, focused on the human's instinctive orientation towards self-accomplishment. This latter one takes particular forms, individual specific. There is universally human the orientation towards individuation, in the way there is universal the kantian categorical imperative. In the economy of this universal orientation, there naturally places itself the symbol. This necessary cognitive to the extent in which there are things beyond the limits of comprehension, in the boundless reality.

Jung manages to interweave his teleological determinism with freedom. Analytical psychology signals the existence of

numerous paths towards the unique target of human existences, still unknown to the one on the path, but prefigured in multifarious cultural modalities. Analytical psychology, associating as well becomes any discourse upon freedom, the issue of responsibility, likewise signals the duty of every human individual towards himself/herself.

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## CLASSROOM MANAGEMENT – COMPETITION IN THE CLASSROOM

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**Abstract:** *Competition exists when there is scarcity of a desired outcome. Individuals or groups are then positioned to vie for the attainment of that outcome. Educators collectively create a more or less competitive future by the way they encourage their students to think and treat one another. When a teacher introduces the competitive element into a situation it creates a sense of external urgency and drama. Competition brings a variable into the equation that shifts the participants' attention from the task itself to attention to the cost of their performance in the task. There is some subscription to the position that there is no such thing as healthy classroom competition. While it can be debated whether competition should be incorporated in schools at all, it is a prevalent practice and will likely continue.*

**Key Words:** *management, classroom, competition, students, teachers, winning, losing, play*

### 1. COMPETITION IN THE CLASSROOM

There are a few principles to consider when judging whether a competitive classroom situation is more beneficial or less.

*First principle:* competition for valuable outcomes will have more detrimental effects on a class than competition for trivial and/or symbolic outcomes. There are essentially three types of “valuable or real” outcomes. They are:

a) material things of value - this includes privileges that have a substantive impact;

b) the teacher's conspicuous and/or lasting affection;

c) recorded grades. When the teacher gives students a meaningful reward for winning, the winning becomes important, and he makes a statement that students should care at least as much about getting the reward as they do about the quality of their effort. Recall the discussion of motivation: when the teacher does this he has extracted the intrinsic motivation from the situation by introducing an extrinsic reward.

*Second principle:* the shorter the life of the competition the more likely it is to have a beneficial effect. The length of the contest

increases its sense of prominence and decreases its sense of intensity and fun - both undesirable effects. For example, if the teacher keeps track of the number of books each student has read over the course of the semester and he posts the tally on the classroom wall, the initial effect may be an increased motivation to read. Initially the teacher may assume the strategy is effective. However, as the contest goes on he notices that students are reading books just for the sake of winning the contest and he will have an incentive to falsify the number of books they have read. Over time he will notice the competition is becoming less fun and increasingly burdensome. At the end of the year the competition will have produced one somewhat happy and very relieved student, many students who feel unhappy about losing, a good number who will feel a little unhappy but highly relieved that the chart is no longer being held over their heads to shame them.

*Third principle:* the leader of the competition must place a conspicuous emphasis on process over product. If winning is the point, students will take on a “just do what it takes” attitude. If students are encouraged to value the process, they will feel justified in staying focused on the learning

outcome and feel assured that it is okay to put their attention into quality as the primary goal. However, facilitating this mindset is only possible when the context itself does not place so much value on winning that the leader's emphasis falls on deaf ears. The two first principles are prerequisite.

## **2. THE PLACE OF COMPETITION IN THE CLASSROOM**

A thoughtful and intentional use of competition has its place in a classroom. Competitive contexts offer unique learning and growth opportunities. The primary goal in the classroom is to help students become familiar with the feelings and tendencies that can emerge and take a thoughtful and intentional approach to their participation within the competitive context. Teaching students how to deal with competition could be compared to sex education. The teachers are not endorsing any particular behavior; they are assuming that students may find themselves in situations where knowledge and a proactive mindset could be valuable. They should have a healthy and informed approach to it.

In most cases, the competitive context brings out feelings in students that seem natural. In a sense, these feelings are natural; however, they are not going to lead to a feeling of natural happiness and peace (the natural condition). Students should receive guidance to see that feelings that competition brings out are normal and predictable but not necessary. Feelings such as worrying about losing, needing to win to feel good about oneself, needing the drama of the competition to feel interested, or being so worried about the outcome that one loses focus on the process are all normal but ultimately dysfunctional habits of mind. Teachers must help students recognize these normal tendencies and replace them with more functional thinking to guide their choices and define their state of mind during a competitive experience.

To accomplish "competition education," a teacher incorporates three factors. First, make certain all competitive contexts are healthy. If he creates unhealthy

contexts (he gets excited about or give meaningful rewards to the winners or he places a great deal of emphasis on the outcome as important) he creates confusing messages and undermine results. Second, help students be aware of their competitive feelings in low stakes contexts. Third, help students test their ability to stay conscious and intentional in higher stakes competitive situations.

Low stakes competition includes situations such as "looking for a ready group," having students engaged in group presentations, or have them take part in small-scale competitive games. During these low-threat competitive contexts the teachers must be clear about the purpose of the competition (i.e., fun and learning, not winning) and help students pay attention to what is going on internally. When it comes to facilitating games, they have to be very direct, making the statement: "If we can play these games for fun, we will keep playing them. If we start worrying about who wins or loses or we start doing sloppy work to be done first, we will stop doing them." If the teacher gives minor privileges (e.g., getting to go line up first) to groups or individuals for being "ready" early, he needs to make it clear that they all need to be "ready," that it helps the whole class, and the teacher is just using the game to emphasize an important collective skill. His message to students may be, "This is good practice for games in life. We are all capable of being the first ones ready; if your group is ready first, great. If not, you made a good effort that helps us all. So we all win when we try our best."

As the teacher raises the level of competitive energy he should help students keep in mind that the reason that he uses skills that they have developed in a competitive context is not to see who is better, but to practice how each of them does with a competitive learning environment. He is primarily testing his character, and only secondarily testing their skills. He is helping students learn how to perform under pressure, and to learn that one can actually perform in high stakes contexts without feeling pressured, anxious, or that their self-esteem is attached to the outcome.

As students grow in their understanding of how to take part in competition without losing awareness of the most intentional, functional and productive outcome, the teacher must be specific and proactive in the messages he send and the consequences he delivers. In each competitive situation, he has to keep in mind the following:

- a) potential problems,
- b) messages to resolve and bring awareness to those problems,
- c) the actions that he will take if students cannot do it on their own.

Below are three example problems that could arise as students learn to be effective within competitive contexts.

*Example 1:* the teacher notices students being tentative and anxious - showing that they are working in part out of a fear of failure.

Teacher's intention: When students take on a fear of failure mindset, the teacher needs first bring their awareness to their thinking. He would ask if they are working from a desire to grow and learn or spending a lot of mental energy and attention on protecting their self-image. He wants to remind them that he is playing for fun, and their learning is the important thing. He would remind them to stay in the moment, focus on the process, and let the outcome take care of itself.

Possible Teacher Action: First, he needs to be sure that he can back up what he is saying. The competition should not be for meaningful stakes, the students should be prepared for what they are to do, and who should not have created an emotional climate that glorifies winning. Second, he needs to send a message that he cares about each student and want them all to do well. He needs to act as teacher, not as judge. Students should see him putting their attention into instruction and supporting their efforts with that instruction.

*Example 2:* Students begin to put too much focus on the outcome/winning and lose sight of quality, cooperation, process, sportsmanship, and ethics, or become too concerned with fairness and cheating.

Teacher's intention: When students get too focused on the competitive element of the task, the teacher has to remind them that their

learning and treatment of one another is what is important and this competition does not affect their grade or anything else that is important. If they are obsessed with fairness, this can be used as a means to become bigger than their situation. That's why the teacher has to explain them that winners overcome adversity and don't get sidetracked by bad calls, corrupt systems, bad breaks, and so on. He has to help them to see that this is good practice for life. Real victory is the ability to look back and be happy with how one acted during competition.

Possible Teacher Action: An assessment system should support the message that the process is what is being rewarded. If a team or individual does not show the ability to work in a competitive context without becoming emotional, blaming, cheating, or complaining excessively, a consequence is required. The best consequence will be losing the opportunity to take part. Having a group or student sit out to reflect on previous actions and priorities that motivated them is valuable. It may help to do some reflection with them if they are having trouble seeing where they veered off. As always the message is, "I know that you will be able to do this eventually; relax, take a few deep breaths, think about it a while. During this past situation you were not able to show the level of self-discipline that is needed to take part. You are smart, capable, and reflective and you have a lot to contribute. Let's work on this so you can join the group as soon as possible."

*Example 3:* Things get too heated and students become competitive and place too much value on winning. When this happens the teacher can recognize that students are trying to enhance their egos and defend their self-images by winning. In this case the students have lost perspective and are following unhealthy instincts.

Teacher's intention: When things get heated that is a clear sign that students are letting their egos get too involved. In this case the teacher has to help them stay in the moment and enjoy the process and recognize that peak performance comes from being completely in the moment and from letting go of the outcome and shift their goal toward



staying present and doing a good job with the quality of the relationships and performing the task and away from the illusion that wanting to win will help him to win and/or be happy and satisfied.

Possible Teacher Action: If students cannot hear teacher's redirection message because they are too immersed in the drama of trying to enhance their self-images by winning, he will need to withdraw the privilege of competition. His message to them at this point must be: "In this class, we compete to learn how to compete. When we cannot demonstrate that we are ready for it, we need to stop for a time. We can try again when we are ready." When the emotions are still fresh an episode such as this may provide a powerful opportunity for the class to reflect on why it is so difficult to avoid getting tied up in the desire to win. If he has allowed the game to come to completion, however, this processing will not be as powerful. There should be an opportunity to recognize the clear cause-and-effect significance of teacher action: "In this class we use competition to the degree that we are ready for it."

In the classroom, the feedback and positive recognitions are reserved entirely for process-related performance and the quality of the participation. The students learn that winning is not the point, and losing is not a big deal. Neither winning nor losing is meaningful. What is meaningful is what the teachers learn about themselves in the process, how they treat each other, and what they learn about their skill level.

### 3. CONCLUSION

The teacher needs to remember that, in a class, games are for fun. Games and competition provide a combination of learning opportunities and a chance to play. What makes a game fun? The greatest indicator is that the participants do not fear the potential consequences. Teaching students how to play without fear of failure or letting their egos become too involved is prerequisite. Second, students can access the joy of the moment and have fun with the process. Involvement,

challenge, adventure, and suspense all can feel fun if the students feel free and the situation supports fun over comparison. The influence of comparison will be a fun-killer. Fun during a competitive context occurs when the participant sees the competition as the game, and the fleeting reality, and the learning, relationships, and self-respect as the lasting reality.

The use of competition can produce beautiful results, but unless the teacher takes great precautions he will regret putting it in the hands of young people. If it seems harmless, it is because he does not perceive the threat clearly. While consequences for promoting a fear of failure are not the same as they would be if a student were to injure themselves with a power tool, the teacher needs to be just as safety-conscious.

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## THE RIGHT TO BE INFORMED – THE RIGHT OF PERSONALITY

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**Abstract:** *Should the society's goal be the release of constructive energies of each individual's personality, then it is mandatory for the Law to have as its final target the defense of its subjective rights.*

*The rights of personality are subjective rights that follow the availability principle, the law presuming only the interest and not the will - as is the case of human rights. By the right to be informed the human personality has enriched. Having the information weighing it and sharing it one can decide with full responsibility whether to assume an idea, a principle, a value or not, having the obligation of not breaking the rights or fame of others and of not harming the national security, morality and public order.*

The social history of individuals is, from a certain perspective, the history of their social roles, socially formed within the assembly of social relations. The individual changes together with his businesses and reformations – from a simple human being into a social person, inside the environment that he considers his own. The degree of amplification and enrichment of relations shows the degree of freedom, information and expression of what people potentially detain.

Being able to act freely and consciously, a person bears unsuspected psychic and physical resources so as to make his being known to the world, by converting the self into cultural goods, that is – values. This phenomenon is yet limited since it occurs within a normative net of interdictions and moral-judicial obligations, which determine *how-how much* of it has to come true but also *how-where* it has to fulfill.

The notions *person* and *personality* refer to the same human being, although under various aspects. Nevertheless, it is not the person able to create values but the personality, that is the individual taken as a whole, able to create epistemologically, pragmatically and axiologically. The individual rejoices over his possessions: rights and moral, judicial and economic obligations, while his personality lies in a cognitive-affective and actionable world.

The defense of the person by the Law equals the defense of the “mask” which the Law itself obliges the individual to wear within the society organized by it. By doing this, one can say that the concern is about only the individual with his given mask, thus, the public order, the security

of the state and good manners remain in place. It is visible then that within the social relations regulated by Law the public bodies are modeled as personalities that are not each defended because the Law defends the generic personality, in other words, those epistemic-pragmatic-axiological features through which the individual manifest. Therefore, the law does not define all the features through which a person can be differentiated from others, but only those features bearing judicial relevance, namely, those features able to embody social values sufficiently important to be defended by Law, all the others being left inside the prescriptive sphere of different types of norms, less strict than the judicial system.

The judicial definition of the rights of personality is, if not impossible, certainly very difficult. In the specialty literature, it is regulated that the rights of personality are subjective rights. They consist of the prerogative attributed to a person to ask all the other persons to respect his/her personality (rights of personality), or his/her exclusive power over one thing (real rights), or to oblige another person to give back a thing or to execute some business for him/her (personal rights).

Accordingly, based on the two constitutive elements – interest and volition – subjective rights may be grouped into:

a) subjective rights where there is no prior presumption over the interest or volition of the holder; the interest is to be approved and the volition has to be expressed judicially. These are pecuniary rights;

b) subjective rights where both the interest and the volition are presumed by the legal representative in favor of the holder. These are the person's attributes: name, address, social status;

c) subjective rights in which the interest is presumed and the manifestation of volition is at the potential holder's will. These are the rights of personality.

Consequently, the subjective rights in which the interest is presumed and the manifestation of volition is at the potential holder's will are rights of personality which, technically speaking constitute what may be called "civil liberties". Yet, not all subjective rights may be seen as a "liberty" by visible analogy with the "public liberties". One needs to understand that a subjective right without material expression expresses a civil liberty. Therefore, the defended judicial value is sufficiently important for the legal representative to consider necessary to presuppose that the holder is interested in manifesting that right. Finally, the specific particularities of this prerogative have to make it necessary that its concrete exercise to be left at the free manifestation of will of the potential holder, or to be generated by the principle of "availability" [1].

Resulting from here is the fact that the rights of personality in which the right to a private life, image, honor, dignity and prestige, the unpecuniary right of authorship, the right to move freely, the right to be educated, informed and to have an opinion – all belong to the category of subjective rights without material expression since honor, dignity, prestige, private life and others are not values that can be evaluated in money. Due to this reason, the rights of personality will have common characteristics with those of the category of civil subjective without material expression known as *attributes of the person* and in which the right to a name(nomination), residence (home) and certain social status are included. Both the former and the latter are, undoubtedly, absolute rights, inalienable, exempt from seizure and strictly personal.

Nonetheless, the rights of personality cannot be considered a prolongation of the attributes of the person, the latter being attributed by definition, while the rights of personality are assumed, by excellence. Generally, a person can choose a name or another, a residence or another, a certain social status or another, but

throughout his/her life as a person, he/she has to hold a name, a residence and a social status, no matter which they are. Thus, it results that the attributes of the person are dual: they are not only rights to the holder, but also obligations. As a result, the distribution of these elements is beyond the individual interest and is relative to the juridical society's interest. Juridically, this status is similar with presuming by the law representative of both the interest and the volition of the prerogative holder. From this perspective, the situation of rights of personality differs from the situation of the attributes of the person because, in their case, the law presumes only the interest but not the volition, which is left at the potential holder's will.

One of the rights of personality is the right to be informed. The human being needs to know and to establish a spiritual community with various implications over his material life, through information which he can apply while he gets to know it. People are interested in the natural reality, while personalities are interested in the social reality, because there will be commitments within a world governed by the moral-juridical and political aspects. Therefore, the need for information – a hunger of the human social spirit – completely, correctly, and authentically satisfied leads to a complete, correct and authentic directing of behavior and this behavior will meet the society's expectations. The data processing by the society before it is sent to its members, so as to satisfy its own interests and which would lead to a distortion of the information, to its truncating and unilateralism, represents a form of manipulation of the society's members and it generates their alienation while inspiring fear and lack of trust.

On the other hand, we equally benefit from information and produce it, we co-inform, inter-inform, we evaluate and co-evaluate. The role of information, as source of knowledge, selection and affinity with others, is amplified or diminished by the right to speak freely. For the juridical body, the easy finding and opting for information, which would be able to meet his landed dignity, means an extra possibility of designing a new appropriate model of adaptation to the world, as well as the possibility of producing as many bridges to understanding. The human personality is enriched by its right to be informed, which better explains the meaning of life, so that it can

decide with full responsibility to assume an idea, a principle or value if he/she detains the data that he/she can afterwards judge, endorse, distribute, stock and select.

Although mentioned in bills and international agreements, in general formulations, the rights of personality do not apply *ad literam, omni eo soli* in the same manner, because they come to life through the mediation of various national legislations. Concepts such as 'juridical body', 'juridical value', 'subjective rights' without material expression, or 'availability' – are abstract notions which, in fact, can be rendered definitions, yet the main difficulty with regard to the contents of these Bills and International Agreements is that the practices meant to adjust them differ from one society to another.

The UN organization has reached one of its major objectives, which had been aimed at when two juridical international agreements came into effect for the signing states: defending and promoting the fundamental human rights and liberties. These agreements, together with the Universal Declaration of the Human Rights and the facultative Protocol, offering the solving mechanism for individual complaints about breaking the rights, constitute the main source of training, at international level, of the civil and subjective rights, without material expression of personality.

In accordance with Resolution 59 (I) of the General Meeting of UN, in 1945, *“The liberty to be informed is a fundamental human right and the landmark of all liberties for which defense the United Nations are devoted (...). The liberty to be informed urges that all beneficiaries of these privileges have the will and strength not to take advantage of them. The moral obligation to look for facts without prejudices and to spread the information without malevolent intentions constitutes one of features of the essential liberty to be informed”*.

In the International Agreement of Civil and Political Rights of 1969, Art. 19 stipulates that any individual has the right to the liberty to speak freely, and this rights consists of *“the liberty to search, receive and share information and ideas of any type, disregarding national borders, orally, written, printed or artistically or by any other means at his choice”*. At the same time, the agreement mentions that exercising this liberty involves certain duties and responsibilities and it can be subdued to

some limitations, which need to be established by Law and which are necessary for respecting the rights and reputation of others, for defending the national security, the public order, health or public morality. Simultaneously, similar contents is mentioned within the European Convention for defending human rights and fundamental liberties, in 1950, where there is reference to the liberty to receive or to communicate information or ideas, without being impeded by public authorities and without considering national borders.

At the national level, the right to be informed is stipulated both in the Constitution, where in Art. 31 it is mentioned that *“the right of the person to have access to public information cannot be limited”* and that the right to be informed does not have to harm *“the steps taken for protecting the youth or the national security”*, as well as it is mentioned in other various laws. Such is Law no. 554/2001, regarding the free access to public information, where Art. 12 says that information pertaining to the national defense, security and public order is exempted from free access, if it is included in the classified category. According to Law 182/2002, with regard to classified information, the access to this type of information is granted only in such legal cases, conditions and provisions, without interpreting these provisions as limitations of access to information, or ignoring the Constitution, The Universal Declaration of the Human Rights, agreements and other treaties to which Romania adheres.

Adopting, after the WWII, the international instruments for the human rights, highlights that every human being rejoices certain inalienable rights, without any discrimination with regard to his profession or juridical status, which means that they apply to the members of the armed forces, as well [2]. It is true that these rights may know some limitations, necessary for the benefit of the entire society, but such limitations can only be imposed, according to the Constitution, by Law and only if they strictly necessary to the democratic society.

The liberties to hold an opinion, to speak freely and to be informed are now universally recognized as being part of the fundamental human rights, representing an essential factor of the individual human existence and of the strengthening of peace and international understanding, in a world that is more and more

globalized, where the material support of these liberties is provided by the global proliferation of technical possibilities of presenting the information through mass media. However, the very expression of the liberty to speak freely and to be informed may be the object for some juridical limitations, necessary for respecting the rights and reputation of others, for defending the national security, the public order, health or public morality.

One of the areas in which the liberty to speak freely and to be informed has always been restricted is that of the national defense. In this case, on the one hand, there cannot be a total right of the public to be informed, because the efficiency of military actions would be endangered, and, on the other hand, because there are reasons that involve orders and military discipline and they limit the military personnel right to speak freely, the only modality for them to speak publicly being an authorized permission. In turn, citizens must understand that they cannot access data belonging to the ministry of defense unlimitedly, since part of this information, according to the law, belongs to the category of classified information.

The liberty to speak freely and to receive or communicate data or ideas without the involvement of public authorities and without considering the national borders has, as far as military personnel are regarded special connotations relative to the military press. Usually, it is a departmental press, still, it is also a press appeared due to private initiative of the military personnel, and it is equally controlled and authorized by hierarchically superior military structures, to ensure the correct information of the public opinion.

Since the rights of personality do not belong to the "core" of the human rights, the right to be informed is susceptible to be denied in case of war or in case of a different public danger, which may threaten the life of the nation. In Romania, the regime of the siege status and the regime of emergency, in accordance with the Government' emergency decision no. 1/ 1999, prescribe, for the civil and military authorities, certain duties and responsibilities, among which there are restrictions regarding the right to be informed by protecting the data with military character that are destined to be communicated via mass media. In this case, the information concerning the exceptional status (excepting that referring to disasters) is made public only

with the approval of military authorities, and the mass media (no matter their nature and form of ownership) are obliged to transmit the messages to the military authorities at their request. Equally, the temporary suspension in issuing or broadcasting certain programs of radio stations or television channels is possible. All of these steps may be taken by the Romanian authorities, respecting Art. no. 53 of the Constitution, in which it is mentioned that diminishing the exercise of certain rights or liberties may be done, only if there is proportionality with the situation that cause it, on condition of its application in an indiscriminating manner and without harming the right or liberty.

Both from the international and national documents result that there is evident concern for the affirming and defending the right of personality for its access to information, under the obligation to respect the rights and reputation of others, to defend the national security, the public order, health or public morality.

The right to be informed correlates with the right to hold an opinion from the perspective that only under the conditions of an enlarged possibility of obtaining the data correctly and unchanged may the individual hold an opinion; only under the conditions of a great amount of information can he select, weight and decide with full responsibility.

The right to be informed also correlates with the right of personality as an author to publish his work, to make it known to the collectivity he lives in. A literary, scientific or artistic work [3] represent the development of certain topics, the proposal of some solutions from a personal perspective, both profound and vast, and the absence of information or the lack of information or possession of unilateral, distorted data leads to creating dissatisfactory works.

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## PERMENENT EDUCATION THROUGH THE MILITARY ACADEMIC ENVIRONMENT

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**Abstract:** *We live in a constantly changing society, not just in terms of informational, social, economic, but also in terms of environment. Each individual should have a minimum knowledge, skills, abilities competences from physical (such as moving through rough terrains) to the orientation in nature, first aid, identifying good locations for housing and construction of temporary shelters, removing victims from the wreckage/terrain sliding etc. Not all of these skills can be formed in the school through formal national curriculum because no such provisions are made. This study aims to identify civilians' needs and demands as concerning forming and developing their capacities to help themselves and help others in difficult circumstances, emergency situations, situations that seem to occur increasingly often in nowadays' society. It also seeks to identify public preferences regarding the means of achieving these skills and competences, with the support of specialized institutions such as "Henri Coanda" Air Force Academy*

**Key words:** *permanent education, civilian protection, volunteers' involvement, emergency situation, training volunteers*

### 1. THEORETICAL FRAMEWORK

We live in a society marked by permanent changes, not only from the informational, social, economical point of view, but also from the environmental point of view. Things that used to be indisputable truths just a few decades ago now are out-of-date, where from comes the need of permanent education. The world changes at a stunning speed and we are not always prepared for these changes, especially when they are not in our benefit, we haven't caused them and we can do nothing to confront or stop them. For example, natural disasters (earthquakes, fires, floods, etc.) or man-made disasters (wars, arsons, etc), and of course the every day inherent accident require people certain competences so that they can

manage, survive and help the ones in difficulty.

Every individual should have a minimum of knowledge, skills, competences starting with physical abilities and continuing with orientation in wilderness, giving first aid, identifying places for shelters and building shelters, helping the deprived, the persons caught under ruins/terrains sliding, etc. Not all of these competences can be formed in school, through formal education because the national curriculum does not allot classes for such training. We consider that a military established institution, like the Air Force Academy, trains its students so that they achieve such skills and competences besides the specialty ones. And more important, it could train other people too who are not

involved in the military service, such as the civilians that volunteer to different non-governmental organizations or foundations which provide assistance to people in jeopardy or any other crisis situations.

Why an individual would make significant personal sacrifices for another person, particularly a stranger is a question many researchers from Western European and USA have lately asked and answer. Spontaneous helping (when someone is faced with an unexpected need for help, calling for an immediate decision to act and an opportunity to provide one) is different from the act of volunteering which can be described as a planned helping, which often implies planning, sorting out of priorities, and matching of personal capabilities and interests with different types of intervention [1].

Clary et al. identified six motives for volunteering: values (to express values related to altruistic and humanitarian concerns for others); understanding (to acquire new learning experiences and/or exercise skills that might otherwise go unused); social (to strengthen social relationships); career (to gain career related experience); protective (to reduce negative feelings about oneself or address personal problems); and enhancement (to grow and develop psychologically) [1].

But volunteering can be regarded as a kind of charitable activity which bears resemblance to consumer behavior. This is because carrying out voluntary work goes along with deciding how much of one's leisure time one is willing to spend on volunteering instead of other (leisure) activities [5]. This also shows the need for advertising about the possibility of offering help to others by volunteering.

Volunteerism provides a crucial component of civil society. For example, participation in voluntary work is widespread in the United States and other European countries. In 2005, about 65.4 million American citizens were engaged as volunteers (Corporation for National and Community Service 2006). In the United Kingdom, around 22 million people participate in voluntary projects in their leisure time (Volunteering England 2007). In 2004, approximately 36% of the German population older than 14 years

volunteered (Gensicke et al. 2006) [5]. Unfortunately, we do not have similar data from Romania.

The need of volunteering is felt only when you are the person in need but it should be taught, in school or any other institution that would undertake such a great responsibility. Our century is that of permanent education, of continuous adaptations to the changes in society and nature. This permanent education could be much more useful if it "remedied" such deficiencies before these shortcomings are felt by the individuals. Being able to help yourself and to help the others, in any situation, can form the fundament for a better society.

## **2. GOALS AND METHODOLOGY OF THE RESEARCH**

Our research also aims to identify needs and requirements of civilians as concerning forming and developing their capacities to help themselves and to help others in crisis situations, situations that seem to occur increasingly often in the Romanian society. Also, another objective of our research was to identify preferences regarding the means by which these skills can be shaped, with the support of specialized institutions such as the Air Force Academy "Henri Coanda" from Braşov.

Our research **hypotheses** are:

1. Young civilians' involvement in courses for forming first aid competences varies depending on the perception they have on their own skills.
2. Young people believe that they are prepared at a greater extent to give first aid in cases of domestic accidents than in more serious situations such as terrorist attacks.
3. Civilians' representations on authorities' degree of involvement in resolving emergency situations differ depending on their age, students being more interested in this issue than high-school pupils.
4. Involving young people in first aid courses organized by different institutions vary depending on the representations that they

have about the implication of these institutions in managing emergency situations.

**Sample:**

Our research was conducted using 140 subjects from high-school and university levels. Thus, 69 subjects are from „Iosif Șilimon” Technical College (47) and from "Mircea Cristea" Technical College (22) from Brasov, and 71 subjects are students of the Mathematics-Informatics Faculty (14), from the Faculty of Letters (30) and from Engineering Technology Faculty (27), all belonging to Transylvania University of Brasov. In terms of gender, the research group is balance, consisting of 70 boys and 70 girls, aged between 15 and 30.

**Procedures:**

The research study was conducted by applying a questionnaire regarding civilians’ attitudes and opinions on the perceptions of their own capacity to provide first aid in emergency situations such as arsons, household accidents, floods, road accidents, earthquakes or terrorist attacks. Also, the questionnaire aimed to discover young people’s views on how they would prefer to form or develop their capacity to grant the first aid in various emergency situations.

**3. RESULTS**

The data obtained from the analysis of the responses given by our subjects to the questionnaire were processed statistically, taking into account parameters such as level of education, gender, and the field studied by the subjects.

As regarding the extent to which subjects perceive that they are prepared to give first aid in emergency situations, the results were as follows:

- 39% of the subjects consider that they are only little prepared to give first aid in cases of fire/arson;
- 51.4% believe that they are largely ready to give first aid in cases of domestic accidents;
- In case of flooding, only 26% would be prepared in large measure to give first aid;

- 26.7% of the subjects consider themselves highly trained to give first aid in cases of traffic accidents;
- Part of the subjects (30.8%) feel prepared to a great extent to manage in case of earthquakes;
- 41.1% consider that are not very well prepared to give first aid in cases of terrorist attacks.

The results vary depending on the seriousness or importance young people attach to certain events and the frequency of such situations in everyday life. Thus, household accidents or fires are emergency situations where young people feel they would manage much better than in case of earthquakes or terrorist attacks. At the same time, except terrorist attacks, in case of any other emergency, at least 25% of subjects feel very much prepared to face them. This could be explained by the fact that, although they have never been in such situations, they have heard of such situations from others and they know, at least in theory, what to do, while in care of terrorist attacks we can not say that.

There were differences between high school pupils and students as concerning these representations, but only the ones concerning terrorist attacks were statistically significant. Using the t test, we found that there is a significant difference between students and high school pupils with a value of .000 at a significance threshold of less than .01 in terms of representations that they have on their own ability to provide first aid in case of terrorist attacks (fig.1). High-school pupils are considered to a greater extent than students to be prepared to face such situations.

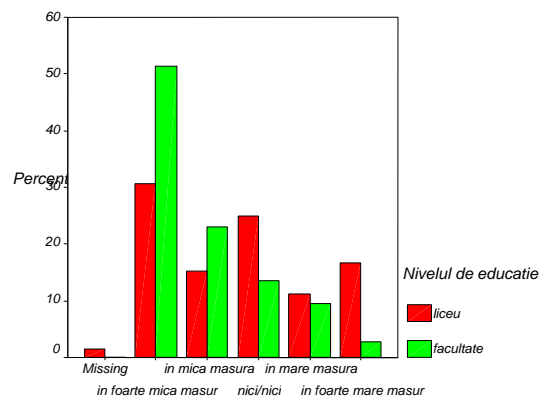




Fig.1. To what extent are you prepared to grant first aid in case of terrorist attacks?

These results might be influenced by their age. High-school pupils are in the period when they shape their image of themselves, have more confidence in themselves, have more enthusiasm. Meanwhile, there is a possibility that students have a much better contoured self-image, they know themselves better, know their own possibilities, and limits. The slightly greater life experience students have can help them to properly assess the seriousness of an emergency and to correct analyze themselves to see if they can or can not cope with such situations.

With the help of the t test, we tried to determine whether there are significant gender differences regarding the representations that subjects have about their ability to provide first aid and other situations. The results showed that there are significant gender differences in granting first aid in case of fire, boys being convinced that they are more prepared than girls to cope with such situations. The mean for the male subjects is 2.8857 and it is 2.2571 for the girls' mean, the difference between these being at a threshold of significance less than .01 (.001).

Another statistically significant difference we obtained is in the case of the representations about the abilities of providing first aid in cases of domestic accidents. This time, the situation is changed, because girls consider themselves more prepared than boys for this situation. The value of t is .009 at a significance threshold of less than .01, so statistically significant. These results can be explained by the different perceptions that girls as compared to boys have on household activities, due to stereotypes inoculated even through education, stereotypes according to which the words "domestic"/"home" are mainly associated to females than to males.

Using the questionnaire, we wanted to also identify the perception that young people have on the ability to engage in emergency situations directly / actively (solving emergencies) or indirectly / passively (to keep cool in such situations). Thus, subjects were asked to assess the extent to which they are

able to keep calm in emergencies, and the results were as it follows:

Table 1. Representations on the ability to keep calm in emergency situations

	The extent to which they perceive their own abilities	Percent
1.	To very little extent	6,2%
2.	To little extent	25,3%
3.	Neither/nor	18,5%
4.	To great extent	34,9%
5.	To very great extent	14,4%

As it can be seen from the table above, most young people consider that, to a great extent, they can keep calm in case of emergencies. Linked to this aspect, we obtained statistically significant differences (a value of .000 at a significance threshold of .01) between girls and boys, as seen in Figure 2.

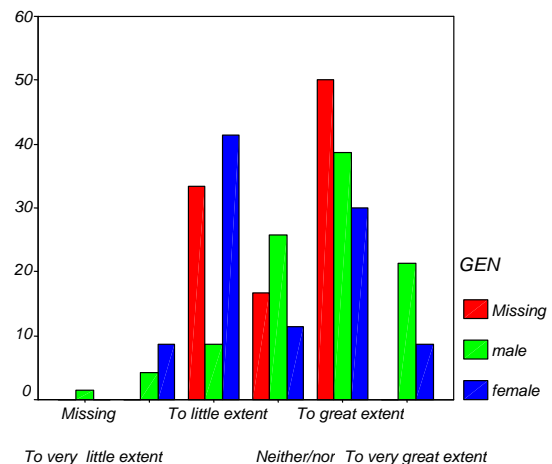


Fig. 2 Do you keep calm in cases of emergency?

As illustrated in the graph above, in cases of emergencies, male subjects have more confidence in their abilities than girls do. This could be explained through gender stereotypes that are inoculated to children through education from the earliest ages.

As concerning the ability to respond to emergency situations (i.e. to voluntarily engage in them or not), the results showed that a large proportion of young people (39.7%) consider themselves, to a large extent, able to react, but we should not neglect the 21.2% of those subjects who felt less prepared in order to cope with such situations. There were not found significant differences in terms of gender or educational level in this variable.

One last aspect covered by this category was the perceived ability to manage emergency situations. In this case, the results showed that only a small percentage of the researched subjects (8.2%) said that, to a large extent, they would be able to get involved in solving an emergency situation, while 39.7% of them feel very much able to do so.

Another goal of our research is constituted of the identifying the representations that young people have about public institutions' involvement in solving emergencies. The confidence that civilians have in the involvement of authorities in these contexts is quite low because a large proportion of them (32.2%) believe that institutions engage in small measure in these situations.

These results could appear due to the fact that the actions of such institutions are not sufficiently known by most people, or that young people are not sufficiently interested in this topic. Also, subjects were asked to specify which institutions should be involved in resolving emergencies, and the results were as follows:

Table 2. Youth's opinions on institutions' degree of involvement in solving emergency situations

	<b>Institutions</b>	<b>no</b>	<b>yes</b>
1.	<b>Firefighters</b>	11%	<b>89%</b>
2.	<b>Police</b>	13%	<b>87%</b>
3.	<b>Gendarmerie</b>	39%	<b>61%</b>
4.	<b>ISU</b>	41,8%	<b>58,2%</b>
5.	<b>Red Cross</b>	46,6%	<b>53,4%</b>
6.	Army	57,5%	42,5%
7.	Community Police	67,1%	32,9%
8.	Volunteer Service for Emergency Situations	67,8%	32,2%
9.	Air Force	74%	26%

As shown in the table above, our research subjects deemed as the most important institutions that should be involved in resolving emergencies the following: Firefighters, Police, Gendarmerie, Emergency Situations Offices, and the Red Cross. These results may be due to the insufficient promotion of the actions they carry out alongside with other institutions such as the Volunteer Service for Emergency Situations, Air Force or NGOs.

Also, the results raise another question about how well young people know the specific activity of each institution in part because, as can be seen from Table 2, young people believe that the Police is the most important institution that should engage in various emergency situations, although there is a specialized service for emergencies.

Although our subjects stated in the first part of the questionnaire that are largely able to keep calm in emergency situations, to face or even to deal with emergency situations, in the second part of the questionnaire the vast majority said that they need, to a large extent, courses to develop skills in one of the following areas:

- Providing first aid-37.7%
- Survival in emergency situations-39.7%
- Saving assets-30.1%
- Identify effective methods of crisis management-37%
- Maintaining calm in emergency situations - 32.2%.

These results contradict the initial results, according to which young people believe they are able to cope with most emergency situations. The explanation for these differences may be given by the declaratory level and the practical-action level when filling in such a questionnaire. Attitude towards research is not an appropriate one, and often participants fill in the items thinking about what they should answer, what "would be better" to say. We believe that the present results cover this situation and prove that both pupils and students felt the need to form or to develop certain skills to help them cope with or solve a particular emergency situation.

In conjunction with this, we tried in this research to identify what would be the arrangements for initial or continuous training in this area preferred by young people and what institutions would be desirable to carry it out. As ways of organizing the training, young people prefer optional courses organized in educational institutions (51.4%) to the ones organized by institutions specializing in civil protection (25.3%) or NGOs (17.8%) and even mandatory courses organized by educational institutions (17.1%) or institutions specializing in civil protection (15.1%). Although much criticized, the official education system (formal education) seems to be still considered the one able to form new skills in these areas. This could be caused by the young people's distrust in systems they do not know either by name or by their specific activity. The institutions preferred by our subjects for such trainings would be the military ones (32.9%) because, as the statistics show, and they are those in which young people most trust.

#### 4. CONCLUSIONS

Although that at the declarative level, young people say that they are largely ready to face emergencies, at the practical-applicative level, they say that they need training to develop capabilities of providing first aid, survival, maintaining calm in extreme situations, managing and resolving emergency situations, etc. In practice, the implications of this research would be:

- Better promotion of the various institutions such as the Air Force, the Volunteer Service for Emergency Situations, and NGOs with the aim of spreading knowledge about their work to the civilian population and especially towards the youth of specific activities;
- Better promotion with consequences on the representation and on the attitudes towards certain military or civilian institutions in order to improve their image;
- Initiation and implementation of projects of cooperation between civil and military institutions in order to prepare civilians so

they can cope with, manage or resolve certain emergencies;

- Initiation of programmes of cooperation between civil and military environment to be exploited under the form of practical changes to the national curriculum level (introduction of optional courses such as: first aid, emergency management, survival course, etc.).

Young people's curiosity can be easily stimulated, but we must also channel this interest towards the practical aspects of life, towards the situations and events that are unavoidable and more and more common, situations for which they must be prepared, where they must assume certain responsibilities that contribute, ultimately, to defining them as people.

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## A GLIMPSE INTO THE PROCESS OF WRITING

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**Abstract:** *It is precisely this capacity of written language to transcend time and space that makes the teaching and learning of writing such an important exercise. Through writing we are able to share ideas, arouse feelings, persuade and convince other people. We are able to discover and articulate ideas in ways that only writing makes possible.*

*Writing takes time. In particular, time is needed to incubate, sift and shape ideas. We also know that time is one of the most precious resources of both teachers and students and that when, as is often the case, time is at a premium, writing is one of the first things to be cut back or relegated to homework. Yet, of all the skills, writing is the one which most needs and benefits from time. So, we advocate devoting classroom time to writing.*

*The writing process is a recursive one, in which the activities we have had to group and present in some kind of linear order in this article do not occur in any fixed sequence in the act of creating a text – though in most cases there will obviously tend to be more generating and focusing activities at the outset, and more emphasis on evaluating and reviewing as the drafting progresses.*

*Writing is far from being a simple matter of transcribing language into written symbols: it is a thinking process in its own right. It demands conscious intellectual effort, which usually has to be sustained over a considerable period of time. Furthermore, precisely because cognitive skills are involved, proficiency in language does not, of itself, make writing easier. People writing in their native language, though they may have a more extensive stock of language resources to call upon, frequently confront exactly the same kinds of writing problems as people writing in a foreign or second language.*

**Key words:** *writing, process, activities, language, thinking, creation, planning, resources.*

When we learn a second language, we learn to communicate with other people: to understand them, talk to them, read what they have written and write to them. An integral part of participating fully in a new cultural setting is learning how to communicate when the other person is not right there in front of us, listening to our words and looking at our gestures and facial expressions.

But the fact that people frequently have to communicate with each other in writing is not the only reason to include writing as part of our second-language syllabus. There is an additional and very important reason; writing helps our students learn. How? First, writing reinforces the

grammatical structures, idioms, and vocabulary that we have been teaching our students. Second, when our students write, they also have a chance to be adventurous with the language, to go beyond what they have just learned to say, to take risks. Third, when they write, they necessarily become very involved with the new language; the effort to express ideas and the constant use of eye, hand and brain is a unique way to reinforce learning. As writers struggle with what to put down next or how to put it down on paper, they often discover something new to write or a new way of expressing their idea. They discover a real need for finding the right word and the right sentence. The

close relationship between writing and thinking makes writing a valuable part of any language course.

It is precisely this capacity of written language to transcend time and space that makes the teaching and learning of writing such an important experience. Through writing we are able to share ideas, arouse feelings, persuade and convince other people. We are able to discover and articulate ideas in ways that only writing makes possible.

Yet despite the power of writing – as a permanent record, as a form of expression and a means of communication – it has tended to be a much neglected part of the language programme, both in first and in second language teaching. A great deal of writing goes on in ESL lessons, especially in an elementary-level class, is sentence writing. Students repeat or complete given sentences to reinforce the structure, grammar, and vocabulary they have learned. They work with pattern sentences, performing substitutions or transformations.

Some of you may wonder why it is not enough to teach our students how to speak English adequately: won't they then obviously be able to write? Not necessarily, for writing is not simply speech written down on paper. Learning to write is not just a "natural" extension of learning to speak a language. We learnt to speak our first language at home without systematic instruction, whereas most of us had to be taught in school how to write that same language. Many adult native speakers of a language find writing difficult. The two processes, speaking and writing, are not identical. Let's look at some of the differences between writing and speaking:

**a.** Speech is universal; everyone acquires a native language in the first years of life. Not everyone learns to read and write.

**b.** The spoken language has dialect variations. The written language generally demands forms of grammar, syntax, and vocabulary.

**c.** Speakers use their voices (pitch, stress, and rhythm) and bodies (gestures and facial expressions) to help convey their ideas. Writers have to rely on the words on the page to express their meaning.

**d.** Speakers use pauses and intonation. Writers use punctuation.

**e.** Speakers pronounce. Writers spell.

**f.** Speaking is usually spontaneous and unplanned. Most writing takes time. It is planned. We can go back and change what we have written.

**g.** A speaker speaks to a listener who is right there, nodding or frowning, interrupting or questioning. For the writer, the reader's response is either delayed or nonexistent. The writer has only that one chance to convey information and be interesting and accurate enough to hold the reader's attention.

**h.** Speech is usually informal and repetitive. We say things like, "What I mean is..." or "Let me start again." Writing, on the other hand, is more formal and compact. It progresses logically with fewer digressions and explanations.

**i.** Speakers use simple sentences connected by a lot of **and**'s and **but**'s. Writers use more complex sentences, with connecting words like **however**, **who**, and **in addition**. While we could easily say, "His father runs ten miles every day and is very healthy," we might well write, "His father, who runs ten miles every day, is very healthy."

When we look at just these few differences – and there are many more – we can see that our students will not just "pick up" writing as they learn other skills in ESL classes. We have to teach writing. And that, of course, leads to the next question and the subject of how to do this.

There is no one answer to the question of how to teach writing in ESL classes. There are many answers as there are teachers and teaching styles, or learners and learning styles. Treating any piece of writing

as a source of language errors misses the point of our approach. Grammar is important – but as a tool, a means, and not as an end in itself. Such research evidence as we have suggests that focusing on language errors in writing improves neither grammatical accuracy nor writing fluency.

Writing takes time. In particular, time is needed to incubate, sift and shape ideas. We also know that time is one of the most precious resources of both teachers and students and that when, as is often the case, time is a premium, writing is one of the first things to be cut back or relegated to homework. Yet, of all the skills, writing is the one which most needs and benefits from time. So, we have to devote classroom time to writing. As it happens, many of the activities we have suggested involve pair and group work, not to mention discussion and collaboration, so that the writing class becomes, in a very genuine sense, a communicative experience in which much more than skill in writing is practiced and developed.

Writing is far from being a simple matter of transcribing language into written symbols: it is a thinking process in its own right. It demands conscious intellectual effort, which usually has to be sustained over a considerable period of time. Furthermore, precisely because cognitive skills are involved, proficiency in language does not, of itself, make writing easier. People writing in their native language, though they may have a more extensive stock of language resources to call upon, frequently confront the same kinds of writing problems as people writing in a foreign or second language.

In order to think of effective ways of coming to grips with these problems, we have to find out what actually goes on when people write. And this is notoriously difficult. Much of the evidence that we do have has been obtained from various kinds of observations of writers at work, and introspections of writers themselves, as in the

‘compose aloud’ activities. What the transcripts from such activities help reveal is that there is much more to writing than a mere learning and applying of linguistic or rhetorical rules. Rather, writing is a form of problem-solving which involves such processes as generating ideas, discovering a ‘voice’ with which to write, planning, goal-setting, monitoring and evaluating what is going to be written as well as what has been written, and searching for language with which to express exact meanings. Moreover, writers rarely know at the outset exactly what it is they are going to write because many ideas are only revealed during the act of writing itself.

Another challenging task which writers face is that they have to organize an amorphous mass of ideas, information and associations into coherent, linear text. Moreover, they can neither speak to nor see the person or persons they are addressing. All they have to convey their message is the abstract symbol system of written language. With this, they must make explicit every aspect of their meaning; their text must create its own context.

At the same time, writers have to consider what we might call the ‘laws of communication’. Whenever we engage in any kind of communication which requires language, we operate within a framework of unspoken rules or conventions. Thus, readers expect that writers will give them neither more nor less information than is needed for the message to be understood. They assume, too, that writers will not give them information which they know to be false, or for which they lack sufficient evidence, or which is irrelevant to their purpose of writing. And finally, readers expect writers to use language which is clear, unambiguous, and appropriate to the context and type of text concerned. If writers deliberately flout these unwritten laws, they do so in order to make some kind of extraordinary impact on their readers. If, however, they simply fail to

observe these conventions, they produce writing which is unsatisfactory and ineffective.

It is easy to neglect these 'laws' when we write, for the nature of writing is such that it engrosses us in our thought processes, and carries us off into a mental world where there is no feedback from a present audience. Thus, as writers, we need to make a constant and conscious effort to imagine our intended readers and anticipate their reactions to the symbols we have put on the page. We have to evaluate, for instance, how much knowledge we share with our readers, and how much is exclusive to us; we must decide how to 'package' our information to achieve our purpose in writing; we have to judge whether the language we have chosen conveys the whole of our meaning; and we need to make sure that readers will be able to follow the train of thought underpinning the whole text.

What is important for us teachers of writing is to engage our students in that creative process; to excite them about how their texts are coming into being; to give them insights into how they operate as they create their work; to alter their concepts of what writing involves. What we get across is the notion that writing is re-writing; that revision – seeing with new eyes – has a central role to play in the act of creating a text, and is not merely a boring error-checking exercise; and above all, that evaluation is not just the province of the teacher alone at the final stage of the process, but that it is equally the concern and responsibility of every writer at every stage.

The main aim is to arrive at the best product possible. What differentiates a process-focused approach from a product-centered one, though, is that the outcome of writing – that is, the product – is not preconceived. Writing in a process approach is divergent, with as many different outcomes as there are writers. In a typical product-centered approach, on the other hand, writing will converge towards a pre-defined goal,

with a model text being presented to form the focus of comprehension and text manipulation activities. What will not be obvious in this latter approach, either from the model text, or from the activities based on it, is *how* the writer actually composed it. By contrast, process-focused lessons may introduce texts written by other people, but only *after* the students have written something of their own, so that the text is now a resource for further ideas rather than a model for mimicry.

It is as well to remember, though, that whatever the enthusiasm and commitment generated by a process approach, neither teachers nor students should expect sudden miracles to occur, such that elementary students suddenly become intermediate level writers as a result of the activities they have engaged in. indeed, it would be unreasonable to expect such transformations to occur. What process-focused activities will do is help students develop in ways which are appropriate to and fulfilling to their level of language proficiency. More than that cannot be expected.

Disorder, imprecision, recursiveness, complexity, individual variation – these are the very problems of a process-oriented approach to writing. And the more we find out what writers actually do when they write, the more comprehensive a specification of writing skills we shall be able to develop, and in turn, a more flexible and adaptable range of teaching techniques. This is especially important in the context of foreign or second language teaching, where writing has often tended to be used as a vehicle for little more than either language-learning reinforcement or for the display of linguistic proficiency. What we, as teachers, should be aiming at is creating an environment in which our students, rather than being intimidated and frustrated by the complexity of writing, are engaged in and enthused by it, and where they feel that credit is given for every aspect of the effort which goes into the writing

process. Our goal is to present writing as a stimulating process centered upon the 'matching of matter and manner' such that it becomes 'the ferry' between the writer and the reader.

However, although we have left it upon you to decide how and in which order to use the activities, we do advocate planning a series of lessons around the particular writing assignment you have in mind, which will draw upon a selection of tasks from various sections. Thus, your students may end up writing fewer essays per term or course than customary, but these pieces of work will have had the chance of being carefully thought out and worked through.

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## NARROWING THE GAP BETWEEN THEORY AND PRACTICE OF TRANSLATION

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**Abstract:** *Language is an expression of culture and individuality of its speakers. It influences the way the speakers perceive the world. This principle has a far-reaching implication for translation. If language influences thought and culture, it means that ultimate translation is impossible. The opposite point of view, however, gives another perspective. Humboldt's "inner" and "outer" forms in language and Chomsky's "deep" and "surface" structures imply that ultimate translation is anyhow possible.*

*In practice, however, the possibility depends on the purpose and how deep the source text is embedded in the culture. The more source-text-oriented a translation is, the more difficult it is to do. Similarly, the deeper a text is embedded in its culture, the more difficult it is to work on.*

*Since its inception, translation has not ceased to play its indispensable role of transferring messages across languages and cultural barriers. By so doing it continuously weakens the fences between languages, exposing their similarities, getting a consensus on their differences and easing interactions that will assist in developing cross-cultural integrative skills useful in an interdependent world.*

*Related to translation, culture manifests in two ways. First, the concept or reference of the vocabulary items is somehow specific for the given culture. Second, the concept or reference is actually general but expressed in a way specific to the source language culture. In practice, however, it is suggested that a translator should take into account the purpose of the translation in translating the culturally-bound words or expressions. The translation procedures discussed should also be considered.*

**Key words:** *culture, language universals, translation purpose, translation procedure, translation possibility*

Since its inception, translation has not ceased to play its indispensable role of transferring messages across languages and cultural barriers. By so doing it continuously weakens the fences between languages, exposing their similarities, getting a consensus on their differences and easing interactions that will assist in developing cross-cultural integrative skills useful in an interdependent world. Several theories have been suggested to explain the concept of translation. In view of the dichotomy between theory and practice of translation, an attempt is being made to narrowing the gap. It was found that each school of thought on translation has its peculiarity and none should be neglected. This study underscores

the need for a consensus between practical and theoretical translation in guessing right the mind of the author by making efforts to minimize the gap between original text and its translation.

Expressed in Saussurean terms, translation operates the transfer of an instance of *parole* from one *langue* (code) to another. However, every *langue* is an autonomous system where elements are arranged in a particular order and are governed by specific rules, often different from other systems. The situation is more complicated if one considers not only internal rules that govern a language, but also cultural factors, which may render languages untranslatable. According to Saussure, the

message is structured as a string of linguistic signs, organized according to a paradigm. In his view, the linguistic sign is a mentally construed dual entity, composed of a signified—the concept, and a signifier—the acoustic image. There is no necessary relation between these two, as there is no necessary relation between sign and its referent, which Saussure chooses to exclude from his definition.

### 1. Cultural Consideration in Translation

It has been long taken for granted that translation deals only with language. Cultural perspective, however, has never been brought into discussion. This can be seen in most of the following definitions.

The first definition is presented by Catford. He states that translation is the replacement of textual material in one language by equivalent textual material in another language. In this definition, the most important thing is equivalent textual material. Yet, it is still vague in terms of the type of equivalence. Culture is not taken into account.

Very much similar to this definition is that by Savory (1968) who maintains that translation is made possible by an equivalent of thought that lies behind its different verbal expressions.

Next, Nida and Taber (1969) explain the process of translating as follows. Translating consists of reproducing in the receptor language the closest natural equivalent of the source language message, first in terms of meaning and secondly in terms of style.

In *Translation: Applications and Research*, Brislin defines translation as: "the general term referring to the transfer of thoughts and ideas from one language (source) to another (target), whether the languages are in written or oral form; whether the languages have established orthographies or do not have such standardization or whether one or both languages is based on signs, as with sign languages of the deaf."

In the definitions appearing in 1960s-1970s, some similarities have been found: (1) there is a change of expression from one language to the other, (2) the meaning and message are rendered in the TL, and (3) the translator has an obligation to seek for the closest equivalent in the TL. Yet, there is no indication that culture is taken into account except in that of Nida and Taber.

In the following definition, Newmark does not state anything about culture.

"Translation is a craft consisting in the attempt to replace a written message and/or statement in one language by the same message and/or statement in another language"

It is known that out of the definitions above only one takes cultural aspects into account, the one by Nida and Taber. This definition is actually a specific one, rooted from the practice of the Bible translation. By nature, it is understood that the translation should be done to every language. As the content addresses all walks of life and culture plays an important role in human life, culture, therefore, should be considered.

The other definitions, however, are meant to explain the experts' view on translation theory to be applied in the translation of all types of material, including scientific or technical texts which are not deeply embedded in any culture. Thus, it can be momentarily hypothesized that cultural consideration must be taken if the material to translate is related to culture. For material that is not very much embedded into a specific culture, cultural consideration may not be necessary.

According to Snell-Hornby, however, this exclusion of cultural aspect from the discussion of translation theory is due to the view of the traditional approach in linguistics which draws a sharp dividing-line between language and "extralinguistic reality" (culture, situation, etc.). The contemporary approach, according to her, sees language as an integral part of culture.

### 2. Language and Culture

Culture in this discussion should be seen in a broad sense, as in anthropological

studies. Culture is not only understood as the advanced intellectual development of mankind as reflected in the arts, but it refers to all socially conditioned aspects of human life.

Another point of view, however, asserts the opposite. Ironically this also goes back to Humboldt's idea about inner and outer forms of language. Later it is developed into the concepts of deep structure and surface structure by Chomsky. Inner form and deep structure is what generally known as idea. Following this concepts, all ideas are universal. What is different is only the surface structure, the outer form. If it is so, translation is only a change of surface structure to represent the universal deep structure. Accordingly, translation is theoretically always possible.

All in all, we are faced with two extremes. Which one is right? The answer, according to Snell-Hornby lies not in choosing any of the two. If the extremes are put at the ends of a cline, the answer lies between the two. In brief, theoretically the degree of probability for perfect translation depends on how far the source language text (SLT) is embedded in its culture and the greater the distance between the culture between SLT and target language text (TLT), the higher is the degree of impossibility. See the following excerpts for illustration.

The term 'culture' addresses three salient categories of human activity: the 'personal,' whereby we as individuals think and function as such; the 'collective,' whereby we function in a social context; and the 'expressive,' whereby society expresses itself.

Language is the only social institution without which no other social institution can function; it therefore underpins the three pillars upon which culture is built.

Translation, involving the transposition of thoughts expressed in one language by one social group into the appropriate expression of another group, entails a process of cultural de-coding, re-coding and en-coding. As cultures are

increasingly brought into greater contact with one another, multicultural considerations are brought to bear to an ever-increasing degree. Now, how do all these changes influence us when we are trying to comprehend a text before finally translating it? We are not just dealing with words written in a certain time, space and socio-political situation; most importantly it is the "cultural" aspect of the text that we should take into account. The process of transfer, i.e., re-coding across cultures, should consequently allocate corresponding attributes vis-à-vis the target culture to ensure credibility in the eyes of the target reader.

Multiculturalism, which is a present-day phenomenon, plays a role here, because it has had an impact on almost all peoples worldwide as well as on the international relations emerging from the current new world order. Moreover, as technology develops and grows at a hectic pace, nations and their cultures have, as a result, started a merging process whose end (-point?) is difficult to predict. We are at the threshold of a new international paradigm. Boundaries are disappearing and distinctions are being lost. The sharp outlines that were once distinctive now fade and become blurred.

As translators we are faced with an alien culture that requires that its message be conveyed in anything but an alien way. That culture expresses its idiosyncrasies in a way that is 'culture-bound': cultural words, proverbs and of course idiomatic expressions, whose origin and use are intrinsically and uniquely bound to the culture concerned. So we are called upon to do a cross-cultural translation whose success will depend on our understanding of the culture we are working with.

Is it our task to focus primarily on the source culture or the target culture? The answer is not clear-cut. Nevertheless, the dominant criterion is the communicative function of the target text.

Finally, attention is drawn to the fact that among the variety of translation approaches, the 'Integrated Approach' seems

to be the most appropriate. This approach follows the global paradigm in which having a global vision of the text at hand has a primary importance. Such an approach focuses from the macro to the micro level in accordance with the Gestalt-principle, which states that an analysis of parts cannot provide an understanding of the whole; thus translation studies are essentially concerned with a web of relationships, the importance of individual items being decided by their relevance within the larger context: text, situation and culture.

In conclusion, it can be pointed out that the transcoding (de-coding, re-coding and en-coding?-the term 'transcoding' appears here for the first time) process should be focused not merely on language transfer but also-and most importantly-on cultural transposition. As an inevitable consequence (corollary?) of the previous statement, translators must be both bilingual and bicultural, if not indeed multicultural.

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## 4. ELECTRICAL AND ELECTRONICAL ENGINEERING

„THE MANAGEMENT OF POSITIONING SYSTEMS POWER SUPPLIES USING PROGRAMMABLE LOGICAL CONTROLLERS”, <b>Cornel Ovidiu BADEA, Aurelian CRĂCIUNESCU, Valentin NĂVRĂPESCU</b>	663
„THE PERFORMANCES OF THE SYNCHRONOUS MOTOR WITH PERMANENT MAGNETS USING IN TROLLEY-BUS TRACTION”, <b>Ioan BELE, Liviu-Sevastian BOCÎI, Valentin MULLER, Mihaela POPA</b>	669
„ELECTRO ANALYTICAL MEASUREMENT METHODS USING VIRTUAL INSTRUMENTATION ASSISTED BY LABVIEW PROGRAMMES”, <b>Marius BENTA, Laura RAB, Alexandra MARMANDIU</b>	673
„EXPERIMENTAL RESEARCH ON THE MEASURING METHODS OF METALLIC SURFACES”, <b>Marius BENTA, Alexandra MARMANDIU, Cătălin MIHAI</b>	678
„MULTILAYER COMPOSITE FOR ELECTRICAL INSULATION”, <b>Florin BUȘE, Emil Dumitru POPESCU, Traian ZAHARESCU</b>	681
„THE REGULATION OF THE POWER FOR THE MODERNIZED ELECTRICAL RAILWAY-ENGINE BO-BO OF 3400KW”, <b>Gabriela CRISTESCU, Laurentiu JITARU</b>	687
„STRUCTURAL-KINEMATICAL RELIABILITY ASPECTS OF EXTERNAL MEMORY WITH RIGID MAGNETIC DISKS”, <b>Petre-Daniel DINESCU, Dinu COMĂNESCU, Adriana COMĂNESCU,</b>	690
„CONSIDERATIONS ABOUT THE ELECTRICAL ENGINE VIBRODIAGNOSIS”, <b>Melania FILIP, Elena HELEREA, Ioan Călin ROȘCA, Doru LUCULESCU</b>	696
„THOMSON JUMPING RING SIMULATION”, <b>Laurian GHERMAN</b>	704
„HIGH PRECISION LI BATTERY MONITOR”, <b>Dan LOZNEANU, Gheorghe PANĂ, Ioan-Răzvan LOZNEANU</b>	710
„FLY ASH CAPTURING AND ENVIRONMENTAL ISSUES”, <b>Alexandra MARMANDIU, Rodica POPESCU, Marius BENTA</b>	716
„STUDY ON THE COMPOSITION AND PROPERTIES OF FLY ASH THERMAL FROM STEAM POWER PLANT”, <b>Alexandra MARMANDIU, Rodica POPESCU, Marius BENTA</b>	720
„CONSIDERATIONS ABOUT MODELLING OF THE AC CIRCUIT WITH SCR”, <b>Ecaterina Liliana MIRON, Mihai MIRON</b>	724
„OPTICAL CHANNELS IMPLEMENTATION BE MEASUREMNT AND CONTROL SYSTEMS”, <b>Mihai MIRON, Ecaterina Liliana MIRON</b>	728
„POLYETHYLENE ELECTRICAL INSULATION MATERIALS UNDER ACCELERATED DEGRADATION”, <b>Emil Dumitru POPESCU, Traian ZAHARESCU, Gheorghe SAMOILESCU</b>	732
„GENERALIZED GRAPHIC REPRESENTATION OF NOISE MARGINS FOR TTL INTEGRATED CIRCUITS”, <b>Mircea Iulian PORTEANU</b>	739
„ENERGETICAL MONITORING OF THE STORAGE DEVICES BY USING SENSORS NETWORK PLACED INSIDE THE MOBILE SYSTEMS”, <b>Ana Maria PUȘCAȘ, Radu MUȘAT, Marius CARP, Paul BORZA, Elena HELEREA</b>	745
„SYNTHESIS OF THE MAGNETIC COMPENSATION WRAP AROUND FOR A SHIP UNDER CONSTRUCTION”, <b>Gheorghe SAMOILESCU, Mircea CONSTANTINESCU, Alina BARBU, Adelina SAMOILESCU</b>	753
„NEW SOLUTIONS FOR THE MAGNETIC PROTECTION OF SHIPS”, <b>Gheorghe SAMOILESCU, Mircea CONSTANTINESCU, Alina BARBU, Adelina SAMOILESCU</b>	757
„THE MECHANISM OF RADIATION DEGRADATION OF SPACE SOLAR CELLS”, <b>Sergiu SHISHIYANU, Teodor SHISHIYANU, Ioan CALINIUC</b>	762
„CONSIDERATIONS ABOUT OF THE RC LOADED, SINGLE PHASED TRANSFORMER IN PERIODICAL A.C. SWITCHING MODE”, <b>Constantin STRIMBU</b>	768
„BROADBAND MICROWAVE ANTENNAS”, <b>Andrei SZILAGYI, Daniela CAZANARU, Adina BOTEANU</b>	773

„EVALUATION OF THE SHIELDING EFFECTIVENESS OF A MULTIMODE METALLIC CAVITY”, <b>Andrei SZILAGYI, Daniela CAZANARU, Adina BOTEANU</b>	<b>777</b>
„DESIGN AND IMPLEMENT OF DIGITAL ASYNCHRONOUS SYSTEMS USING VERILOG HDL”, <b>Mihai TIMIS, Alexandu VALACHI</b>	<b>781</b>
”SYNTHESIS OF THE ASYNCHRONOUS DIGITAL SYSTEMS USING RECONFIGURABLE DEVICES”, <b>Mihai TIMIS, Alexandu VALACHI</b>	<b>785</b>
„ELECTROMAGNETIC SYSTEM WITH TWO ASYNCHRONOUS GENERATORS”, <b>Daniel TOADER, Valentin MÜLLER</b>	<b>789</b>
„THE MATHEMATICAL MODELING OF THE ELECTROMAGNETIC GROUP - WIND TURBINE AND ASYNCHRONOUS GENERATOR”, <b>Daniel TOADER, Valentin MÜLLER</b>	<b>792</b>
„AN APPROACH TO IMPROVED QUALITY OF CURRENT”, <b>Dan George TONȚ, Gabriela TONȚ</b>	<b>796</b>
„IMPROVING QUALITY PERFORMANCE OF CURRENTS”, <b>Dan George TONȚ, Gabriela TONȚ</b>	<b>801</b>

## THE MANAGEMENT OF POSITIONING SYSTEMS POWER SUPPLIES USING PROGRAMMABLE LOGICAL CONTROLLERS

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**Abstract:** *The essay presents some aspects regarding the management of positioning systems power supplies using programmable logical controllers.*

*Starting with the input necessities with electricity of equipments that forms a positioning system and programmable logical controller performances it is established and simulated a power supplies management system, in normal and damage situations.*

*This study is an improvement solution of power supplies management for positioning systems.*

**Key words:** *power supplies management, programmable logical controller*

### 1. INTRODUCTION

A positioning system in two plans (elevation –  $\varepsilon$  and azimuthally –  $\beta$ ) which assures the motion of guidance radar antennas needs a few power supplies. In many cases, the antennas systems are disposed separately by the command system. The links between those are maddened using wires or optical fibers.

In antennas plant we introduced a system which assures the management of four power supplies. The system was developed using a programmable logical controller which was programmed using dedicated software. For this controller we simulated it function in normal and damage situations considering analog voltages inputs connected at operational amplifiers which assure voltage level conversion.

### 2. SUPPLY VOLTAGES

In the process of modernization of guidance radar we developed one system which assures the positioning of guidance radar antennas. During this process we projected a few equipments which need the implementation of adequate power supplies.

The positioning system of antennas is connected at the alternative supply voltage

(3x220V/50 Hz) using one 4 wire-cable. In the antennas plant are disposed four power supplies which are developed for assuring the motion of antennas positioning system.

These power supplies form the next voltages:

- + 5V, used for universal asynchronous receiver transmitter circuits, all TTL integrated circuits, latches, optical fibers transmitters and receivers;
- ± 11 V, used for differential operational amplifiers;
- ± 15 V, used for thyristors command;
- + 220 V, used for DC motors excitation drive.

### 3. SEQUENTIAL SWITCH-ON ALGORITHM

For reducing the starting current the power supplies are switched on in 3 seconds. We developed one sequential switching on algorithm which takes into consideration the following starting conditions:

- The first power supply which switches on is the one which forms +5V. It starts at the moment of coupling alternative supply voltages. After that the communication between antennas system and control post of guidance radar is initialized and assures the

conditions for transmitting the POWER ON command to the antennas system;

- At the transmitting moment of the POWER ON command (1 second after coupling of alternative supply voltages) is supplied the scheme which forms  $\pm 11V$ ;

- After 0.25 seconds, if the  $\pm 11V$  supply voltage is at nominal value, it is formed the command which assures the supplying of the scheme which forms  $\pm 15V$ .

- After another 0.25 seconds, if the  $\pm 15V$  supply voltage is at nominal value, it is formed the command which assures the supplying of the scheme which forms  $+220V$  for DC motor excitation drive of elevation ( $\epsilon$ ) plan.

- After 0.5 seconds, if the  $+220V$  ( $\epsilon$ ) supply voltage is at nominal value, it is formed the command which assures the supplying of the scheme which forms  $+220V$  for DC motor excitation drive of azimuthally ( $\beta$ ) plan.

- After another 0.5 seconds, if the  $+220V$  ( $\epsilon$  and  $\beta$ ) supply voltages are at nominal values, it is formed the command which assures the supplying of the elevation drive.

- After other 0.5 seconds, if the  $+220V$  ( $\epsilon$  and  $\beta$ ) supply voltages are at nominal values, it is formed the command which assures the supplying of the azimuthally drive.

The POWER OFF command can be transmitted from the control post of guidance radar (in normal situations) or from one smoke detector (in fire situation). The both situation assure switching-off case for all supply voltages.

The smoke detector is mounted inside the antennas post. If a fire beginning is detected the smoke detector will switch-off all the power supplies.

The sequential switch-on algorithm is showed in figure 1.

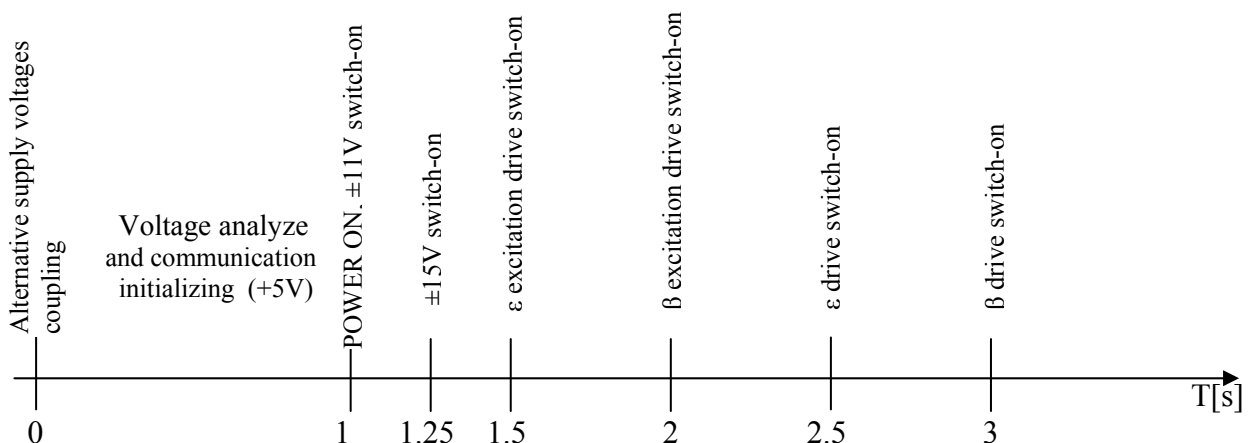


Fig.1. Sequential switch-on algorithm

#### 4. THE INTRODUCTION OF PROGRAMMABLE LOGICAL CONTROLLER INTO POWER SUPPLIES MANAGEMENT

The introduction of programmable logical controller into the power supplies management is based on the following technical characteristics:

- a level of flexibility like a computer but at a price comparable with a system developed using relays;
- easy programmable and maintained;
- work in dust condition, electromagnetically fields and vibrating structure;

- a modular structure which allows easy components changing;
- easy expanded.

For implementing power supplies management system we selected a programmable logical controller made by Moeller. The controller is from **EASY 700** series family and its code is **EASY 719-DC-RCX**. It has next technical characteristics:

- inputs – 12;
- analog inputs (0÷10V DC, 10 bit) – 4;
- outputs – 6;
- markers – 32 (M1÷M16, N1÷N16);
- rungs – 128;
- analog value processing – 16;



- counters – 16;
- timing relays – 16;
- supply voltage – 24V DC;
- type of outputs – relay (8A);
- temporized commutation – disposable;
- LCD display – no.

For power supplies management implementation we configured the programmable logical controller inputs and outputs like bellow:

**Inputs:**

- Input I01 – POWER ON command from guidance radar control post;
- Input I02 – POWER OFF command from guidance radar control post;
- Input I03 – POWER OFF command from smoke detector;
- Input I07 – analog input –  $5.5V \pm 10\%$  DC;
- Input I08 – analog input –  $7.5V \pm 10\%$  DC;
- Input I11 – analog input –  $5.5V \pm 10\%$  DC;
- Input I12 – analog input –  $5.5V \pm 10\%$  DC.

**Outputs:**

- Output Q01 – POWER ON/OFF power supply which forms  $\pm 11V$ ;
- Output Q02 – POWER ON/OFF power supply which forms  $\pm 15V$ ;
- Output Q03 – POWER ON/OFF power supply which forms + 220 V  $\epsilon$  excitation drive;
- Output Q04 – POWER ON/OFF power supply which forms + 220 V  $\beta$  excitation drive;
- Output Q05 – POWER ON/OFF  $\epsilon$  drive;
- Output Q06 – POWER ON/OFF  $\beta$  drive.

For programming the controller we used another functions of this device like:

**Timing relays:**

- Timing relay T01 – relay = 1 sec. – represent the time between alternative supply voltages coupling and POWER ON command ( $\pm 11V$  switch-on);

- Timing relay T02 – relay = 0.25 sec. – represent the time between POWER ON command and  $\pm 15V$  switch-on;

- Timing relay T03 – relay = 0.25 sec. – represent the time between  $\pm 15V$  switch-on and +220V  $\epsilon$  excitation drive switch-on;

- Timing relay T04 – relay = 0.5 sec. – represent the time between +220 V  $\epsilon$  excitation drive switch-on and +220V  $\beta$  excitation drive switch-on;

- Timing relay T05 – relay = 0.01 sec. – represent the time between +220V  $\beta$  excitation drive switch-on and +220V  $\beta$  excitation drive at nominal value

- Timing relay T06 – relay = 1 sec. – represent the time between +220V $\epsilon$  excitation drive switch-on and  $\epsilon$  drive switch-on;

- Timing relay T07 – relay = 1 sec. – represent the time between +220V $\beta$  excitation drive switch-on and  $\beta$  drive switch-on.

**Analog comparators:**

- Analog comparators A01 and A02 – assure the surveillance of  $\pm 11V$  power supply, monitoring the +5.5V DC value provided by an operational amplifier;

- Analog comparators A03 and A04 – assure the surveillance of  $\pm 15V$  power supply, monitoring the +7.5V DC value provided by an operational amplifier;

- Analog comparators A05 and A06 – assure the surveillance of +220V  $\epsilon$  excitation drive, monitoring the +5.5V DC value provided by a voltage divisor and an operational amplifier;

- Analog comparators A07 and A08 – assure the surveillance of +220V  $\beta$  excitation drive, monitoring the +5.5V DC value provided by a voltage divisor and an operational amplifier.

The PLC programming was developed in *ladder diagram* using EASY 6.0 software. In this program we configured 16 rungs which assure the implementation of required power supplies management.

The circuit diagram is illustrated in fig. 2:

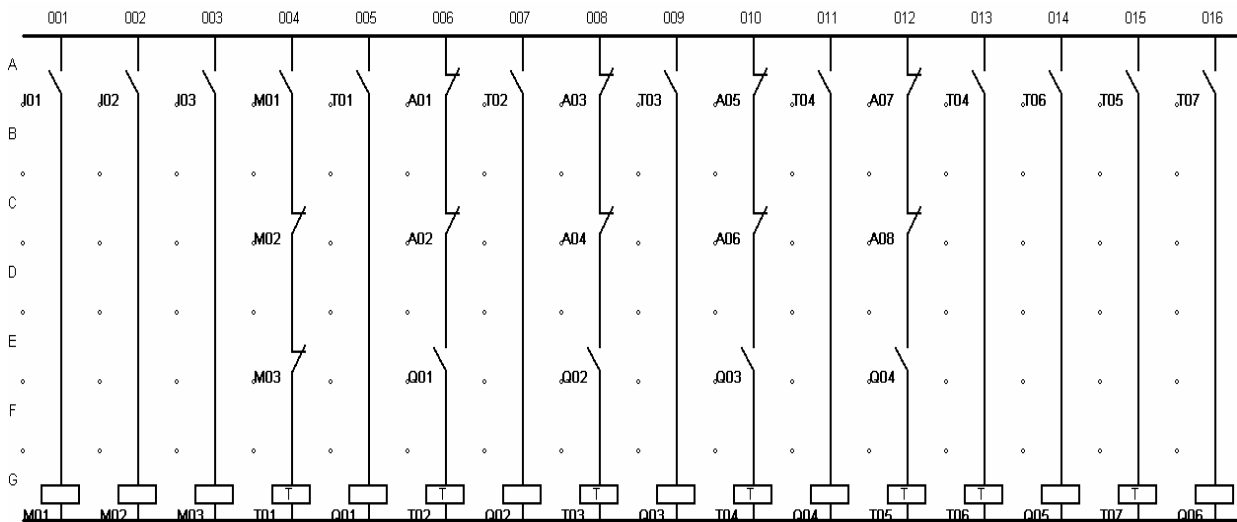


Fig.2. Diagram circuit

### 5. SIMULATION IN NORMAL SITUATION

In the diagram circuit above presented it is showed the situation which exist before

POWER ON command. When the POWER ON command is transmitted and all power supplies form supply voltages at nominal values, the diagram circuit shows like bellow:

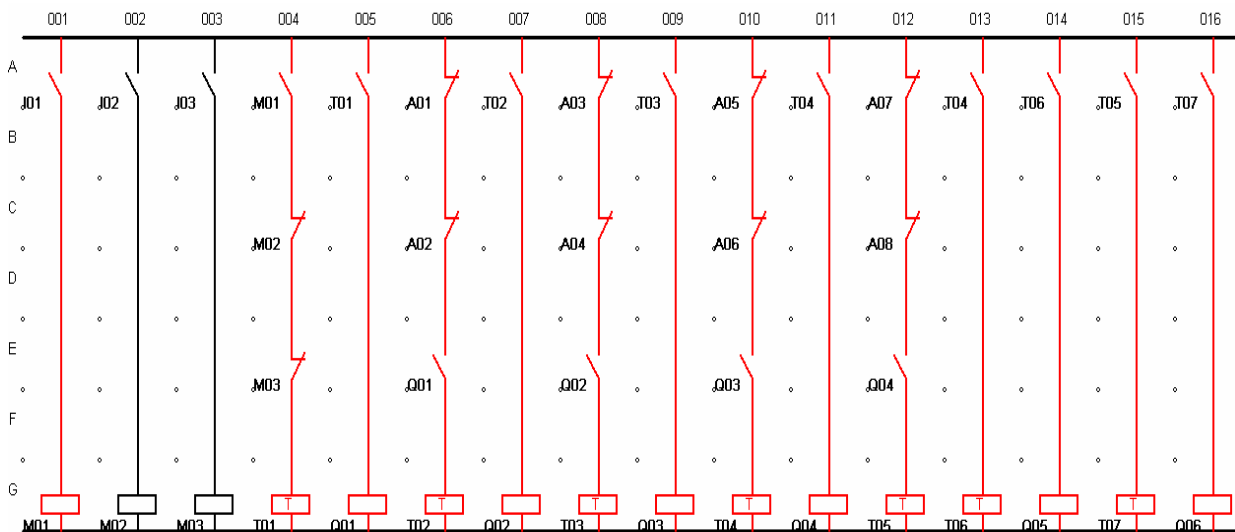


Fig.3. Diagram circuit in normal situation

For simulation in normal situation we introduced at input 1 – POWER ON command and at input 7, 8, 11 and 12 – voltages of power supplies converted by the operational amplifiers in compatible levels.

The results are showed in fig. 3 in two colors: red color – coupling and black color – not coupling. We can observe that all outputs are coupled and in this case the drives are normally supplied.

### 6. SIMULATIONS IN DAMAGE SITUATIONS

For power supplies management system simulation in damage situation we considered three situations:

a) The smoke detector shown a fire beginning;

- b) The  $\pm 15V$  power supply not forms voltages at nominal values;
- c) The  $+220V\beta$  excitation drive is not applied to DC motor.

**a) Simulation when the smoke detector shown a fire beginning**

We simulated this damage situation establishing I01 (POWER ON) and I03 (FIRE

BEGINNING) on make position. In this situation analyzing simulation result we can observe that none of the power supplies are connected. The smoke detector assures the end of drives supplying when a fire beginning is detected. In this case the diagram circuit shows like bellow:

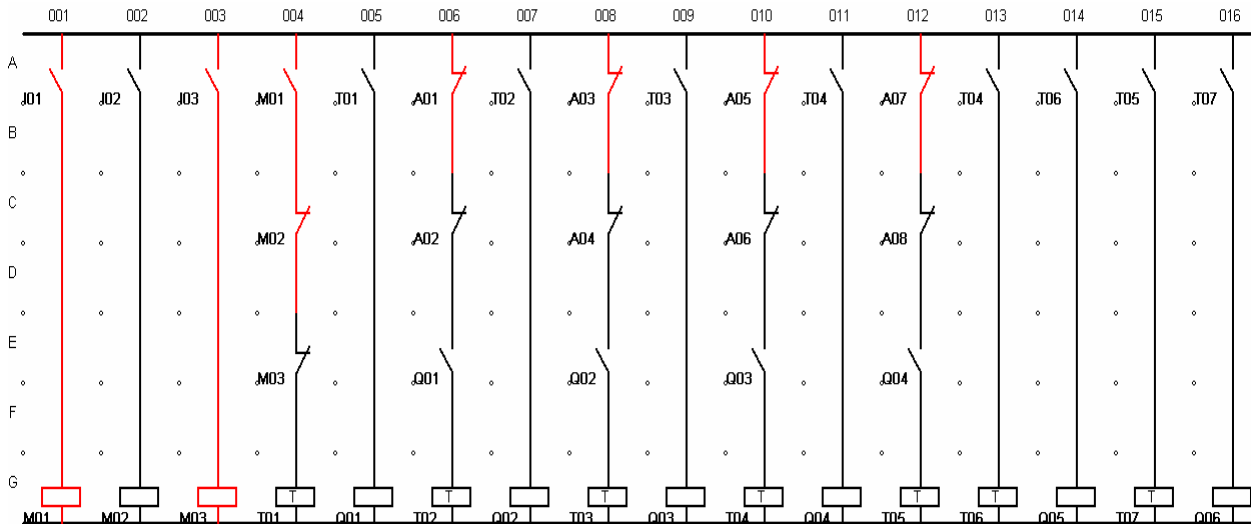


Fig.4. Diagram circuit in fire beginning situation

**b) Simulation when the  $\pm 15V$  power supply not forms voltages at nominal values**

We simulated this damage situation establishing I01 (POWER ON), I07 at  $+5.5V$  value and I08 at one value situated outside accepted values ( $+6V$ ). In this situation

analyzing the simulation result we can observe that the  $+220V \epsilon$  and  $\beta$  excitation drive supplies are not started. The  $\epsilon$  and  $\beta$  drive are also not started.

The diagram circuit shows like bellow:

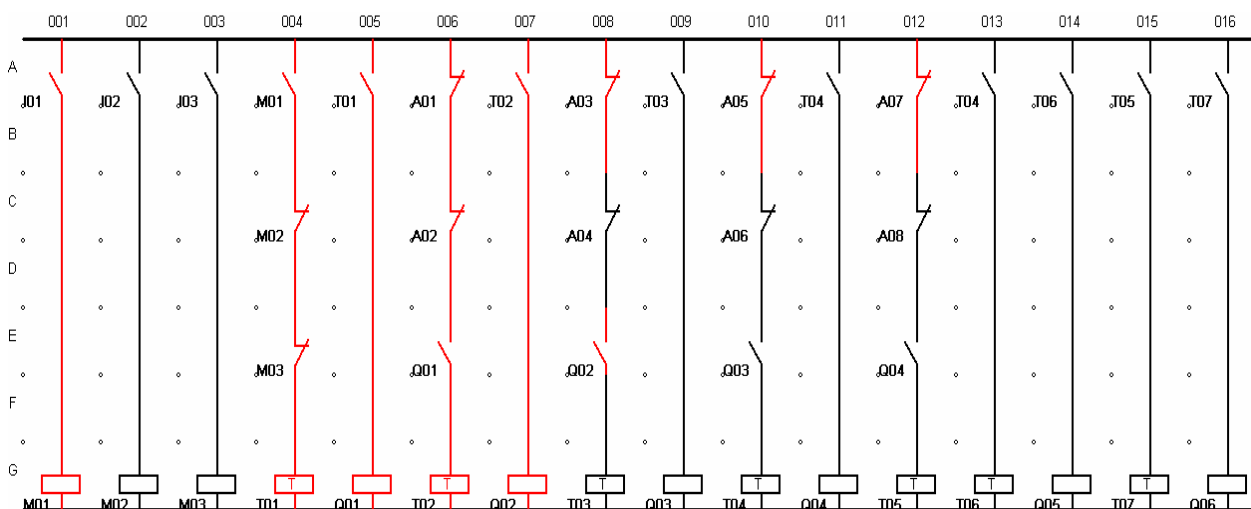


Fig.5. Diagram circuit when the  $\pm 15V$  power supply not forms voltages at nominal values

**c) Simulation when the +220V  $\beta$  excitation drive is not formed at nominal value**

We simulated this damage situation establishing I01 (POWER ON), I07 at +5.5V,

I08 at +7.5V, I11 at +5.5V value and I12 at one value situated outside accepted values (+4.8V). In this case the diagram circuit shows like bellow:

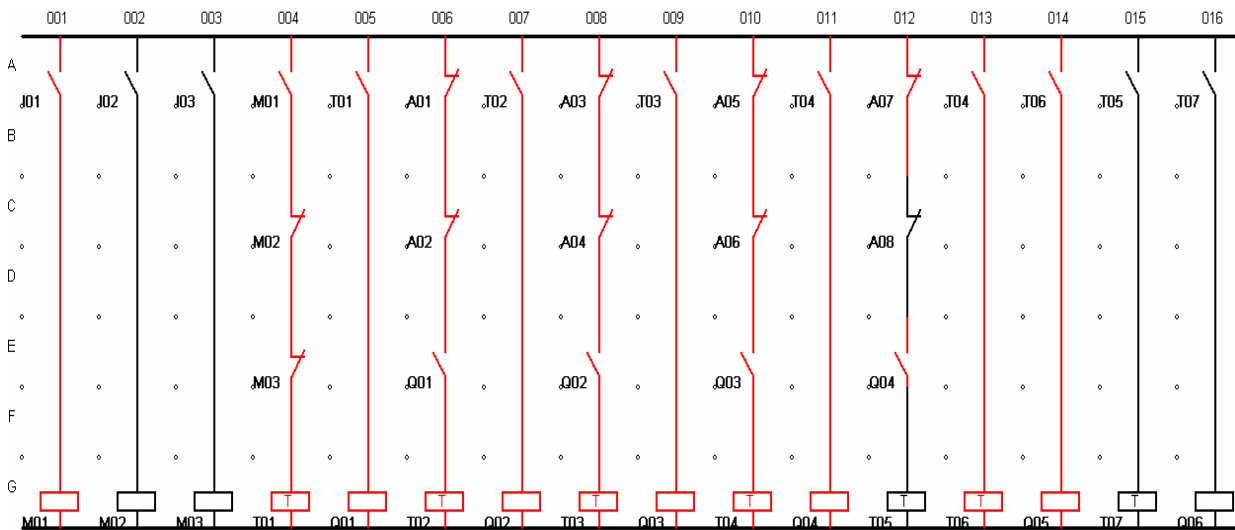


Fig.6. Diagram circuit when the +220V  $\beta$  excitation drive is not formed at nominal value

In this situation analyzing the result of simulation we can observe that +220V  $\epsilon$  excitation drive supplies is started and assures  $\epsilon$  drive functioning. Also the +220V  $\beta$  excitation drive power supply is not started then  $\beta$  drive is not functioning.

**7. CONCLUSIONS**

The introduction of programmable logical controller in power supplies management presents a few advantages like:

- A high level of flexibility into the power supplies management system implementation. In the implementation process we can use all programmable logical controller functions and we can obtain a few variants of sequential switching-on algorithms without to be necessary to modify the external connections;
- Using programmable logical controller it is not necessary the presence of analogically comparators or externally timing relays;
- The price is comparable with a system developed using relays, comparators and timing relays;
- The programmable logical controller is easy of use, maintenance and works in dust condition, electromagnetically fields and vibrating structure;

- Any parameter modification can by easy operated using dedicated software without modifying external connections;
- The operating configuration can be programmed using a computer and later on transferred to the programmable logical controller using dedicated communication cable;
- Can be reduced the dimensions and weight of montage.

Analyzing these advantages we concluded that the using of programmable logical controller is a future solution for power supplies management system implementation.

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## THE PERFORMANCES OF THE SYNCHRONOUS MOTOR WITH PERMANENT MAGNETS USING IN TROLLEY-BUS TRACTION

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**Abstract:** We analyze the working characteristics of the synchronous motor with permanent magnets for a variable electromagnetic torque considering like parameter supply voltage frequency.

**Key words:** synchronous motor, permanent magnet, working characteristics.

### 1. INTRODUCTIONS

Electric motors for tractions are different from the other electric machines by hard working conditions and a small overall size because of the reduced space of the trolley-bus.

These electric machines must allow at starting a current (2÷3) times bigger than the rated current, a regular working at a rotative speed at least double rated rotative speed, a maximum face to acceleration of (1,8÷2,2) m/s<sup>2</sup> and to be insulated for the contact network voltage.

### 2. WORKING CHARACTERISTICS DETERMINATION

Synchronous motors with permanent magnets are characterized by a constant rotor flux ( $\Psi_{MP} = ct$ ).

In the working study of the synchronous motor, it will be adopted the association of the positive senses proper to the user.

The phasorial diagram [1] of the synchronous motor with permanent magnets is shown in figure 1.

From this diagram, neglecting the electric resistances, we can write:

$$U_1 \cdot \sin \theta = \omega_1 \cdot L_s \cdot I_q \quad (1)$$

$$U_1 \cdot \cos \theta = \omega_1 \cdot (\Psi_{MP} - L_s \cdot I_q) \quad (2)$$

From which we can determine  $I_q$  component of the stator current:

$$I_q = \frac{1}{L_s} \sqrt{\left(\frac{U_1}{\omega_1}\right)^2 - (\Psi_{MP} - L_s \cdot I_q)^2} \quad (3)$$

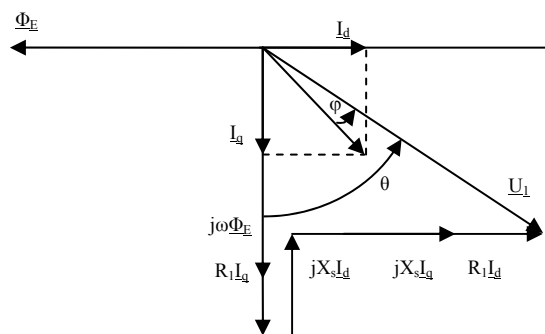


Fig. 1 The phasorial diagram of the synchronous motor with permanent magnets

With  $I_d$  like parameter at a given value from the stator supply voltage, results the electromagnetic torque of the synchronous motor:

$$M = m_1 p_1 \Psi_{MP} \sqrt{\left(\frac{U_1}{\omega_1}\right)^2 - (\Psi_{MP} - L_s I_q)^2} \quad (4)$$

where  $m_1$  is the stator number of phases.

From relation (4) we can determine the mechanical characteristic of the synchronous motor at a constant impulse flux:

$$\omega_1 = \frac{m_1 p_1 \Psi_{MP} U_1}{\sqrt{(ML_s)^2 + (m_1 p_1 \Psi_{MP})^2 (\Psi_{MP} - L_s I_q)^2}} \quad (5)$$

For the determination of the loading angle it is used the next relation:

$$\sin \theta = \frac{\omega_1 \cdot L_s}{U_1} \cdot I_q \quad (6)$$

or:

$$\theta = \arcsin \left[ \frac{\omega_1}{U_1} \sqrt{\left(\frac{U_1}{\omega_1}\right)^2 - (\Psi_{MP} - L_s I_q)^2} \right] \quad (7)$$

The stator winding current is determined by relation:

$$I_1 = \sqrt{I_d^2 + I_q^2} \quad (8)$$

or:

$$I_1 = \sqrt{I_d^2 + \frac{1}{L_s^2} \left[ \left(\frac{U_1}{\omega_1}\right)^2 - (\Psi_{MP} - L_s I_q)^2 \right]} \quad (9)$$

The efficiency according to the electromagnetic torque is determined using the next formula [2]:

$$\eta = \frac{P_1}{P_2 + I_1^2 \cdot R_1 + P_{Fe}} \quad (10)$$

where  $P_2$  is the given power to the synchronous motor axle and the losses in the ferromagnetic core  $P_{Fe}$  of the synchronous motor are determined from the rated date ( $P_N, \eta_N, I_{1N}$ ).

The power factor depending on the electromagnetic couple is determined from the basis relation:

$$\cos \varphi_1 = \frac{M \cdot \Omega_1}{\eta \cdot m_1 \cdot U_1 \cdot m_1 \cdot I_1} \quad (11)$$

In which by substituting  $I_1$  results:

$$\cos \varphi_1 = \frac{M \cdot \Omega_1}{\eta \cdot m_1 \cdot U_1} \cdot \frac{1}{\sqrt{I_d^2 + \frac{1}{L_s^2} \left[ \left(\frac{U_1}{\omega_1}\right)^2 - (\Psi_{MP} - L_s I_q)^2 \right]}} \quad (12)$$

The dependance of the stator voltage  $U_1$  of the frequency  $f_1$ , at a constant rotoric flux is:

$$U_1 = 2 \cdot \pi \cdot f_1 \cdot \sqrt{I_d^2 + \frac{1}{L_s^2} \left[ \left(\frac{U_1}{\omega_1}\right)^2 - (\Psi_{MP} - L_s I_q)^2 \right]} \quad (13)$$

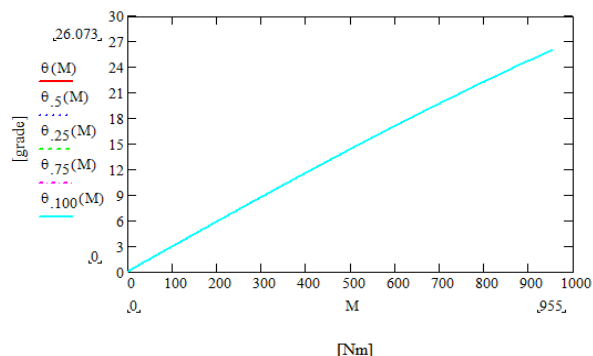
The previous determined relations, on the basis of whom we can analyse the working characteristics of the synchronous motor are depending on the current component  $I_d$ . Frequency modification is achieved at  $I_d = ct$  (controled).  $I_d$  component value can be positive, null or negative.

### 3. CASE STUDY

We consider a synchronous motor with permanent magnets with a power  $P_N = 150$  kW at 1500 rpm. The parameters of this motor are:  $R_1 = 0,048 \Omega$ ;  $L_s = 2,195 \cdot 10^{-3}$  H;  $\Psi_{MP} = 1,036$  Wb;  $p_1 = 2$ ;  $U_{1N} = 335$  V;  $f_{1N} = 50$ Hz;  $\eta = 0,96$

In following these are shown the working characteristics of the synchronous motor at a constnt impulse flux for different frequencies of the supply voltage  $f_1 = 5, 25, 50, 75, 100$  Hz, considering  $I_d$  current component like being constant.

Supply voltage varies depending an frequency according with relation (13).



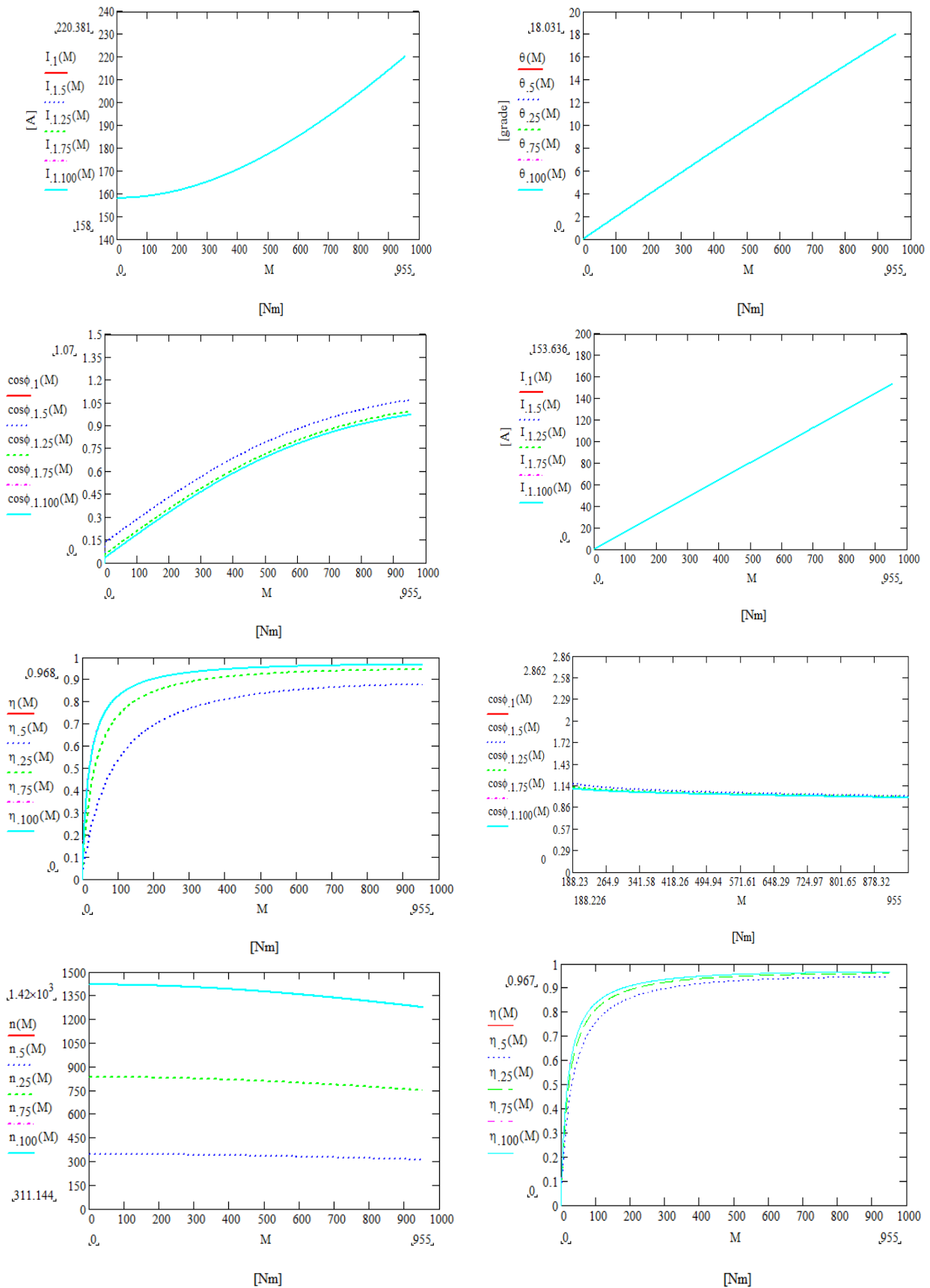


Fig. 2. Working characteristics at a constant rotor flux  $\Psi_{MP} = 1,036$  Wb și  $I_d = 158$  A

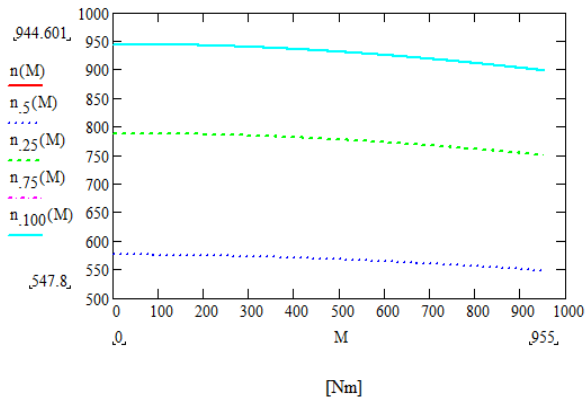


Fig. 3. Working characteristics at a constant rotor flux  $\Psi_{MP} = 1,036 \text{ Wb}$  și  $I_d = 0 \text{ A}$

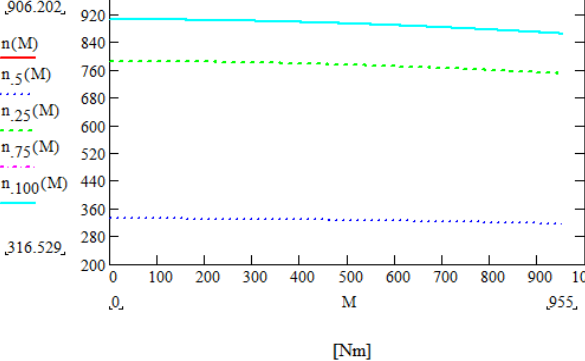
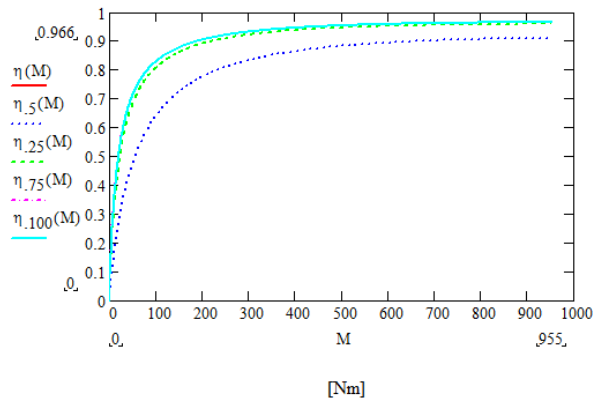
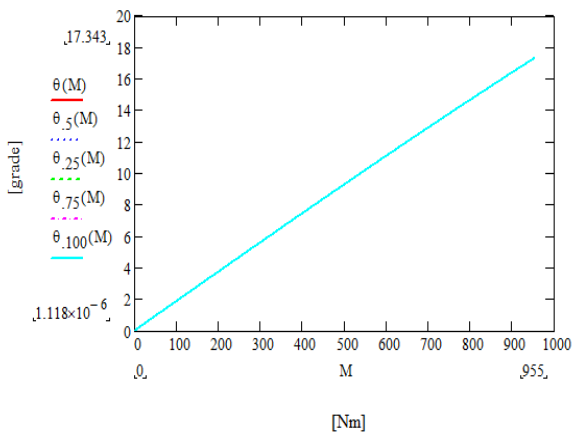


Fig. 4. Working characteristics at a constant rotor flux  $\Psi_{MP} = 1,036 \text{ Wb}$  și  $I_d = -20 \text{ A}$

#### 4. CONCLUSION

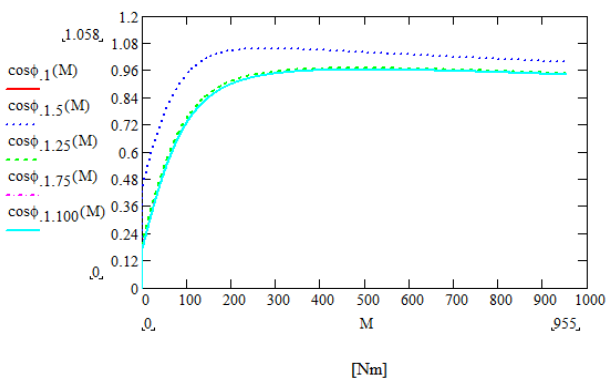
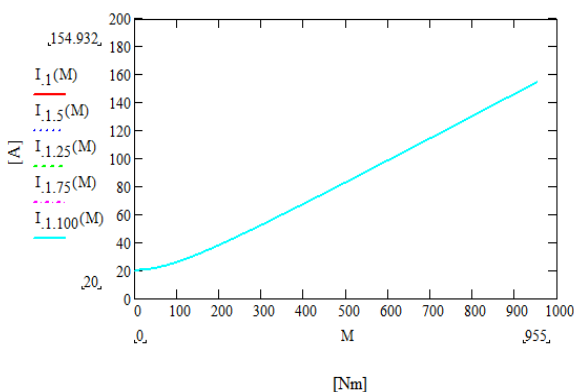
The characteristic of the load angle  $\theta$  (M) and of the current depending on the electromagnetic torque  $I_1(M)$  for a constant rotor flux are not depending on the voltage and frequency supply.

The extension of the control range of the rotative speed can be realised with positive  $I_d$  (demagnetising) according to a field loosening process, but with big values of the  $I_d$  component.

For frequencies bigger than or equal with 50 Hz, the voltage on the motor is the rated one, and therefore the characteristics for  $f_1 = 50, 75$  and 100 Hz overlap.

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## ELECTRO ANALYTICAL MEASUREMENT METHODS USING VIRTUAL INSTRUMENTATION ASSISTED BY LABVIEW PROGRAMMES

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**Abstract:** *The paper herein presents the authors' researches on "Electro analytical measurement methods using virtual instrumentation assisted by Lab VIEW Programmers. In recent years there has been a considerable interest in the development of electro analytical methods, due to its theoretical and practical significance in many fields.*

*The paper presents some theoretical and experimental data regarding the design, characterization and analytical applications. This paper focuses on the development of a different mode for electro analytical measurements without using a Signals Generator. A solution is to use a signal conditioning system, a data acquisition system and Lab VIEW analysis toolkit. The acquisition card provided a method for obtaining a digital representation of the signal. A low-power versatile miniaturized potentiostat is controlled by Lab View.*

**Key words:** *Lab VIEW, Electro analytical measurement, virtual instrumentation, potentiostat*

### 1. INSTRUCTIONS

At present time the investigations in electro analytical measurements and environmental monitoring are focus of interest. Chemists may be required to setup, troubleshoot, repair and sometimes construct the instruments they use for analytical measurements. The potential for environmental applications lies in the ability of biosensors to measure the interaction of pollutants with biological systems through a molecular recognition capability. Pollution of environmental water and soil by pesticides has received much attention due to the use of large amounts of pesticides in agriculture and related activities. Small concentrations of such toxicants in soil and food products are the reason for many diseases in the population.

Our implementation belongs to a very actual domain: virtual instrumentation. Today, virtual instrumentation system becomes more and more usual in many domains and applications. In the last years the need for analytical devices to be used for

environmental, industrial or medical controls has been growing very quickly.

Virtual instruments are computer programs that interact with real world objects by means of sensors and actuators and implement functions of real or imaginary instruments. The sensor is usually a simple hardware that acquires data from the object, transforms it into electric signals and transmits to the computer for further processing. Simple virtual measuring instruments just acquire and analyze data, but more complex virtual instruments communicate with objects in both directions (fig.1). The outgoing signals execute probing and control by actuators. Real world signals are of analogue nature, while a computer is a digital instrument; therefore the computer needs also interpreters – analogue-to-digital and digital-to-analogue converters for communication with the object under investigation. ADC and DAC boards that implement this function in inexpensive systems are usually placed inside the computer. Compact external ADC/DAC

converters with USB interface are also becoming popular.

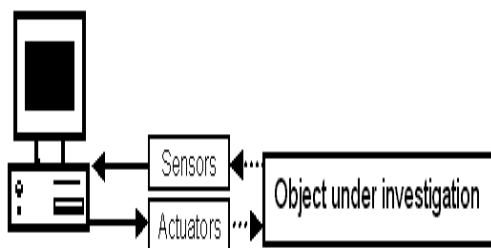


Fig. 1 The schematic virtual measurement system.

## 2. ELECTROANALYTICAL METHODS

Electro analytical methods represent the most effective answer to the increasing worldwide demand of reliable and rapid determinations of the widest variety of analytes in complex matrices. Electro analytical chemistry can play a very important role in the protection of our environment. In particular, electrochemical sensors and detectors are very attractive for on-site monitoring of priority pollutants, as well as for addressing other environmental needs. Such devices satisfy many of the requirements for on-site environmental analysis. They are inherently sensitive and selective towards electro active species, fast and accurate, compact, portable and inexpensive [1]. The electro analytical techniques are concerned with the interplay between electricity and chemistry, namely measurements of electrical quantities, such as current, potential and charge, and their relationship to chemical parameters. The three types of electro analytical measurements that can be performed offer different degrees of selectivity. Into the context of electrochemical sensors, the most promising ones, in special in terms of sensibility, are the amperometric biosensors, which monitor the faradic currents resulted of electronic interchanges between the biological system and the electrode with the recognition system. In the amperometric biosensors, the measuring of the quantity of analyte present in the sample is made from the current generated in the induced electrochemical reaction, keeping a

constant potential between the electrodes. The value of this voltage depends on the substance to determine. Amperometric biosensors function by the production of a current when a potential is applied between two electrodes. They generally have response times, dynamic ranges and sensitivities similar to the potentiometric biosensors.

The simplest amperometric biosensors in common usage involve the Clark oxygen electrode. The most suitable method of fast and simple control of the presence of dangerous substances is analytical detection by means of simplified methods- the so-called express-tests which allow quickly and reliably revealing and estimating the content of chemical substances in various objects [2]. Express tests are based on sensitive reactions which fix analytical effect visually or by means of portable instruments. Interfacial electrochemical methods measure the interactions between an electrode and the solution in contact with the electrode. Electrical and chemical transport properties are measured with various methods, which also allow to determine electronic or ionic conductivities and to investigate the elementary processes which determine the transport properties

## 3. MEASUREMENT SYSTEM IMPLEMENTATION

Our implementation for the electro analytical measurement includes:

- The PC-AT- computer.
- The Lab Jack U12 Data Acquisition Board
- The software component: Lab VIEW package.
- A micro power potentiostat.
- The electrochemical cell.

The measurement system is based on Personal Computer with software and specific hardware components: the acquisition board Lab Jack U12 Data Acquisition Board that allows the multiple input/output modes (Fig 2).

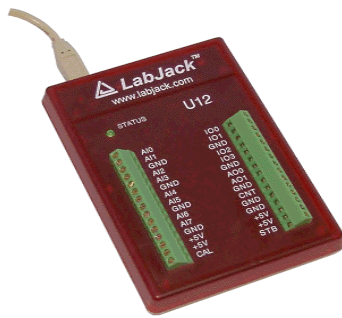


Fig. 2 The Lab Jack U12 Data Acquisition Board

The acquisition board is totally software configurable by the “panel” created in LabVIEW context for displays and user control. LabVIEW is being used in a wide range of test and measurement applications. The hardware is driven from P.C. by a virtual instrument developed in National Instrument’s Lab VIEW. Both the input and output signals in electrochemistry are of electric origin, so the sensors and actuators in principle may be omitted. However, a potentiostat is a common instrument available in every electrochemical laboratory and there is no absolute necessity to simulate its functions.

We use a potentiostat as the only hardware component of the virtual instrument, besides a computer with its ADC/DAC interface. Most electrochemical work with an electrochemical cell is achieved using what is called a potentiostat. Potentiostats are amplifiers used to control a voltage between two electrodes, a working electrode WE and a reference electrode RE, to a constant value. A potentiostat is an electronic device that controls the voltage difference between a working electrode and a reference electrode. Both electrodes are contained in an electrochemical cell.

The potentiostat implements this control by injecting current into the cell through an auxiliary, or counter, electrode CE (fig. 3). In almost all applications, the potentiostat measures the current flow between the working WE and auxiliary electrodes RE [3], [4]. Potentiostats in their electronic action are identical with difference operational amplifiers whose power output provides voltage and current for the cell in the feedback loop. The controlled variable in a potentiostat is the cell potential and the measured variable is the cell

current. The potentiostat also adjusts power consumption in the electrochemical experiment (the power of a common DAC board is sufficient to control electrochemical reaction just on microelectrode).

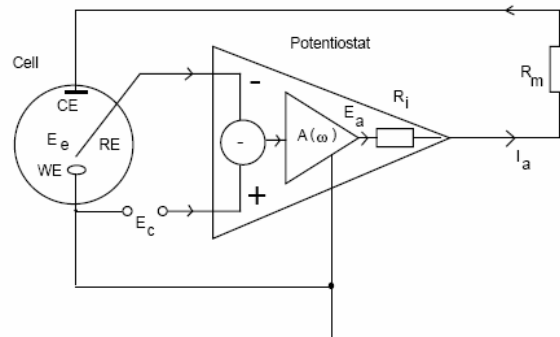


Fig. 3. The schematic diagram of the potential control

The amperometric measurements were carried out with a micro power potentiostat. The schematic micro power potentiostat was verified with the Simulink program (fig. 4).

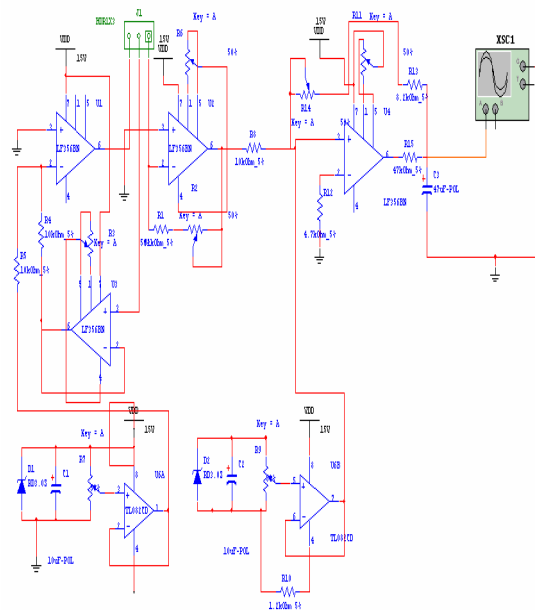


Fig. 4 The schematic micro power potentiostat

While the virtual instrument controls the electrode potential by a potentiostat with low load on the CPU, the major part of the computer resources is consumed to implement probing, data acquisition and signal processing visualisation of the potential scan in the real-time mode [5].

In Figure 5 it is shown the front panel of the instrument.

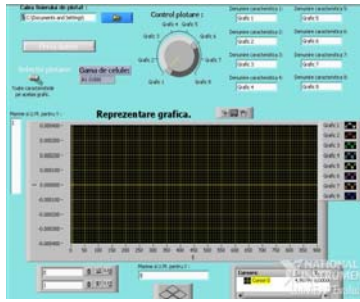


Fig. 5. The the front panel of the instrument

In Figure 6 it is shown the block diagram of the instrument.

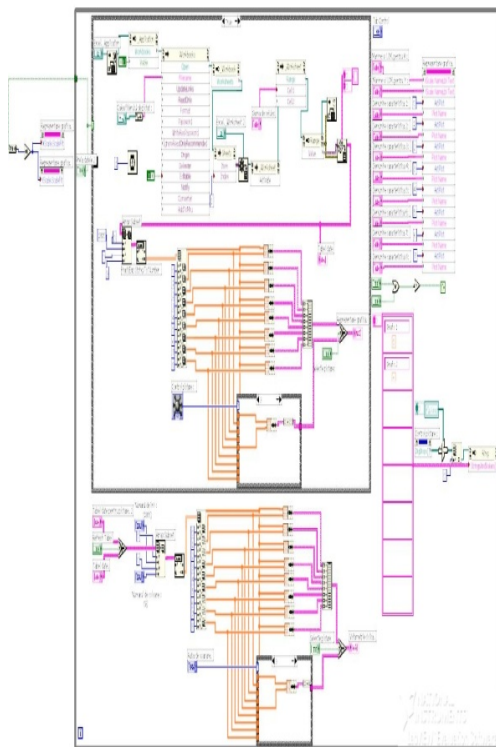


Fig 6. The block diagram of the instrument

In Figure 7 it is shown how the control amplifier kept this reference voltage. In Figure 7 it is shown how the control amplifier kept this reference voltage.

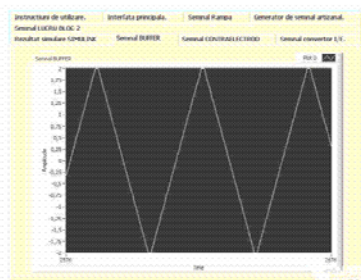


Fig 7. The voltage at the reference electrode

In Figure 8 it is shown voltage at the work electrode. Concentration potential and time were -0.4 V and 3 min respectively.

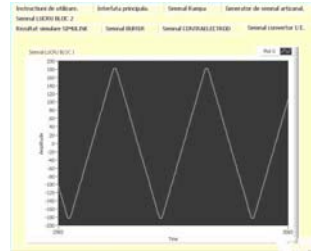


Fig 8 The voltage at the work electrode

The above VI it is responsible for the control and acquisition of the main parameters: input limits initial potential, final potential, scan rate, number of samples and gain. (Table 1.)

Table 1. The main parameters

Nr.	Parameterts	Values
2.	Final Potential	- 0.5 V
3.	Scan rate	0.001 V
4.	Number of samples	10
5.	Gain	+0.5 V si -0.5 V
1.	Initial Potential	0.5 V

#### 4. CONCLUSIONS

It is well known that the electronic test systems are very complex and high cost. A solution that reduces system cost increases its flexibility and can also remove the need for operator skill is virtual instrumentation.

It is a fact that the biosensors require low-power electronics for providing the interface between biological electrode and signal processing devices. The amperometric potentiostat is suitable for the above presented direct interfacing. The control part of the circuit is realized by an virtual instrument. The low-power versatile miniaturized potentiostat was controlled by Lab View. Compared to the traditional measurements using Signals Generator the implementations described in the present paper belong to a very actual domain. This particular design has a very low-power consumption, and may easily be adapted to meet the requirements of different electrode-based amperometric sensors. The above presented amperometric potentiostat

exhibits good linearity in the current range up to 200 nA when calibrated with highly stable thick-film resistors, with a detection limit of approximately 3 nA. In the embodiment tested, a sensitivity of just over 3 Hz/nA was achieved. The potentiostat was able to control the working electrode potential with respect to the counter electrode with a regulation of better than  $\pm 2\%$  under various complex load impedances. The circuit consumes 500  $\mu\text{W}$  of power, achieved through the careful use of low-power CMOS amplifiers in the circuit design, and minimal quiescent current drain, and is therefore suitable for operation from standard 3 V Lithium coin cells. To be effective, the measurement, electronics and control components, and sub-systems, in particular sensors and sensors systems have to be developed in parallel as part of computer-controlled manufacturing systems. Adequate solutions have been found for most practical measurement problems, but there are applications where the available solutions are not fully satisfactory.

This paper is a first attempt of synthesizing the information on this field, and proposes a lot of thoughts, so the authors will continue to do the best to improve it. The above

constructed potentiostatic system is relevant for many chemical and biosensor electrodes.

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## EXPERIMENTAL RESEARCH ON THE MEASURING METHODS OF METALLIC SURFACES

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**Abstract:** *This paper contains the investigation of metallic surfaces using AFM technology. This method provides the possibility to map out surface topography with atomic resolution in all three dimensions. The data are digitally stored, allowing the computer to manipulate and display the data as a three-dimensional rendition, viewed from any altitude and azimuth as shown. For topographic analysis and profilometry, the resolution and three-dimensional nature of the data is unequalled by other techniques. The ease of use and nondestructive nature of the imaging are notable.*

**Key words:** *atomic force microscopy, nanometer.*

### 1. INSTRUCTIONS

Thermally sprayed coatings are now used extensively in a variety of applications. However, their application has often preceded detailed knowledge or understanding of their corrosion mechanisms or rates. Previous studies involving plasma sprayed coatings[5] have shown that good quality coatings, in terms of low porosity, are essential to protect the substrate from corrosion. There are many thermal spray processes available to date: the high velocity oxygen fuel (HVOF) process, which uses higher exhaust velocities and lower flame temperatures than other processes, can produce coatings of low porosity levels (1%) and avoids alteration of the mechanical properties of the substrate.[ 7] .

The corrosion characteristics of thermal sprayed coatings in static saline environments are extremely important where the flow of aqueous solution over components intermittently ceases.

It has been established [1, 2] that where coatings are applied by a high-quality process and under stringent quality control procedures, the coatings can provide a very effective barrier to the substrate and prevent any corrosion from occurring.

In this situation, however, it is very important to appreciate that corrosion of the coating can occur and that initiation and propagation of corrosion, associated with microstructural features of the composite system, are a real issue. For improvements to the coating corrosion resistance to be made, a full understanding of the corrosion rates and mechanisms, and in particular the resistance of the metallic binder (in cermet systems), is required.

In addition, an understanding of static corrosion behaviour can help reveal the mechanisms of the coating degradation in erosion-corrosion environments. [9, 10].

This article investigates the corrosion rates and mechanisms of two HVOF coatings (WC-Co-Cr and WC-Co).

### 2. EXPERIMENTAL

Two HVOF sprayed coatings are studied in this work: a WCCo-Cr coating with nominal composition 86%WC 10%Co-4% Cr, and a WC-Co coating with a nominal composition 86% WC-14% Co.

The coatings were applied to a stainless steel substrate (UNS S31603). Specimens were soldered on the rear side to an electrical

conducting wire and subsequently encapsulated in nonconducting resin.

The exposed coated face of the specimen was then ground with silicon carbide abrasive papers and polished to a 6  $\mu\text{m}$  diamond finish.

The main seawater constituents were 19 300 ppm chloride, 11 000 ppm sodium, 2700 ppm sulfate, 1300 magnesium, 400 ppm calcium, 400 ppm potassium, and 150 ppm bicarbonate ions.

The specimen-resin interfaces were sealed using Lacomit varnish (Agar Aids, UK) to prevent interference from the substrate. Electrochemical monitoring was carried out with a standard three-electrode cell, comprising a platinum auxiliary electrode and a saturated calomel reference electrode (SCE). Direct current (DC) anodic polarization tests were carried out after 1 h immersion in the seawater at 18 and 50  $^{\circ}\text{C}$ .

The seawater was left open to the atmosphere.

The potentiostat was used to scan the electrode potential of the coating samples from the free corrosion potential ( $E_{\text{corr}}$ ) in the positive (anodic) direction until a current in the range of 500-700  $\mu\text{A}/\text{cm}^2$ .

In addition, an atomic force microscope (AFM) was used to map the topography of the coatings during accelerated corrosion tests. The AFM was configured to probe the surface under water and record images during anodic polarization tests.

Each image took 6 min to produce, during which time the potential had shifted by approximately 90 mV.

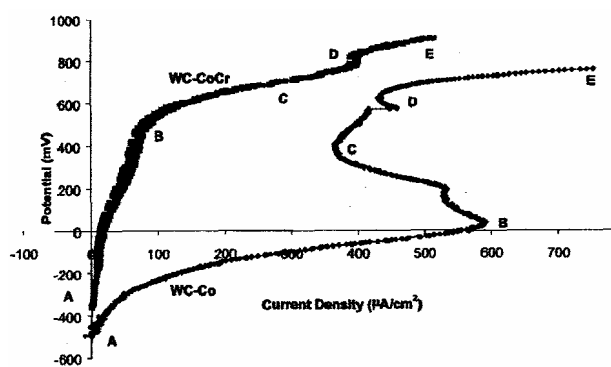


Fig. 1 Anodic polarization curves in static artificial seawater at 18  $^{\circ}\text{C}$  on WC-Co-Cr and WC-Co HVOF sprayed coatings

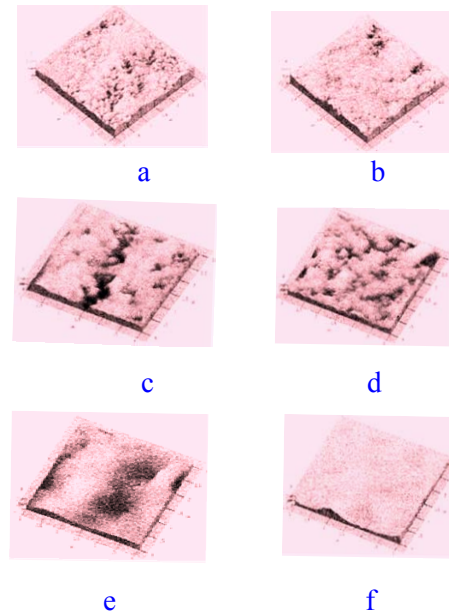


Fig 2. In situ AFM images (a) Polished coating prior to polarization; (b) points A to B; (c) points B to C; (d) points C to D; (e) points D to E; and (f) end of anodic polarization

### 3. RESULTS

During the decrease in current (points B to C), the matrix is dissolving at a steady rate, defining the hard phase particles more clearly (Fig. 2c). As the current increases (points C to D in Fig. 2d), the matrix dissolves further, revealing the smaller hard phases from point D to E (Fig. 2e). At the end of the anodic polarization, areas where the matrix has dissolved in some regions and areas of attack around the matrix-hard phase interface can be seen (Fig. 2f).

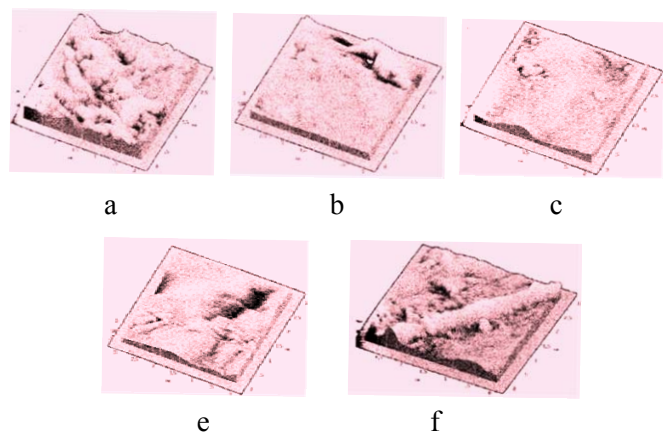


Fig 3 In situ AFM images (a) Polished coating prior to polarization; (b) point B; (c) point C; (d) point D; and (e) end of anodic polarization.

In a similar manner, the corrosion mechanisms during anodic polarization of the WC-Co-Cr coating were examined. Figure 3(a) shows the coating at the free corrosion potential with the light grey hard phases encased in the darker grey matrix.

The rapid increase in current with the potential corresponds to dramatic matrix dissolution and leaves the hard phase protruding from the matrix (Fig. 3c). As the current stabilizes at point D, carbides begin to fall out from the matrix and leave voids behind (Fig. 3d). These progresses until the end of the scan at point E, where the matrix consists mainly of voids left by the carbide particles and a few carbides on the next layer are visible (Fig. 3e). After immersion in seawater for 1 h at 50 °C, the kinetics of the anodic polarization processes are accentuated on both coatings.

#### 4. CONCLUSIONS

The use of an AFM can aid the determination of corrosion mechanisms on a microscale.

The addition of chromium to a cobalt matrix increases the corrosion resistance of a WC-based HVOF sprayed cermet coating and the extent of this has been quantified.

Although the WC-Co-Cr coating suffers from more localized attack at 18 °C, accentuated at the hard phase-matrix interface, the WC-Co has more uniform corrosion affecting the entire matrix.

An increase in temperature results in extensive dissolution of the cobalt matrix, whereas on the CoCr matrix more severe attack is further localized in regions not associated with any specific microstructural features.

#### 5. ACKNOWLEDGEMENTS

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## MULTILAYER COMPOSITE FOR ELECTRICAL INSULATION

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**Abstract:** *The multilayer structure consisting of alternative sheets of paper and ethylene-propylene elastomers was investigated for electrical applications. The changes in several characteristics, namely volume resistivity, dielectric loss, permittivity and impedance were determined for the evaluation of material stability under accelerated degradation. The ageing of material was performed under the action of high energy radiation, because the limits of applicability have to be known. The discussion on the degradation effects on the functional features of multilayer polymer/dielectric paper structure is based on the generation of dipoles inside the organic phase that in the most instable component fraction. The correlation between different studied properties was established for the depicting of structure durability under hard service conditions. The oxidative degradation of multilayer system generates spatial charge distribution, which is changed after the action of stressor. The modification in the dielectric properties due to the accumulation of oxygenated products involves the orientation polarization of material. Simultaneously, the properties related to the structural alterations lead to the smooth increases in the permittivity and dielectric loss of studied structure.*

**Key words:** *electrical insulation, synthetic rubber, cellulose, multilayer structure*

### 1. INTRODUCTION

The electrical insulation used for the manufacture of capacitors must have certain features, which assure the charge accumulation on the plates without breakdown. These characteristics suppose a long term service that determine the lifetime of equipment. Several polymeric materials (polyethylene, polypropylene, polyvinyl chloride, synthetic rubbers, polyesters) are suitable dielectrics [1,2].

The understanding the functionality of long term service of electrical insulations requires endurance investigations to be performed. The most important aspects are

related to the modifications induced by various damaging factors that act during the operation of electric assembly. The accelerated testing applied to studied material must emphasize the ability to degradation in the direct relation with the intensity and duration of action, the chemical structure, formulation and morphology of samples [3,4].

The absorbed energy transferred onto materials causes scissions and, consequently, free radicals are decayed through crosslinking or degrading processes. For dielectric materials, the changes occurred in the electrical properties of irradiated material are the effects of structural modifications [5,6]. Of a great importance for the alteration in the material properties is the

oxidation through which dipoles are formed; the accumulation of oxygenated products defines the material behavior under overcharge regime.

This paper presents the effects on the electrical performances of multilayer (EPDM/paper) structure subjected to a sustained energetic transfer by  $\gamma$  irradiation.

## 2. EXPERIMENTAL

A 10 layers structure consisting of alternative sheets of ethylene-propylene-diene terpolymer (EPDM, Terpit C<sup>®</sup> delivered by ARPECHIM Pitești, Romania) was prepared. Polymer films were obtained by the removal of chloroform from EPDM solution cast on capacitor paper. Raw elastomers contained 3.5 % (w/w) of 2-ethylidene norbornene as added diene and the ratio of ethylene to propylene units was 3:2.

The irradiation of samples was carried out in an irradiator GAMMACELL provided with <sup>137</sup>Cs source. Dose rate was 0.4 kGy.h<sup>-1</sup>. The exposures were done in air at room temperatures. For avoiding experimental errors, the irradiations were carried out by accumulation on the same specimens.

The electrical measurements were performed with Keithley 7600A multimeter for the determination of resistivity and with Novocontrol dielectric spectrometer for permittivity and loss tangent. All investigations were accomplished 24 h after the end of irradiations.

Three similar samples were prepared and subjected to study for the comparison of recorded results.

## 3. Results and discussion

The radiolysis of each component of multilayer structure is the background that initiates the modifications inside layers. Ethylene-propylene diene belongs to the class of crosslinkable polymers [7]. The mechanism through which this polymer is transformed by the action of ionizing radiation was previously

reported [8,9]. By contrary, paper that is a cellulose material belongs to the group of degradable materials [10]. The mechanism followed in the radiochemical degradation of cellulose has already been presented [11,12]. The opposite behaviors of EPDM and cellulose compete for the evolution of degradation state of samples.

The conductivity of irradiated polymers would be based on the free electrons formed by the ionization of excited molecules as the primary intermediates [14]. The multilayer probe is significantly modified since the amount of  $\delta$  electrons expelled during irradiation increases as the dose enhances. The contribution of electrons to the conduction is demonstrated in Fig. 1, where a difference between the shape of the two functions  $\log \rho = f(t)$  recorded on the same sample at different times in relation to the end of irradiation look unlike.

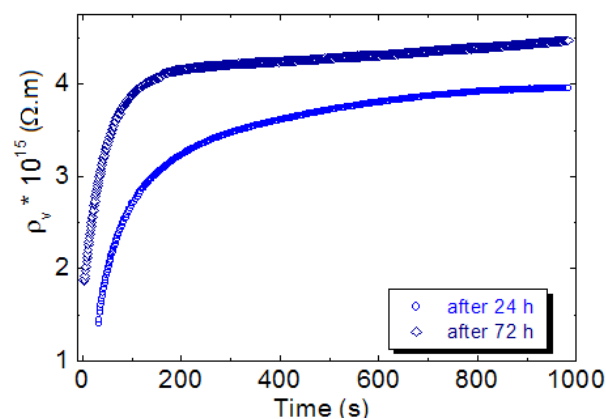


Fig. 1. The variation in volume resistivity of EPDM/paper multilayer sample irradiated in air at 15 kGy measured after two different times after irradiation

In Fig. 2 the dependences of volume resistivity on measuring time for different exposure dose are illustrated. The increase in the sample resistivity for low dose (8 kGy) can be explained by the radiation crosslinking of elastomers sheets. This process starts as about 5 kGy, the gel dose for ethylene-propylene diene terpolymer [13].

Due to the proportionality of resistivity on the number of collisions between charge carriers

and macromolecules, the relevant decrease in the electrical conduction of low dose irradiated EPDM is displayed. The movement of charge carriers through the enriched hardened phase is prevented by the increased number of new intermolecular bridges and the steady state value of conduction current is attended much later than it is happened in the pristine samples.

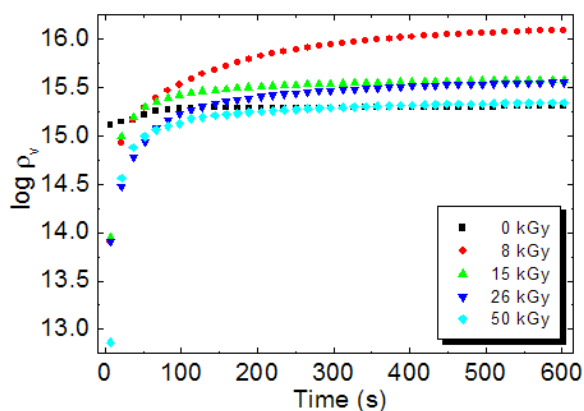


Fig. 2. Resistivity dependences on testing time at different exposure doses

The light increase of resistivity in the neat sample on the first 100 s would be caused by the residual trapped electrons that appear during the randomly applied mechanical stress. The irradiation of multilayer structure creates free electrons, which may be scavenged by molecule entanglement or may be trapped by any electronegative impurities. After the application of tension during measurement these electrons are selectively released in the function of binding strength. For superior dose (15 kGy) the initial value of resistivity is significantly lower than the similar figure for 8 kGy. The noticeable difference between the steady state values of resistivity consists of the upper conductivity in the 15 kGy irradiated specimen. The decrease in the resistivity of advanced exposed sample can be explained by the start of degradation either by higher rate of scission in comparison with the crosslinking rate, on one hand and the progress in the oxidative degradation of ethylene-propylene terpolymer (Fig. 3).

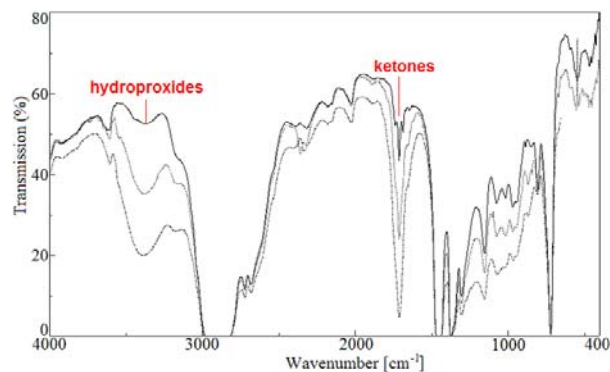


Fig. 3. FTIR spectra recorded for one sheet EPDM/paper for pristine (full line), 40 kGy (dot line) and 100 kGy (dash line)

The exposure of sample to increased doses grows the amount of charge carriers and the number of dipoles, which bring about significant diminishing in the resistivity of sample. The elastomers component which is more affected by the action of high energy radiation than cellulose [15] contributes in a larger extension to the modifications occurred in electrical properties. For the absorbed dose of 50 kGy the resistivity is two orders of magnitude lower than the same property measured on the sample receiving low doses (8 and 15 kGy, Fig. 2.).

After the majority of charge carriers are neutralized after their recombination with the low movable anions (macromolecular entities), the resistivity of 50 kGy irradiated specimen attends the value corresponding to the pristine sample. The other resistivities are higher than they are for unirradiated specimen. The involvement of energy transfer onto polymer molecules affects only the initial conductivity. This behavior can be improved by the application of short term heat treatment (about 30 minutes @ 70-80°C). The high values of resistivities (about  $10^{15}$  Ω.m) allow large use of these multilayer (EPDM/paper) structure. If in elastomers sheets would be added low quantity of proper stabilizer (0.25 or 0.50 % w/w of hindered phenol) the oxidation is diminished and the contribution of polarization and the association with the appearance of mobility band instead of forbidden band.

The evaluation of dielectric behavior of EPDM/paper insulation points out some features, which emphasize the peculiarities of the irradiation effects in hydrocarbon elastomers. The variation in the permittivity for all applied doses presents several maxima, which may be supposed that they are associated with the interaction between different units belonging to the two unlike macromolecules (ethylene propylene diene terpolymer and cellulose), whose structures are presented in Fig. 4.

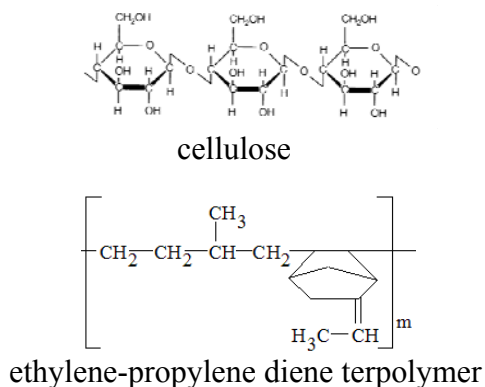


Fig. 4. Molecular structures of the two materials consisting studied multilayer system

The four peaks that appear in the records of permittivity on the high frequency range would be the result of the vicinity of D-glucose units with the unlike macromolecules of EPDM. The comparative analysis of the curves from Figs 5 (a-d) points out some particular aspects:

- $\gamma$  irradiation induced an increased order in the elastomers sheets due to the crosslinking of this component of tested structure; this behavior would be explained by the augmentation of peak heights;
- the oxidation started from the beginning of exposure had generated dipoles (oxygen-containing molecules), which interact with the oxygen atoms belonging to hydroxyl groups and ether bridges of cellulose;
- the degradation of cellulose brings about new structures in cellulose layers as citric

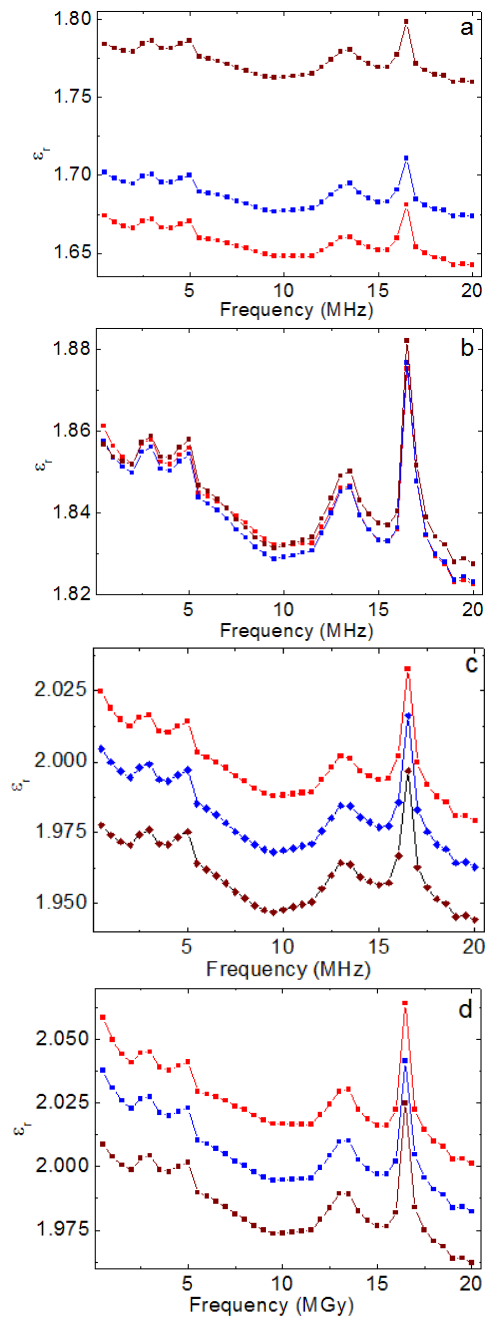


Fig. 5. Variation in the relative permittivity of EPDM/paper applied doses(a) 0 kGy; (b) 10 kGy; (c) 20 kGy; (d) 50 kGy testing temperatures:(■) 298 K; (■) 313 K; (■) 328 K acid and dicarboxylic acids [16];

- as the consequence of  $\gamma$  irradiation, some small fragments which would be trapped in the solid texture exhibit individual dielectric transitions [17]

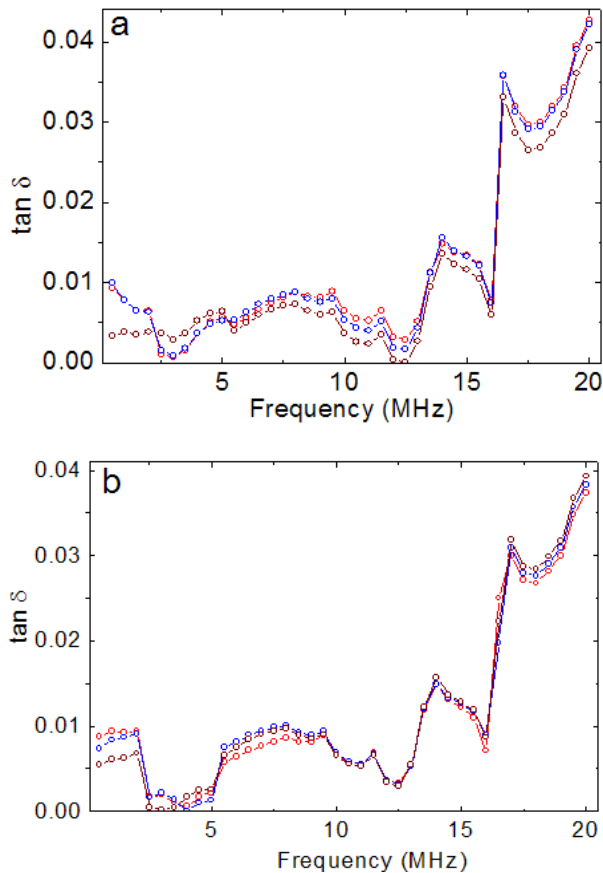


Fig. 6. Variation in the dielectric loss of EPDM/paper measured on unirradiated sample (a) and sample irradiated at 50 kGy (b)

- the noticeable differences between the permittivity of EPDM/paper multilayer structure can be remarked, because the accumulation of oxygenated products during radiation ageing increases in the polarizability of material. For dielectric loss, the differences between the curves shown for various temperatures (298, 313 and 328 K) are very small (almost insignificant) due to the high frequency of applied tension. The movement of dipoles does not follow the fast modification in the electric field direction;
- the same value of frequency, 16.5 MHz, sharp modifications in the values of permittivity and dielectric loss happen (Fig. 7). This jump frequency can be noticed for all absorbed doses and applied temperatures. It seems that this threshold is characteristic

for the accumulation of carbonyl groups (dipole moment,  $\mu = 2.8$  debye [18]) in the amorphous phase of both component materials.

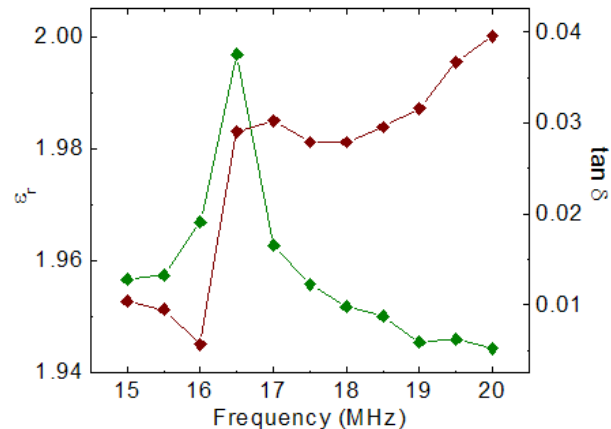


Fig. 7. Dielectric properties measured at 328 K on EPDM/paper multilayer structure  $\gamma$ -irradiated at 20 kGy

- the reverse order in the positions of curves drawn for the three temperatures for unirradiated sample, on one hand and radiation exposed specimens, on the other hand describes the modifications occurred in the components of sandwich structure. It means that the crosslinking imposes a certain rigidity in the relative movement of molecular units and the increase of temperature induces a more fast vibrations of polarizable atoms diminishing the level of polarization.

#### 4. Conclusion

The multilayer structure consisting of repeated sheets of ethylene-propylene terpolymer and paper preserves in satisfactory limits the values of electrical properties, permittivity and dielectric loss after the exposure to  $\gamma$ -radiation up to 50 kGy. However, the insulation behavior is improved for low dose (8 kGy). Despite of the low resistivity measures on the first 100 s of current measurement, when available charge carriers retained into shallow traps are released, the steady state conduction

shows similar values of resistivity for pristine sample and 50 kGy exposed specimen.

The present results underline that the  $\gamma$ -exposure of this insulation structure possible happened during accidental overirradiation does not affect the good performances of this type of dielectric structure.

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## THE REGULATION OF THE POWER FOR THE MODERNIZED ELECTRICAL RAILWAY-ENGINE BO-BO OF 3400KW

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**Abstract:** Following the extension of the Romanian Railways electrical network, there has been raised the problem of endowing the electrical railway-engines park also with EC railway-engines on 4 shafts Bo-Bo type. A complex rehabilitation program of the electrical railway-engines park and especially of the electrical railway-engines type Bo-Bo was launched along 2004-2006. The process of the complex modernization of the EC railway-engines especially focused on the improvement of the regulation of the railway-engine power.

**Key words:** railway-engine, modernization, regulation

### 1. Introduction

Considering the rugged profile of the railway network from Yugoslavia, there has been necessary the endowment of the railway-engines park JZ with electrical railway-engines Co-Co type. Thus, an agreement of mutual delivery of electrical railway-engines, between Romania and Yugoslavia was set.

The electrical railway-engines types Bo-Bo from Yugoslavia are produced by the Swedish company ASEA at the plants RADE KONCAR from Zagreb, [2], [3].

Thus, Romania was delivering electrical railway-engines type Co-Co of 5100KW [1] presented in the fig. 1, produced by Electroputere plant from Craiova to Yugoslavia, and Yugoslavia was delivering to Romania electrical railway-engines type Bo-Bo of 3400KW, presented in the fig 2.

First railway-engines of this type started to be delivered in Romania in 1973.

From the beginning these railway-engines proved to be very good for the service of towing of passenger and freight trains on the electrified sections with medium and light profile.



Fig. 1 Electrical railway-engine type Co-Co of 5100Kw



Fig. 2 Electrical railway-engine type Bo-Bo of 3400Kw

The advantages of the railway-engines on four shafts are numerous, especially to the fact that there are less aggressive for the railroad and they have a simpler and cheaper maintenance.

Following the political and economical circumstances, due to the lack of original spare parts, the maintenance of the electrical

railway-engines EC type Bo-Bo has become more difficult and problematic.

A complex rehabilitation program of the electrical railway-engines park of the passenger Romanian Railways and especially of the electrical railway-engines type Bo-Bo was launched along 2004-2006. Further to the rehabilitation and modernization process of the electrical railway-engines type Bo-Bo, these have been re-painted from grey-blue in red-white, as it can be seen in the fig. 3.



Fig. 3 Electrical railway-engine Bo-Bo type, rehabilitated and modernized

## 2. Regulation of the electrical railway-engine power

One of the most spread methods of power regulation of the electrical railway-engines is the regulation of the stress applied to the draught engines.

In the case of continuous power railway-engines, the regulation of the stress can be achieved by eliminating step by step the controller resistors, or by changing the grouping of the serial draught engines, serial parallel and respectively parallel concomitant with the elimination step by step of the controller resistors.

The railway-engines with alternative power, the regulation of the stress can be done also by the variation of the stress applied to the draught engines and by reducing the inductor field (shunting).

The regulation of the stress can be achieved progressively or continuously.

The progressive regulation is achieved by a device called graduator. This graduator modifies the transforming ratio of the primary winding (of regulation) which is a self-transformer. The number of regulation stages for the electrical railway-engines endowed

with graduator of Elin type is from 41 to 65V and from 65V to 1265V. These stresses are applied to the draught transformer that has an incidental for each draught engine. The power on each incidental of the transformer is redirected and applied to the draught engines.

This progressive regulation is less favorable for an optimal use of the adhesion, because the crossing from one stage to the other is made with an important power fluctuation and traction force. In this way, the mechanical transmission of the railway-engine, with everything that means, starting with the engine shaft to the hoop shaft, suffers important moment and force fluctuations.

Due to the appearance of the power transistor in '70, together with diode and semiconductor controlled rectifier, and their disposal in layouts clever conceived, they made possible that the regulation of the stress applied to the draught engines of the electrical railway engines to be continuous. So, it was possible to pass from a limited area of characteristics to an infinite one, fact that could cover the entire domain of the railway-engine functioning.

This system of continuous regulation can be applied both to the alternative power railway-engines and to the continuous power ones.

The continuous power semiconductor controlled rectifier extinguishing has been problematic for a long time, fact that delayed the application of the continuous power variators (CPV) or Choppers. Although, once the GTOs appeared (semiconductor controlled rectifier with door extinguishing), and later the IGBTs (power transistors), that are more rapid, much of the semiconductor controlled rectifiers inconveniences have been eliminated. Power electronics especially that with direct applicability to the force circuit configuration of the railroads traction vehicles is progressing.

So, after many hesitations, convertors with semiconductor controlled rectifiers in mixed bridge, diodes with semiconductor controlled rectifiers were also applied to our railway-engines.



This system applied to the electrical railway-engines Bo-Bo type of 3400 KW presents the following advantages:

1. - the graduator is being removed (see fig. 4) and allows the regulation of the stress in a continuous way on the low stress side;



Fig. 4 The Removal of the graduator

2. - it allows the functioning in manual and automatic mode at speed default (the difference between the speed imposed by the engine driver and the actual one)

3. - it ensures the increasing of the power factor and the non-influence of the railroad signals without the use of the harmonics filters;

4. - it permits the functioning of the anti-skidding and anti-blocking system of the shafts by using a proximity transducer with hysteresis, on the case of each redactor;

5. - it permits the isolation of each engine;

6. - it is economic due to the costs decrease for the harmonics filters;

7. - the costs decrease by removing the graduator, due to the reduced operations for its maintenance;

8. - The power of the railway-engine increases at approx. 4000KW, as a result of the stress increase applied to the draught engines.

### 3. Conclusions

As per the above-mentioned, we can conclude that this system has improved the railway-engine power and represents an important step towards a modern railway-engine of a brand new concept as those of the administrative railroads from the EU countries. The impact on the environment of each modernization of this type is part of the project IDEI-1239/2007.

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## STRUCTURAL-KINEMATICAL RELIABILITY ASPECTS OF EXTERNAL MEMORY WITH RIGID MAGNETIC DISKS

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**Abstract:** *In this paper, we introduce the structural-kinematical reliability issue of the bimobile systems, in general, and of external memory with rigid magnetic disks, in particular.*

*The structural-kinematical reliability aspects are based on the parametric method proposed by S. K. Banerjee and K. Rajamani in the scientific paper called "Parametric Representation of Probability in Two Dimension "(IEEE Trans. On Reliability).*

### 1. Solving the structural-kinematical reliability issue using the parametric method

Should  $r$  be a parameter that defines the reliability of some component parts of the bimobile system; a new  $\Theta$  parameter is attached, defined by:

$$\Theta_i = \frac{1-r}{r}$$

where:

$$r = \frac{1}{1+\Theta} \quad (1)$$

In the hypothesis of a great reliability of the system's component parts, it results:

- for the system components that are serially connected, it results:

$$\Theta_{Syst.\text{-series}} \cong \sum_{i=1}^n \Theta_i \quad (2)$$

- for the system components that are connected in parallels, it results:

$$\Theta_{Syst.\text{-parallel}} = \prod_{i=1}^n \Theta_i \quad (3)$$

- where  $\Theta_i$  stands for the new parameter attached to component  $i$ ,

$$\Theta_i = \frac{1-r_i}{r_i}, \quad i \in 1, 2, \dots, n$$

Within the series systems, since:

$$r_{Syst.\text{-series}} = \prod_{i=1}^n r_i \quad (4)$$

it results:

$$\frac{1}{1+\Theta_{Syst.\text{-series}}} = \prod_{i=1}^n \frac{1}{1+\Theta_i} \quad (5)$$

or the equivalent:

$$1+\Theta_{Syst.\text{-series}} = \prod_{i=1}^n (1+\Theta_i) \quad (6)$$

Since:  $\Theta_i \ll 1, \quad i \in 1, 2, \dots, n$

it results that the terms that have two factors at least can be ignored and we get approximate inequality (2).

Thus, the series system's reliability can be calculated according to:

$$R_{Syst.\text{-series}} = \frac{1}{1+\Theta_{Syst.\text{-series}}} \quad (7)$$

For the systems in parallel, we can calculate it according to:

$$r_{Syst.\,parallel} = 1 - \prod_{i=1}^n (1 - r_i) \quad (8)$$

Replacing:

$$1 - r = \frac{\Theta}{1 + \Theta},$$

Respectively, one should get:

$$\frac{\Theta_{Syst.\,parallel}}{1 + \Theta_{Syst.\,parallel}} = \prod_{i=1}^n \frac{\Theta_i}{1 + \Theta_i} \quad (9)$$

if  $\Theta \ll 1$  then:

$$\Theta_{Syst.\,parallel} \cong \prod_{i=1}^n \Theta_i \quad (10)$$

It results that the reliability of the systems in parallel can be appreciatively determined using the equalities:

$$R_{Syst.\,parallel} = \frac{1}{1 + \Theta_{Syst.\,parallel}} \quad (11)$$

For the series systems, where each subsystem is a parallel redundant system, the calculation

relation of the system's parameter can change as it follows:

$$\Theta_{series,\,parallel} = \sum_{i=1}^n \Theta_i^{k_i} \quad (12)$$

where  $k_i$  indicates the number of the components connected in parallel for the subsystem  $i$ ,

Using equality (12), one can solve the problem of determining a maximum reliability for a given structural-kinematical complexity.

The problem is reduced to a function optimum one:

$$f(k_1, \dots, k_n) = \sum_{i=1}^n \Theta_i^{k_i} \quad (13)$$

with the connection:

$$\sum_{i=1}^n c_i k_i \leq C \quad (14)$$

where  $c_i$  stands for the structural-kinematical complexity factor of a  $i$ ,  $i=1, 2, \dots, n$  component.

Using the Lagrange multipliers classical method, we consider the function:

$$L(k_1, \dots, k_n) = \sum_{i=1}^n \Theta_i^{k_i} + \lambda \left( \sum_{i=1}^n c_i k_i - C \right) \quad (15)$$

The stationary points of the function (15) can be achieved by canceling the partial derivatives as against  $k_i$  and it produces the system:

$$\frac{\partial L}{\partial k_i} = \Theta_i^{k_i} \ln \Theta_i + \lambda c_i = 0, \quad i = 1, 2, \dots, n \quad (16)$$

The system's (16) solution is  $k_1, \dots, k_n$  depending on  $\lambda$ , under the form:

$$k_i = \frac{1}{\ln \Theta_i} \ln \lambda + \frac{1}{\ln \Theta_i} \ln \left( -\frac{c_i}{\ln \Theta_i} \right), \quad i \in 1, \bar{n} \quad (17)$$

or, if we make the notations:

$$a_i = \frac{1}{\ln \Theta_i} \quad (18)$$

$$u_i = -\frac{c_i}{\ln \Theta_i} \quad (19)$$

$$b_i = \frac{\ln u_i}{\ln \Theta_i} \quad (20)$$

the solution can be expressed by:

$$k_i = a_i \ln \lambda + b_i \quad (21)$$

The value of  $\lambda$  can be determined using the restriction, meaning:

$$\lambda = \left[ \frac{C - \sum_{k=1}^n c_k b_k}{\sum_{k=1}^n c_k a_k} \right] \quad (22)$$

The system's solution can be acquired iteratively; an initial solution can be that of taking the smallest  $k_i$  that satisfies the inequality:

$$h_i = \frac{\Theta_i^{k_i}}{(1 + \Theta_i)^{k_i+1}} < \lambda c_i \quad (23)$$

where  $\lambda$  is given by the relation (22).

By choosing decreasing values for  $\lambda$  and using an iterative process (according to the organization chart of the fig. 2) one can get the

optimum number of redundant component parts for each system.

## 2. The structural-kinematical reliability of external memory with rigid magnetic disks

To exemplify, we present the case of an external memory unit with rigid magnetic disks, whose constructive solution is illustrated by the fig. 1.

In the figure, there has been noted by:

- 1 – magnetic rigid disc;
- 2 – circular plate to fix the rigid magnetic disk;
- 3 – axial attachment screw;
- 4 – rotation bearing of the reading-writing head-carrying device;
- 5 – rubber buffer filling;
- 6 – head-carrying device;
- 7 – electrical connection;
- 8 – electrical connection cables;
- 9 – electric fixing shoe;
- 10 – 11 – fixing screws;
- 12 – limiter stud bolt;
- 13 – fixing peg;
- 14 – metallic elastic strap;
- 15 – working engine;
- 16 – capstan;
- 17 – peg;
- 18 – hexagonal head screw;
- 19 – lamellar string;
- 20 – reading-writing magnetic head;
- 21 – air filter;
- 22 – shell;
- 23 – connector;
- 24 – logical plate.

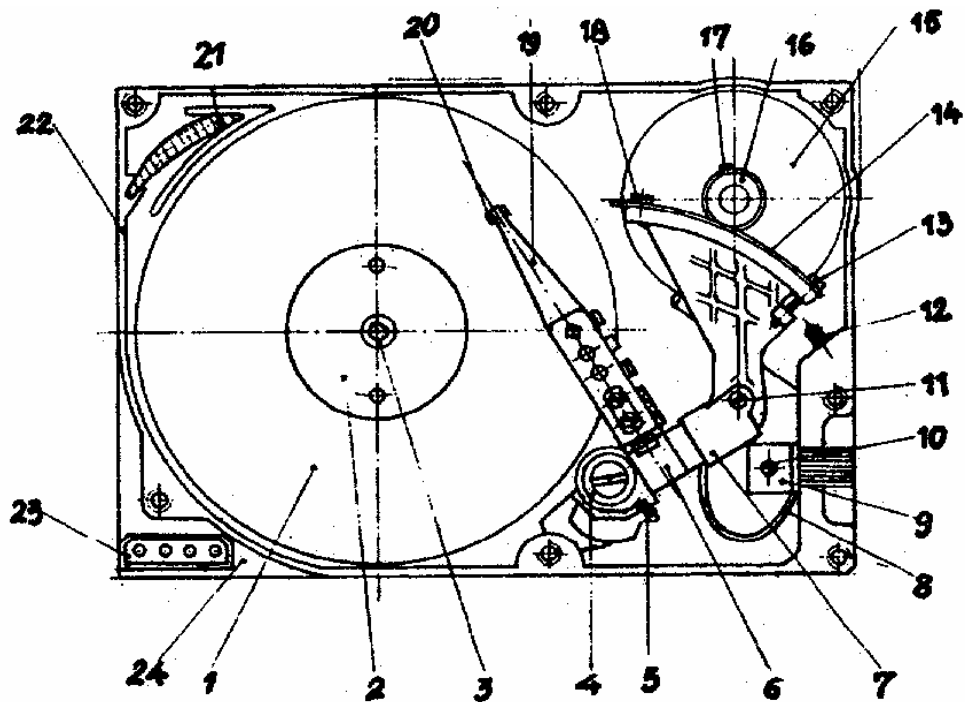


Fig. 1. - Hard disk constructive solution

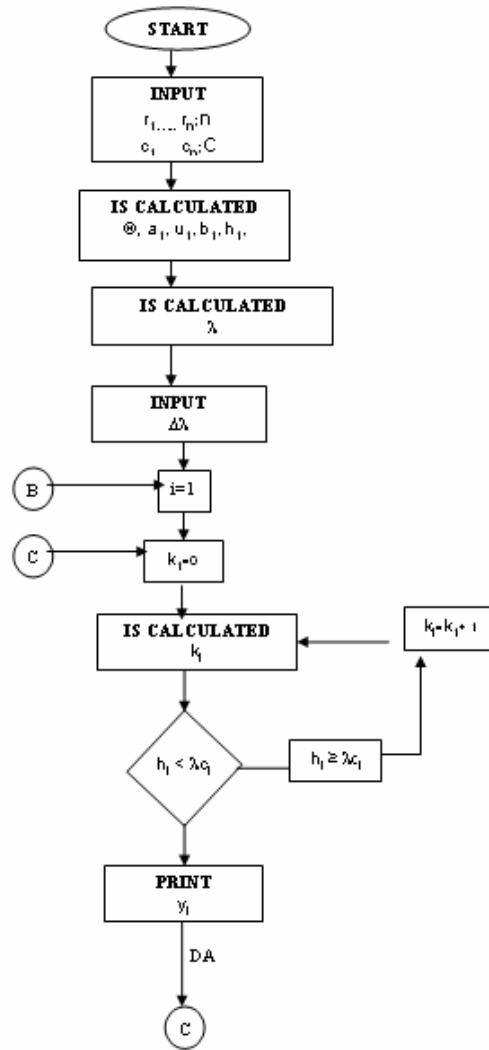


Fig. 2. Iterative process organization chart

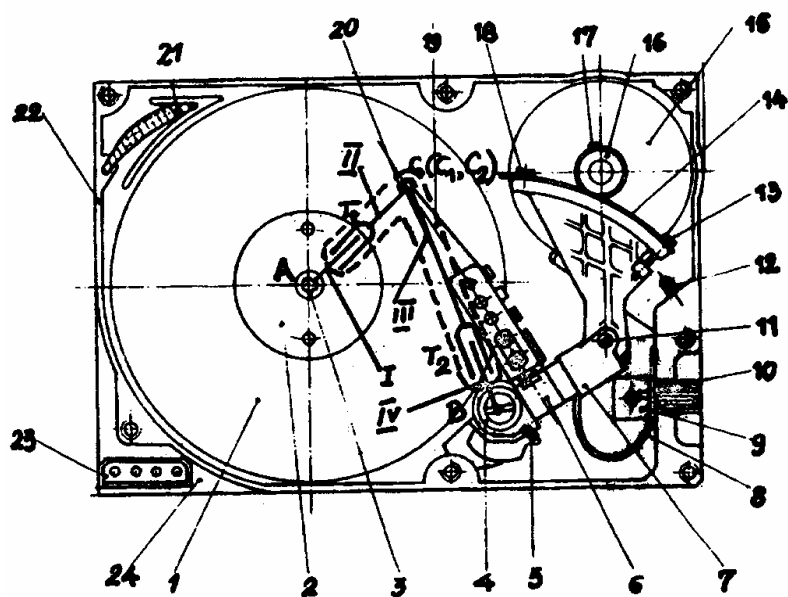


Fig. 3 . Bimobile equivalent bar mechanism

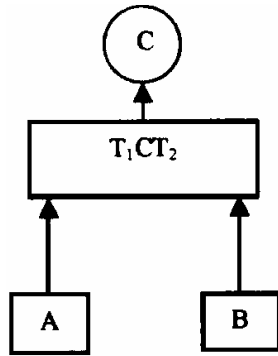


Fig. 4. Kinematical structure body diagram

The bimobile equivalent bar mechanism is presented in fig.3. One can see that the constructive solution presented in fig. 1 is equivalent to the bar mechanism from fig. 3, composed of two active couplings A and B, constructively corresponding to the two operating engines of the magnetic disks package, namely, that of the reading-writing head-carrying device and a 2nd class passive modular group ( $T_1CT_2$ ). Imposing reliabilities:

- $r_1 = 0,95$  for the operating engine of the disk package;
- $r_2 = 0,85$  for the passive modular group;
- $r_3 = 0,98$  for the electric engine that operates the magnetic head carrying device;

The system's parameters  $\Theta_i$  will become:

$$\Theta_1 = \frac{1-r_1}{r_1} = \frac{1-0,95}{0,95} = 0,0526$$

$$\Theta_2 = \frac{1-r_2}{r_2} = \frac{1-0,85}{0,85} = 0,176$$

$$\Theta_3 = \frac{1-r_3}{r_3} = \frac{1-0,98}{0,98} = 0,0204$$

Taking into account the structural-kinematical complexities and the economical-technological aspects of the system's components, the following parameters impose themselves as a quantitative measure of the enumerated features:

- $C_1 = 20$  units;
- $C_2 = 15$  units;
- $C_3 = 30$  units.

To achieve an optimum in point of the controlled designing within the structural-kinematical and technological concept, substantiated on the reliability criteria of the redundant system, whose body diagram is presented in fig. 4 (resulted from the equivalent mechanism from fig. 3), one may raise the function maximization issue:

$$f(k_1, k_2, k_3) = (0,0256)^{k_1} + (0,176)^{k_2} + (0,0204)^{k_3}$$

with the connection:

$$20k_1 + 15k_2 + 30k_3 - 100 = 0$$

if we suppose that  $C = 100$  (imposed). There results the Lagrange function under the form:

$$(0,0526)^{k_1} \ln k_1 + 20\lambda = 0$$

$$(0,176)^{k_2} \ln k_2 + 15\lambda = 0$$

$$(0,0204)^{k_3} \ln k_3 + 30\lambda = 0$$

$$20k_1 + 15k_2 + 30k_3 - 100 = 0$$

where:

$$k_1, k_2, k_3 \in N^*$$

It results:

$$k_1 = \frac{1}{\ln(0,0526)} \ln \lambda + \frac{1}{\ln(0,0526)} \ln \left( \frac{-20}{\ln(0,0526)} \right)$$

$$k_2 = \frac{1}{\ln(0,176)} \ln \lambda + \frac{1}{\ln(0,176)} \ln \left( \frac{-15}{\ln(0,176)} \right)$$

$$k_3 = \frac{1}{\ln(0,0204)} \ln \lambda + \frac{1}{\ln(0,0204)} \ln \left( \frac{-30}{\ln(0,0204)} \right)$$

The value of  $\lambda$  is given by the connection:

$$\lambda = \exp \left[ \frac{100 - (20b_1 + 15b_2 + 30b_3)}{20a_1 + 15a_2 + 30a_3} \right];$$

where:

$$b_1 = \frac{\ln u_1}{\ln \Theta_1} = \frac{\ln\left(\frac{-20}{\ln(0,0526)}\right)}{\ln(0,0526)}$$

$$b_2 = \frac{\ln u_2}{\ln \Theta_2} = \frac{\ln\left(\frac{-15}{\ln(0,176)}\right)}{\ln(0,176)}$$

$$b_3 = \frac{\ln u_3}{\ln \Theta_3} = \frac{\ln\left(\frac{-30}{\ln(0,0204)}\right)}{\ln(0,0204)}$$

and:

$$a_1 = \frac{1}{\ln(0,0526)}$$

$$a_2 = \frac{1}{\ln(0,176)}$$

$$a_3 = \frac{1}{\ln(0,0204)}$$

An initial solution can be judged as being given by the smallest natural number that respectively satisfies the inequalities:

$$h_1 = \frac{(0,0526)^{k_1}}{(1 + 0,0526)^{k_1+1}} < 20\lambda$$

$$h_2 = \frac{(0,176)^{k_2}}{(1 + 0,176)^{k_2+1}} < 15\lambda$$

$$h_3 = \frac{(0,0204)^{k_3}}{(1 + 0,0204)^{k_3+1}} < 30\lambda$$

### 3. Conclusions

By choosing decreasing values for  $\lambda$ , one can get the solution that gives the optimum number of redundant components in the presented case,  $k_1, k_2, k_3$  etc (according to the organization chart from fig.2).

The elaborated reliability theoretic model can be also applied under other restrictive conditions, such as mass limitative conditions, limit gauge etc., individually or cumulated applied conditions.

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## CONSIDERATIONS ABOUT THE ELECTRICAL ENGINE VIBRODIAGNOSIS

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**Abstract:** *In the present paper there are presented the procedure of the electrical engine testing and the obtained results for three different such equipment. There were analysed the FFT spectrum for each engine according with the international standards.*

**Key words:** *vibration measurement, FFT, vibrodiagnosis.*

### 1. INTRODUCTION

From constructive point of view, rotary electric machines are consisting of: rotor, casing, bearing box and commutator brushes. Thus, during their operation, a series of noises and vibrations may be developed, having sources which may be identified directly related to their constructive aspects:

1. Achieving manner of the electric machines;
2. Executing and assembling accuracy of different component parts;
3. Aerodynamic flow within the machine;
4. Magnetic forces developed during the operation.

Among all the causes of generating high amplitude vibrations, the strongest is represented by the rotor unbalance. Regardless to the unbalance type (in a single plane – static unbalance, or in several planes – dynamic unbalance), the negative effects may conduce, especially at high speeds, to the integral destroying of the equipment and, sometimes, generating accidents with grave consequences. This is the reason why a continuous diagnosis of these rotary machines, is a more and more important question. Besides the operating security, a special importance comes to the accurate prediction of the components failure, especially of bearings. Generally, in the case of rotary electric machines, a certain degree of

unbalance is permanently present, generating an harmonic vibration having frequency equal tot hat corresponding to the rotor's rotary motion, its amplitude level being directly related to the rotor's rotation speed.

The commutator brushes represent another source of vibrations and noise overlapping that related to the rotor's unbalances.

The vibration and noise level produced by the commutator brushes is determined by the quality of brushes and of sliding surfaces, of the slideway manner within the brush collar supports, of the brush pressure on the contact surface and the commutation phenomenon, the amplitude values increasing with the speed increases of the rotor and the number of collector bars.

From the point of view of the frequency spectrum generated by the brushes, a series of harmonic components of the basic frequency may be distinguished. These frequencies are defined by a relationship that has as components the rotor's speed, expressed in [rot/min], and the number of collector bars.

Similar, the rotor's notches conduce to the generation of a vibrating motion and of a noise, both of magnetic type and of harmonic type. The frequencies of stationary signals caused by the bearings of the rotary electric machines' bearing boxes are specified in a series of specialty papers [1, 2].



In the calculation of these frequencies both aspects related to the bearing's geometry (its outer and inner diameters, the balls' diameter the contact angle) and the number of rolling bodies and the shaft's speed. Thus, theoretically, frequencies corresponding to the inner ring, outer ring, rolling body of ball cage is determined. From the phenomenological point of view it has to be specified that all defects of the rotor's bearing boxes appear as periodical pulses, being transmitted to the motor's casing.

Another important source of vibrations is represented by offsetting due both to the processing technologies of the components and of assembling. In this case, the spectrum of vibration frequencies is characterized by the existence both of a component having a frequency equal to the rotational one and of a component having a frequency double compared to the rotational one, the ratio between the amplitudes of the two components indicating the offsetting degree.

As a result of the long lasting charged operation, between the components of rotary electric machines, a series of margins produced by wear, may appear. The vibrations appeared manifest themselves especially on the direction of practical aspect margin, helping to the differentiation compared to the vibrations produced by unbalances.

Detecting and checking margins between elements need to carry out measurements in several points, the highest level being achieved near and on the direction of the margin. From the above mentioned facts results that in case of rotary electric machines, vibration sources are varied, starting from the simple components, until the influence of the magnetic field developed as a result of their operating manner.

## **2. EQUIPMENT AND TESTING CONDITIONS**

Overlapping all vibration sources, in the case of rotary electric machines, leads to the appearance of a large spectrum of frequencies, being very difficult to be filtered and interpreted.

Consequently, choosing of diagnosis equipment and checking range of frequencies, is very important. For example, on grounds of the experimental researches it has been determined the fact, that the level of excitations appeared in three-phased motors with shortened rotor having powers on the field of 0,6 – 7,5 kW, present a frequency spectrum of interest, between 16 Hz and 530 Hz, the same range being taken into consideration also for direct current motors using in driving machines and equipment. A first stage in testing rotary electric machines is represented by fixing the measuring system.

The measuring equipment for the vibration's intensity has to satisfy the conditions of ISO 2954 [4] and that for the shaft's vibration, has to be according to ISO/DIN 10817-1. The transducers used in measuring have to allow determination either of the vibration speed or of the acceleration and are installed on the measuring ranges, according to the specifications of the transducer's producer, installation being made in a manner, which doesn't allow perturbations of the tested equipment's vibrating conditions.

For observing this condition, the weight of the transducer's assembly has to be less than 1/10 of the machine's weight [4]. Within the specialty literature, a high variety of installations destined for testing and monitoring generally, machines, their complexity degree depending on the nature and number of operating parameters followed.



Fig. 1 Testing set-up

The testing stand contains the following components, produced by Brüel&Kjaer, (Figure 1): 5 vibration transducers - type 4508

B 001 accelerometer; PULSE 12 platform; computer connected by a LAN system to the PULSE 12 platform.

For testing low power electric engines, the procedure described by the standard IEC 60034 part 14, has been followed.

In processing and checking signals, the following programs, licensed and produced by Brüel&Kjaer, the Department Strengths of materials and vibrations within the „Transilvania” University of Brasov being endowed with them: checking soft FFT type 7770-6, data acquisition soft type 7705, data processing soft type 7709.

The transducers have been mounted on plastic supports, special carried out for them, which, on their turn, have been glued on the motor casing in the points specified by standard (Figure 2).

Technical data of the acceleration transducers, according to the process chart: linear measuring range 0.1 Hz ÷ 8 kHz; operating temperature range -54°C to +121°C; oscillating element - crystal, type PZ23; weight 4.8 grams.

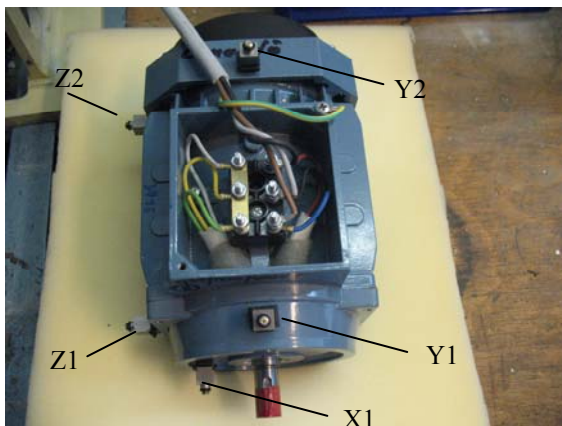


Fig. 2 Transducers mounted according to standard IEC 60034 part 14

The PULSE 12 platform used is of type 3305B, containing a 3039 type module with 6 input channels and a 7536 type module, with an output channel und LAN connection block to Internet networks (Figure 4).

The six input channels consist of BNC type connectors and LEMO type connectors, for the experiment being used the BNC type connections. The connection to computer is made directly by defining a platform IP

(10.10.10.11), the computer having its own IP (10.10.10.50), opportunity used in this experiment.

By its construction, the platform may be coupled to other similar platform; the communication with the basic computer installed with the data processing soft is achieved either directly, or by the internal Internet network.

### 3. TESTING PROCEDURE

The tests were made based on the standards in the field [2, 3, 4, 6, 8]. In data acquiring and processing the LabShop v.12.0 program has been used. The acquiring program imposes to cover some stages, which by their succession, avoids the possibility of introducing measurement errors as a result of connections and definitions of operating components (transducers, types of measured signals, type of analysis etc.).

The main phases covered during preparation and achievement of measurements were: definition of acceleration transducers, assignment to these transducers of the indicators X1, Y1, Z1, Y2 and Z2 (Figure 2 representing the motor's anterior zone – 1, and 2 representing the motor's posterior zone), set-up of accelerometers in three signal groups, selection of the signals' analysing type (within the time and frequency range) and definition of the recorded signals' read out functions.

In view of obtaining accurate data, a pre- and post-calibration of the acceleration transducers has been carried out.

For the calibration proceeding, a caliber of 4294 type produced by the Brüel&Kjaer company has been used for this type of acceleration transducer (Figure 3).

Pre-calibration is carried out for checking if the transducers operating parameters are corresponding to those mentioned within the process chart.

Post-calibration is needed for checking if during the measurements, acceleration transducers have suffered failures (chocks or other stresses), conducing to the modification of operating parameters prescribed by the manufacturing company. Pre- and post-calibrations were carried out by the

„Calibration” module of the data-checking program, the same PULSE 12 (Figure 4) platform being used for.



Fig. 3 Calibrator type 4294 with transducer of 4508 B 001 type

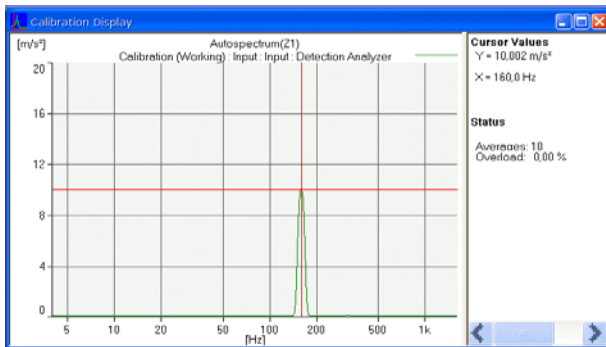


Fig. 4 Calibration oscillogram

#### 4. PROCESSING MEASURED SIGNALS

Within the literature, as general shape, a frequency spectrum for an electric engine, where deliberately, both a certain offsetting of the bearing boxes and an unbalance of the rotor have been introduced - graphic representation in Figure 5 [1].

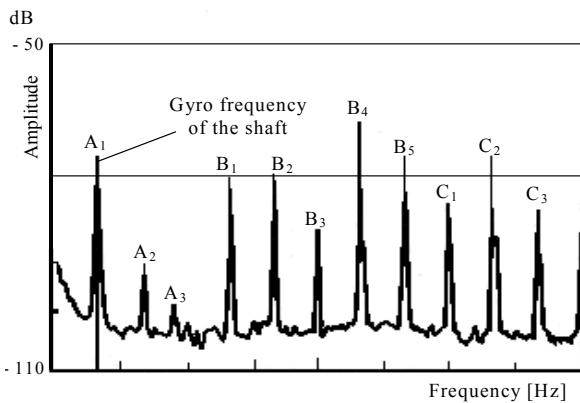


Fig. 5 Frequency spectrum of an electric engine

As it results from Figure 5, there are three zones, denoted A, B and C. The peaks noted with A in the spectrum presents a marked maximum at the basic gyro frequency, having a very fast decrease of the amplitude with the frequency, as a general characteristic of vibrations generated by unbalances of shafts. The bearing box offsetting generates the peaks noted with B, manifested at high frequencies.

The variable forces of the magnetic field generate those noted with C. Starting from the general data of the specialty literature, on grounds of the standards in force and by using the experimental technique described within § 2, a number of three different electric motors have been analysed.

They have operated at speeds of 1000 rot/min, 1500 rot/min and 3000 rot/min and the analyses carried out have been recorded in the time and frequency ranges.

For obtaining accuracies high enough, the same sampling rate of 400 ms for all the three motor types has been selected, considering a maximal level of the measured frequencies of 1600 Hz.

The analysis within the frequency field has been carried out parallel to the analysis within the time filed.

Consequently, settings related to the sampling rate and the field of measured frequencies rested the same.

##### a) Electric engine with 1000 rot/min

The graphic results obtained hereby are presented in Figures 6 ÷ 10.

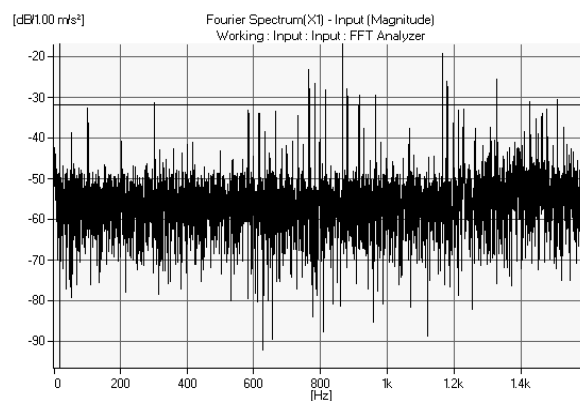


Fig. 6 FFT spectrum of the X1 signal

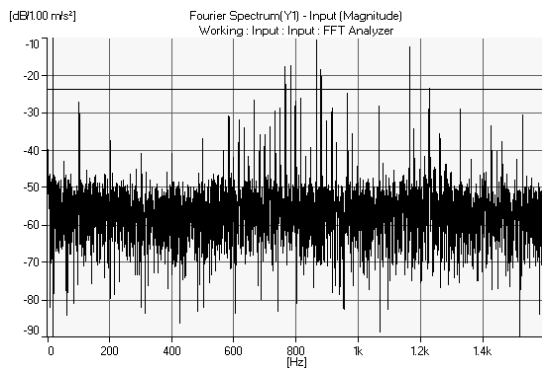


Fig. 7 FFT spectrum of the Y1 signal

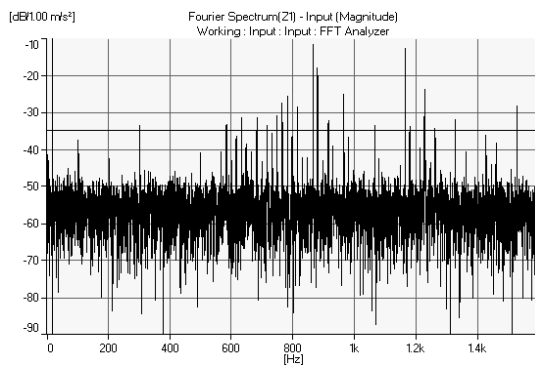


Fig. 8 FFT spectrum of the Z1 signal

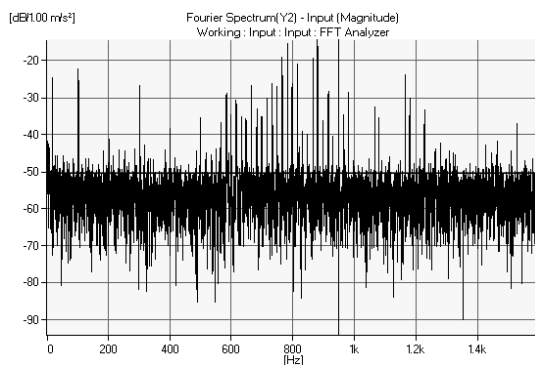


Fig. 9 FFT spectrum of the Y2 signal

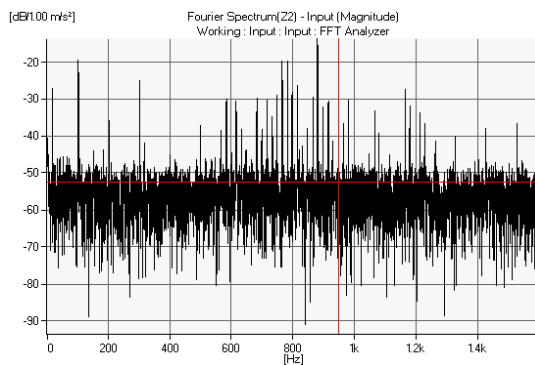


Fig. 10 FFT spectrum of the Z2 signal

From the frequency analysis the following aspects may be pointed out:

- The highest vibration levels are recorded at the frequencies of 764.0 Hz, 864.0 Hz, 880.5 Hz and 1164 Hz;
- At the 1164 Hz frequency an extremely high level is denoted on the directions X1, Y1 and Z1;
- At higher frequencies than 1 kHz axial vibrations are dominant.

**b) Electric engine with 1500 rot/min**

The graphic results obtained hereby are presented in Figures 11 ÷ 15.

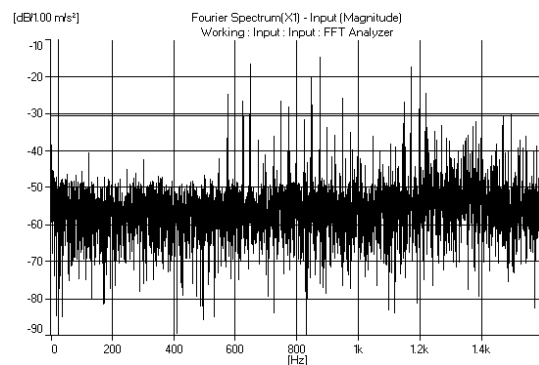


Fig. 11 FFT spectrum of the X1 signal

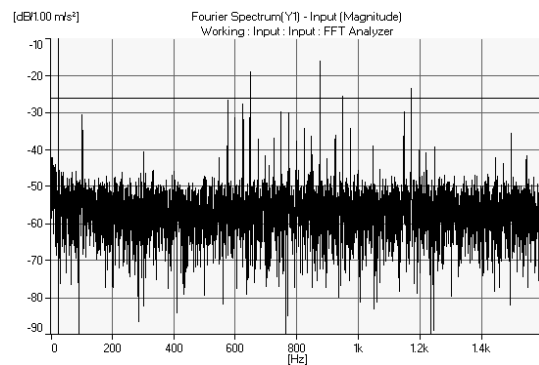


Fig. 12 FFT spectrum of the Y1 signal

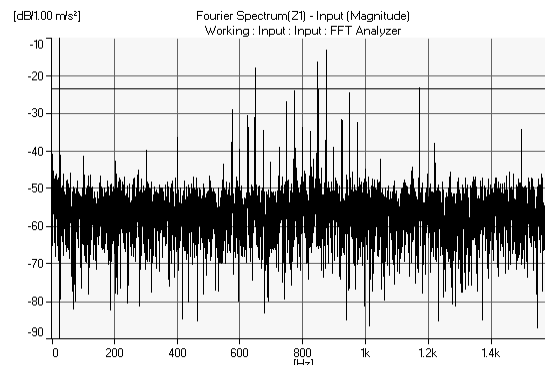


Fig. 13 FFT spectrum of the Z1 signal

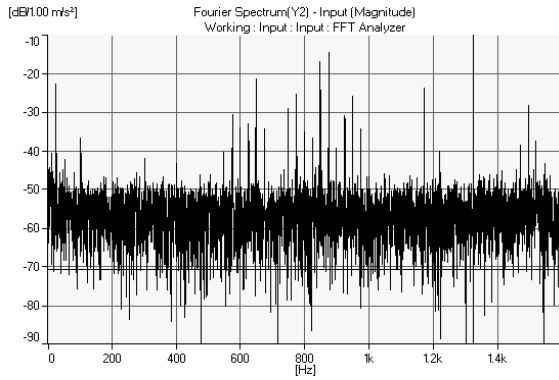


Fig. 14 FFT spectrum of the Y2 signal

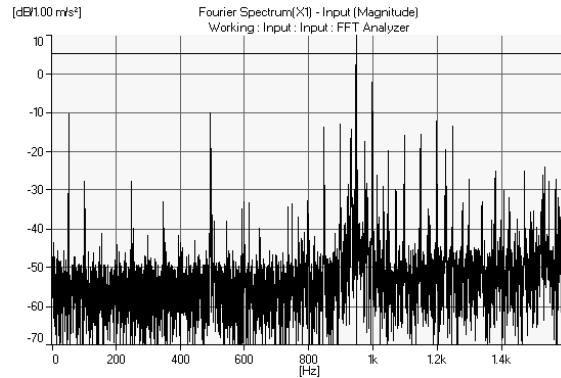


Fig. 16 FFT spectrum of the X1 signal

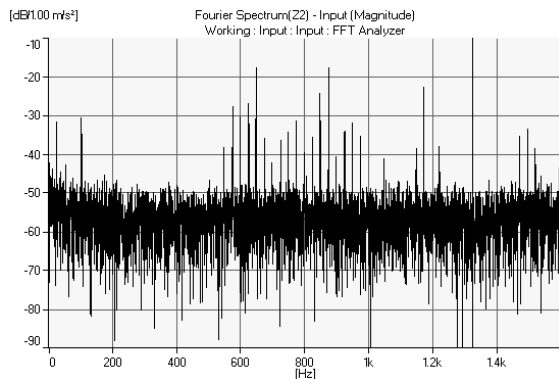


Fig. 15 FFT spectrum of the Z2 signal

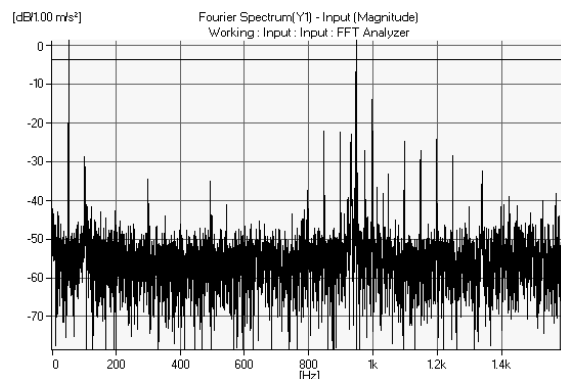


Fig. 17 FFT spectrum of the Y1 signal

The following particular situations may be pointed out:

- The highest vibration levels, in all the measurement points are recorded at the frequencies of 647.50 Hz, 847.50 Hz and 872.50 Hz;
- At frequencies higher than 1164 Hz axial vibrations (X1 direction) are the strongest, but having low level;
- At the frequency of 847.5 Hz the acceleration amplitudes of the frontal area are high on the X1 and Z1 direction (XOZ horizontal plane);
- At the frequency of 872.50 Hz the acceleration amplitudes on all directions are the highest.

In conclusion, it may be stated on grounds of the above presented facts, that the existence of a failure within the horizontal XOZ plane is confirmed.

### c) Electric engine with 1500 rot/min

The measured signals are presented in Figures 16 ÷ 20.

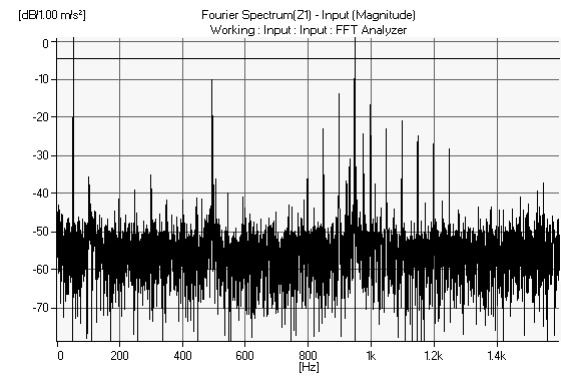


Fig. 18 FFT spectrum of the Z1 signal

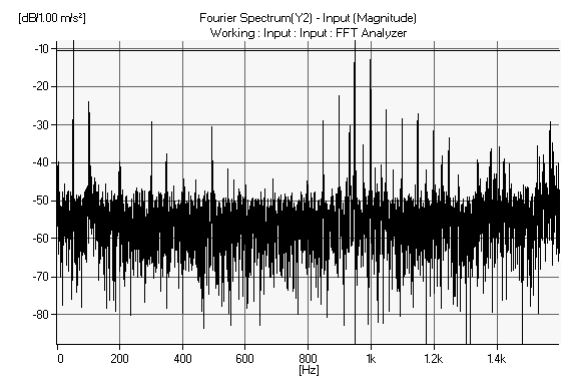


Fig. 19 FFT spectrum of the Y2 signal

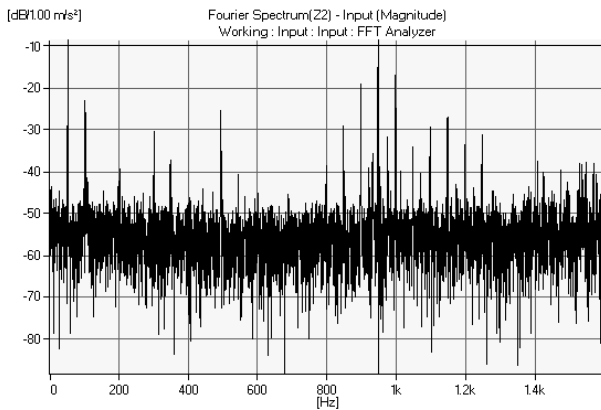


Fig. 20 FFT spectrum of the Z2 signal

From the frequency analysis a series of particular situations may be distinguished:

- The highest vibration levels in all measurement points are recorded at the frequencies of 50 Hz (corresponding to the rotor's speed), 947 Hz and 997.5 Hz;
- At the frequency of 50 Hz an extremely high level within the vertical plane (Y1 and Z1 directions) is noted;
- At higher frequencies than 1 kHz, axial vibrations (X1 direction) are the strongest, but having low level.
- At frequencies of 491.5 Hz and 897 Hz the amplitudes of acceleration of the "frontal" area are higher on the X1 and Z1 directions (horizontal XOZ plane), noting that at the frequency of 897 Hz, a high level appears on the Z2 direction;
- At the frequency of 947 Hz the amplitude of accelerations are the highest on all directions;
- A high level of these amplitudes is also noted for the frequency of 997.5 Hz.

#### 4. CONCLUSIONS

The diagnosis from the vibration levels point of view represents a very strong tool to find out the possible sources of faults at the electrical engines [1, 5, 6].

As is known from the literature the faults are caused by the components of the engine. At the presented tests there were found the three groups of frequencies denoted with A, B and C [1].

The measured values show that:

- The vibrations level in the case of the 1000 rot/min speed motor are lower than for the other two motors;
- At the each measure there were highlight the frequencies that correspond to the rotor's rotation speed;
- There were found the vibration frequencies caused by the electromagnetic field of the engine;
- The frequencies caused by the magnetic field are larger than 800 Hz and are mainly point out on the horizontal direction (X direction);
- The frequencies up to 250 Hz are, generally, caused by the shaft unbalance and this can be seen from fact that there are developed high vibration amplitudes, on Y and Z directions, at the same frequencies;
- The vibrations that are situated in the range of 250 ÷ 800 Hz are mainly caused by different parts of the engine, especially bearings;
- These vibration frequencies can be calculate as is shown in [1] for the inner and outer rings and for the bearing balls.

#### 5. ACKNOWLEDGEMENT

The present paper is supported by The National University Research Council (CNCSIS) under the contract number 848/2009.

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# THOMSON JUMPING RING SIMULATION

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**Abstract:** In this paper an old idea is simulated with powerful software in order to demonstrate their potential to launch objects with hypervelocity. With some improvements this device can be transformed in to a coil gun. I suggest using this approach to achieve hypervelocity for a launch objects with a better efficiency than a rail gun. I used for simulation a high-performance interactive software package that uses finite element analysis (FEA) to solve three-dimensional (3D) electric, magnetostatic, eddy current and transient problems.

**Keywords:** jumping ring, induction coil gun, simulation, Ansoft, Maxwell 3D.

## 1. INTRODUCTION

Elihu Thompson (1853-1937) was an American engineer and inventor. He invented the apparatus described in this paper in 1882, six years before Tesla’s invention of the rotating induction motor, to demonstrate his pioneering research in alternating current and high frequency.

This device is composed by a coil, winded around a ferromagnetic core. The length of core is larger than length of coil. The projectiles are conducting non-ferromagnetic rings. In this simulation I used aluminum rings. The coil is driven by an alternating current for a short period of time, until the ring leaves the core.

This device can work like a coil gun based on the principles of electromagnetic induction and repulsion. If an alternating current flows through the coil an alternating magnetic field is created. This field magnetizes the core which is made by iron in this case, and a circumferential alternating current is induced in the ring.

The result is a very large repulsive force experiences by the ring. In order to simulate this experiment I used software created by Ansoft, Maxwell.

This software is a high-performance interactive software package that uses finite element analysis (FEA) to solve three-dimensional (3D) electric, magnetostatic, eddy current and transient problems.

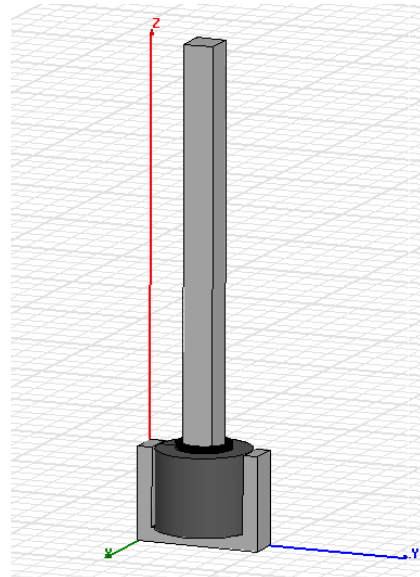


Fig. 1 Drawing model

Maxwell integrates with other Ansoft software packages to perform complex tasks while remaining simple to use.

The following types of solutions are supported by Maxwell 3D:

- Electric 3D fields, which can be one of the following two categories:

- a) Electrostatic 3D fields caused by user-specified distribution of voltages and charges; additional computed quantities include torque, force, and capacitances as indicated by the user.



b) Electric 3D fields in conductors characterized by a spatial distribution of voltage, electric field and current density; additional quantity in this case is power loss.

- Magnetostatic linear and non-linear 3D fields caused by user-specified distribution of DC current density, permanent or externally applied magnetic fields; additional computed quantities include torque, force, inductances (self and mutual) as indicated by the user;

- Harmonic (sinusoidal variation in time) steady state magnetic fields with pulsation-induced eddy currents in massive (solid) conductors caused by a user specified distribution of AC currents (all with same frequency but with possibly different initial phase angles) or by externally applied magnetic fields; this is a full wave solution and includes electromagnetic wave radiation;

- Transient (time domain) magnetic fields caused by permanent magnets, conductors and windings supplied by voltage and/or current sources with arbitrary variation as functions of time; rotational or translational motion effects can be included in the simulation [3].

## 2. THEORY

This device is driven by an alternating current, which flows through the coil creating a magnetic field around it ( Biot-Savart's Law). The alternating current in the solenoid is

$$I_s = I_0 \sin \omega t \quad (1)$$

where  $\omega = 2\pi f$ . The system produces an axial magnetic field with a radial component,  $B_r$ .

The force on a ring of radius  $a$  along the axis is:

$$F = 2\pi a I_i B_r \quad (2)$$

where  $I_i$  is current induced in the ring [3].

By Faraday's Law, the axial component of alternating magnetic field that passes through the ring induces a current. The ring is an LR circuit with inductance  $L$  and resistance  $R$ .

Two conductors with currents flowing in the same direction are attracted to each other and two conductors with currents flowing in opposite direction are repelled from each other.

The same applies to two parallel conductors with the shape of a ring. Using currents that

flow in the opposite directions makes them repel each other.

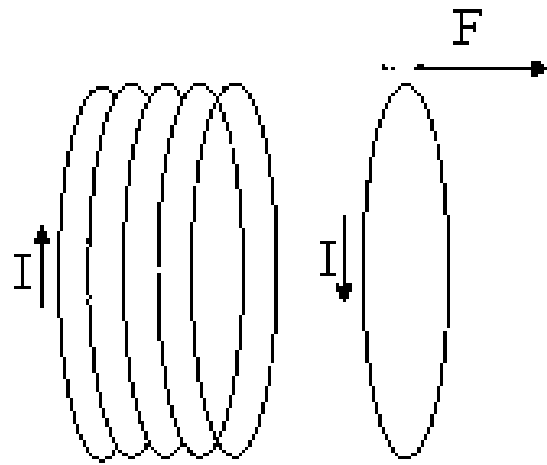


Fig. 2 Resulting force in a ring

The force acting between two circular current loops, of radii  $a$  and  $b$  respectively, placed one on the top of the other such that the  $z$ -axis passes through both centers and the distance between the two centers is  $d$  can be found using the following equations:

$$\vec{F}_{12} = -\hat{z} \frac{I_s I_i}{c^2} d a b 2\pi \int_0^{2\pi} d\phi \frac{\cos \phi}{(d^2 + a^2 + b^2 - 2ab \cos \phi)^{3/2}} \quad (3)$$

## 3. MODEL DESIGN

First of all my design is not the same like original design. I used an E shape core in order to achieve better result. For the E shape core I used the standard E 12.5 shape dimensions used in transformers. The thickness of the core (in  $Ox$  direction) is 26 mm. The ring can move along an I shape core with dimensions (X,Y,Z) 26 mm, 24 mm and 320 mm.

The dimensions of the ring are inner radius 18 mm outer radius 22 mm and height 5 mm.

The coil is fitted inside E shape core and has 300 turns.

I assigned aluminum material for ring, copper for coil and steel for core.

I chose for excitation a voltage source at 220 volts and 50 Hz.

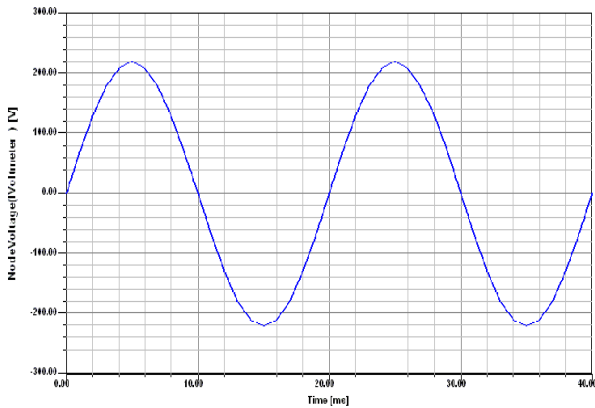


Fig. 3 Voltage source 220 V 50 Hz

My goal is to obtain bigger force acting at ring. Maxwell software computes Lorentz force by:

$$F(t) = \int_{vol} J(t) \times B(t) dVol \quad (4)$$

where:

- J (t) is the current density.
- B (t) is the magnetic flux density.

The average force is found by integrating the instantaneous force:

$$F_{AV} = \frac{1}{2\pi} \int_0^{2\pi} F_{Inst} d\omega t = \frac{1}{2\pi} \int_0^{2\pi} \left( \int_{Vol} J(t) \times B(t) dVol \right) d\omega t \quad (5)$$

#### 4. MODEL ANALISYS

First I set the software to calculate a solution in Transient mode (time domain). The support of voltage excitations for the windings has as consequence the fact that the winding currents are unknown and thus the formulation has to be modified slightly to allow Maxwell to account for source fields due to unknown currents in voltage - driven solid conductors (where eddy effects are evaluated) and in voltage-driven stranded conductors -where the eddy effects (such as skin and proximity effects) are ignored.

The software computes Lorentz force from 0 to 40 ms with 1 ms step. After running program result:

For first report I choose to plot the current absorbed by coil from source.

For current the plot is:

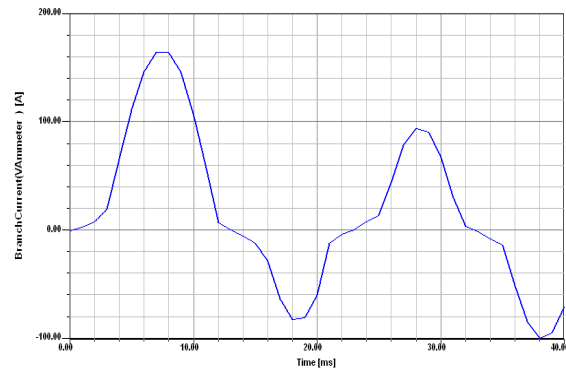


Fig. 4 Plot current

The peak current is 164.4 [A] and is obtained in first half period. The behavior is the same like a transformer with secondary coil in short-circuit.

Now if we looking at current plot we can see the shape of current is not a sinusoid shape. That shape is obtained because the magnetic flux density is in a saturated region for steel.

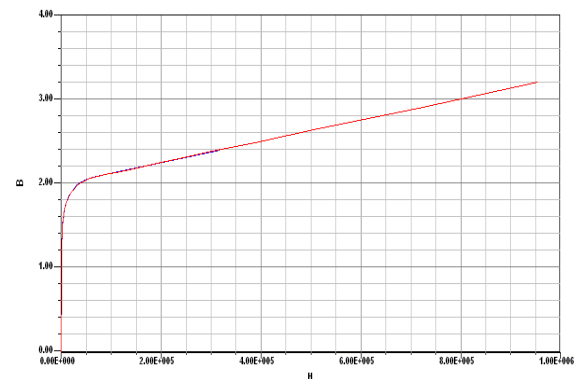


Fig. 5 BH curve for steel

In order to see at what point on BH curve the device is working it is necessary to calculate the distribution of magnetic flux density inside the core.

Next plot show the distribution of magnetic flux density inside the core.

We can see in a region inside coil the magnetic flux density is about 2.5 T.

Usually this situation should be avoided but in this case we can increase the current in coil using a wall plug from our laboratory.

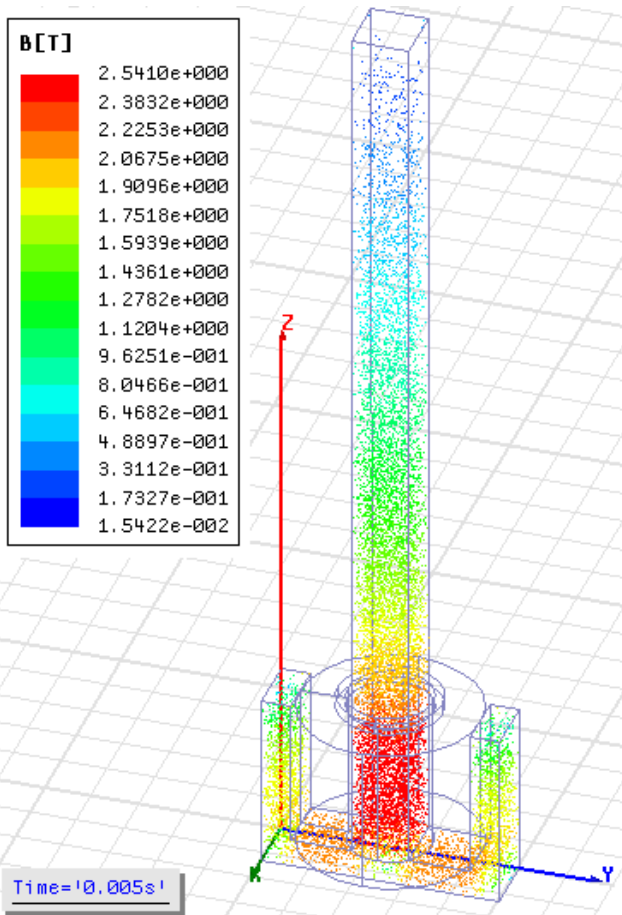


Fig. 6 B inside core

The distribution of magnetic flux density inside core is showed by colored regions. Red color corresponds to 2.5 T magnetic flux density and blue color corresponds to 0.17 T magnetic flux density.

Next step is to find the Lorentz force acting on the ring.

The Lorentz force acting on the ring in Ox direction is showed in next plot.

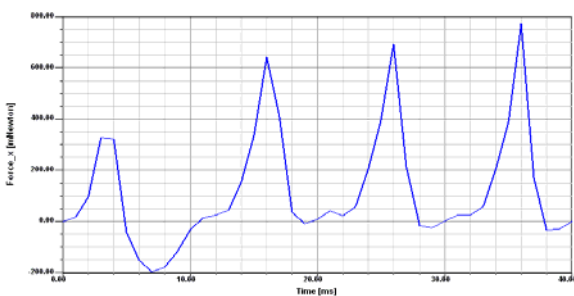


Fig. 7 Lorentz force on Ox direction

The maximum peak force on Ox direction is 775 [mN] and is obtained at 36 ms on time axe.

The Lorentz force acting on the ring in Oy direction is showed in next plot.

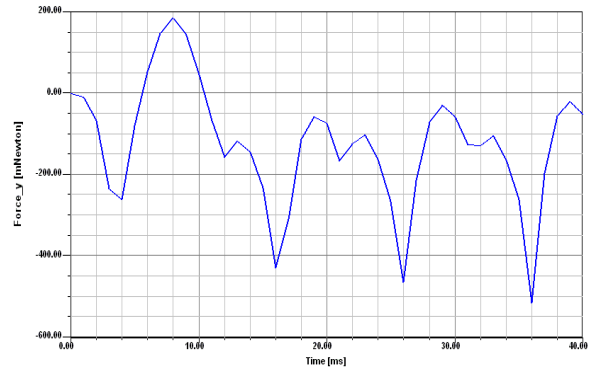


Fig. 8 Lorentz force on Oy direction

The maximum peak force on Oy direction is 184.6 [mN] and is obtained at 8 ms on time axe.

The Lorentz force acting on the ring in Oz direction is showed in next plot.

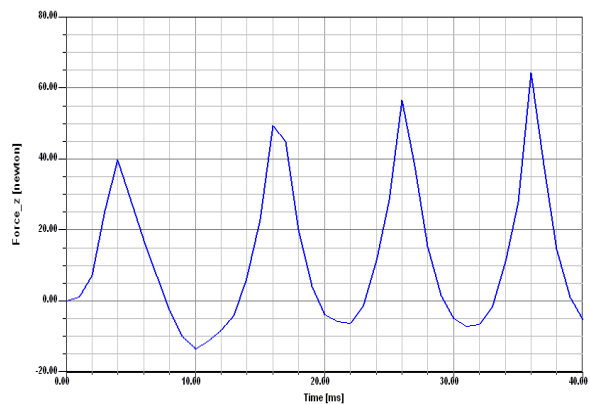


Fig. 9 Lorentz force on Oz direction

The maximum peak force on Oz direction is 64.14 [N] and is obtained at 36 ms on time axe.

Because the positive direction of Oz axe corresponds to a repelled force and the negative direction of Oz axe corresponds to an attractive force we can conclude from this plot the result force is a repelled force.

According with practical result in this situation the ring is launched more than 3 meters high.

Next plot show the evolution of the voltage, current and Lorentz force in Oz direction in time.

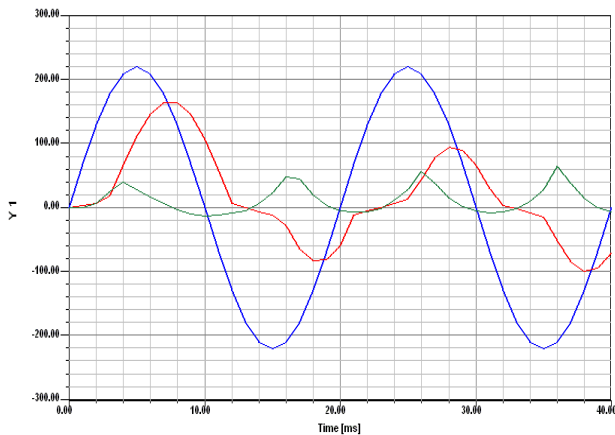


Fig. 10 Voltage, current and Lorentz force Oz

The blue curve represents the voltage signal, the red curve represents the calculated current absorbed by coil and the green curve represents the Lorentz force in Oz direction responsible for repelled of the ring.

This software can calculate also the current density induced in to the ring. In next plot is showed the distribution of the magnetic flux density inside the core at 36 ms and the distribution of the current density induced in to the ring at 36 ms.

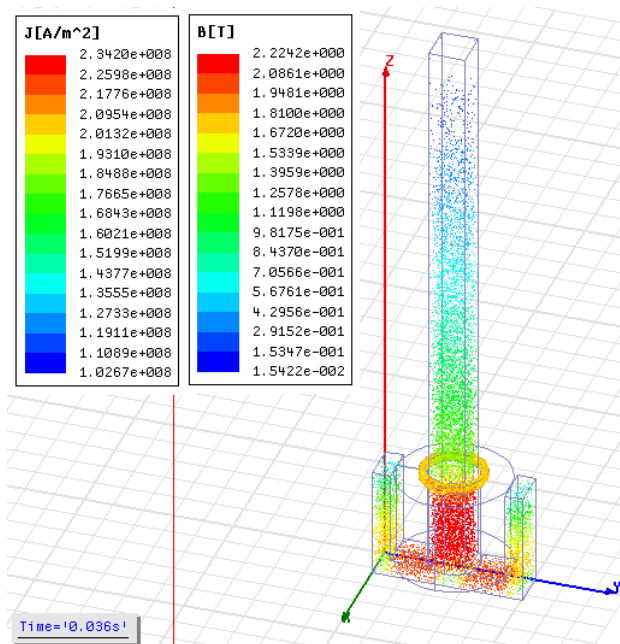


Fig. 11 B and J at 36 ms

As we know only axial component of magnetic flux density is responsible for induced current in to the ring. The radial component of the magnetic flux density is responsible for repelled force exercised on the ring. Finally a large density of magnetic flux inside the core will increase the repulsive force on the ring.

One way is to increase the frequencies of variation of magnetic flux inside the core. For this I will sweep frequencies from 50 Hz to 500 Hz with a step of 50 Hz.

I choose for this the harmonic (sinusoidal variation in time) mode for software which simulate steady state magnetic fields with pulsation-induced eddy currents in massive (solid) conductors caused by a user specified distribution of AC currents (all with same frequency but with possibly different initial phase angles).

The result is showing in to next plot.

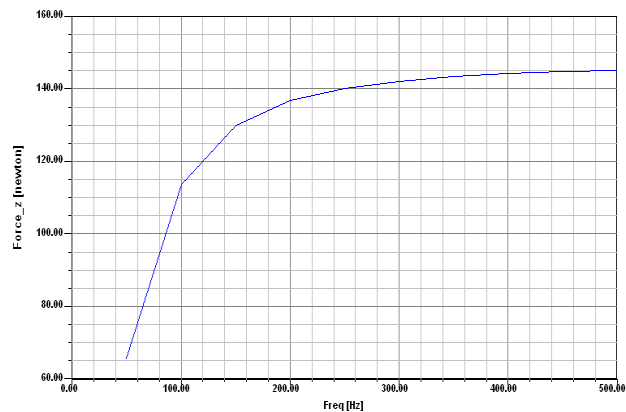


Fig. 12 Variation of force with frequencies

As we can see the force on Oz direction increases from 65 Newton at 50 Hz to 144 Newton at 400 Hz. After 400 Hz the force increases slowly.

As a result the optimal value for the Lorentz force can be achieved at 400 Hz.

In to the next plot is showed the magnetic flux density distribution inside core and current density distribution inside ring at 400 Hz.

The maximum magnetic flux density is  $B=8.3$  T in some region and the maximum current density is  $J=4.96 \cdot 10^8$  A/m<sup>2</sup>.

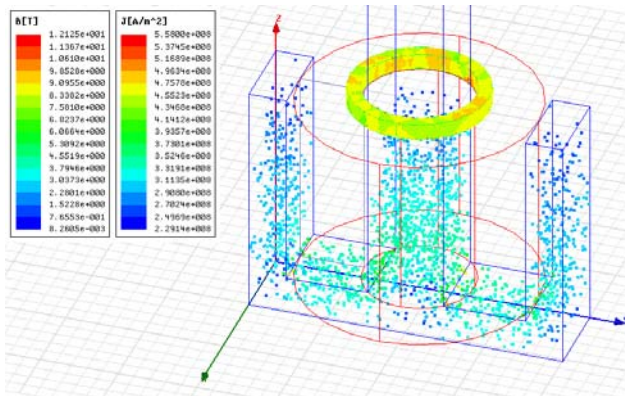


Fig. 13 B and J at 400 Hz

## 5. CONCLUSIONS

Before we are going to build some devices in order to study the behavior in different situation we should take advantages of using the powerful software which can simulate the real world.

I choose for my simulation that model because I was able to make a similar one in order to verifying the theoretical result with practical result.

Actually around the world more and more people spent their energy and time to develop electromagnetic launch technology. First they was concentrated on rail guns, that is a device in which the moving conductor slides between a pair of conducting rails from which it collects direct current as it is accelerated. Until now they achieve some good results but this approach is drawn back by the destruction of the track by

burning as a result of arching at the sliding contacts.

Other approach is an induction accelerator with no electrical connection to the moving part.

This concept has two way of development.

One way consists in accelerating a coil inside a primary coil.

The second way presented in this paper consists in accelerating a coil outside a primary coil by taking advantage of soft magnetic materials.

In this way we can achieve good results with a small amount of power.

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## HIGH PRECISION LI BATTERY MONITOR

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**Abstract:** *The goal of this paper is to combine multiple technologies of monitoring for lithium batteries in order to build a high precision capacity monitor for applications in which it is critical to know the remaining lifetime of the system. In order to accomplish this it was necessary a study of lithium technology for rechargeable batteries. The result was that it is important to follow four main factors which influence the characteristics of this type of batteries: voltage, current, temperature and number of cycles.*

*The created system interpolates these four parameters which have influence on the battery, but it has to be customized for each type of battery. This means that the curves for the parameters studied have to be written in the memory of the controller. The system is dedicated for industrial mobile applications based on lithium technology, and it can be build with the proposed technology or it can be integrated on a chip. This high precision Li battery monitor is designed to be an add-on to the built in protection circuit of rechargeable batteries.*

**Key words:** *monitoring, rechargeable batterie, protection circuit.*

### 1. INTRODUCTION

The newest of the rechargeable chemistries, Li-Ion has been in mass production since 1995. With three times the voltage per cell as Nickel-based chemistries (3.6 V vs. 1.2 V), Li-Ion has a higher energy density and is therefore ideal for lightweight applications. It is currently the chemistry of choice for almost all mobile applications battery applications. Li-Ion battery has had a history of early production overheating related problems and is designed in a battery pack with a Pack Control Circuit (PCC) to protect the cells from abusive conditions such as current and voltage overcharging, high temperature, and over-discharge. The relatively high cost of Li-Ion cells combined with the need for circuitry makes the cost of Li-Ion battery packs higher than for other chemistries.

For measuring the energy stored in Li-Ion cells it is necessary to follow the most important characteristics, such as: current,

voltage, temperature and number of recharged cycles.

This paper main focus is to enhance the PCC for applications in which is critical to know the exact remaining lifetime of battery.

### 2. SISTEM DESCRIPTION

#### 2.1. Battery interface

The system presented in this paper is designed for a battery pack configurations with 2 serial connected battery cells that may have other cells connected in parallel. This pack of cells is part of the battery housing and it requires a connector with 4 wires or contacts.

For minus and plus polarities of the battery are necessary two lines.

The other two lines are necessary for RS232 communication interface which provides information like: information provided by manufacturer (battery ID, battery capacity, battery nominal voltage, maximum number of cycles, allowed temperature range),

real characteristics of battery (voltage, energy stored in battery, temperature of battery) and statistics (average current consumption, remaining lifetime, average temperature of battery, remaining number of cycles).

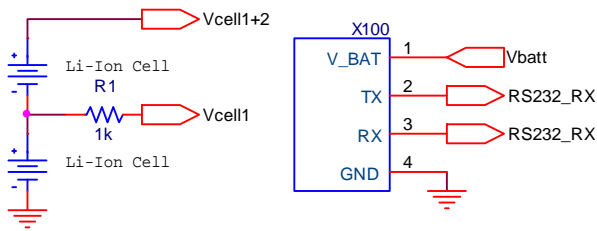


Fig. 1 Cells connection and battery interface: electrical diagram

## 2.2. Battery pack

The cells are assembled into a battery pack configuration to provide a required amount of voltage (V) and capacity (Amperes per hour - Ah) needed to operate the equipment. The number of cells needed and the size of these cells determine the size and shape of the pack. A wire lead or connector is then attached to the positive and negative terminals of the pack for connection to the electronic device. The pack can then be wrapped in heat-shrink plastic or encased in a hard plastic enclosure.

The other important part of the battery pack is the Pack Control Circuit (PCC).

### 2.3. Pack control circuit (PCC)

The core of this system is a microcontroller (MCU) PIC16F688 which analyses and reacts based on the data obtained from the three blocks that are monitoring the battery characteristics (current, voltage and temperature). The MCU has the role of connecting/disconnecting the battery cells to the load and it is responsible for the PCC communication interface.

PCC is designed to operate in a temperature range from a  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ .

In the MCU have to be implemented the charge/discharge curves corresponding to different parameters of climatic conditions or load currents. The measured factors by MCU have to be interpolated.

The PCC is started if a load that require a current higher than 5mA. This current can be adjusted down to  $200\mu\text{A}$  from the load detector that triggers the switch which connects the load to the battery.

### 2.4. Temperature monitor

In the MCU have to be implemented the charge/discharge The Li-Ion capacity is variable with temperature. It is known that most of these cells have a drop of -30% from normal capacity at  $-20^{\circ}\text{C}$ .

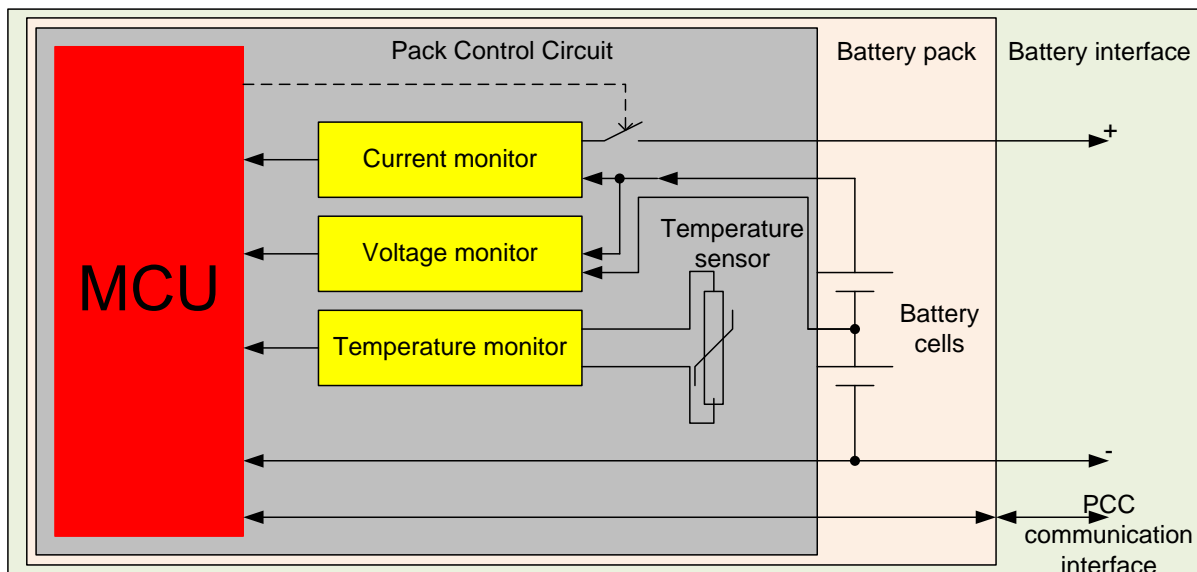


Fig. 2 Pack Control Circuit (PCC)

Usually the Li-Ion batteries can be discharged from  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  and charged between  $0^{\circ}\text{C}$  and  $+40^{\circ}\text{C}$ .

In this design was used an integrated temperature sensor: The LM60 is a precision integrated-circuit temperature sensor that can sense a  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  temperature range while operating from a single  $+5\text{V}$  supply.

The temperature monitor has a typical current consumption during operation  $82\mu\text{A}$ .

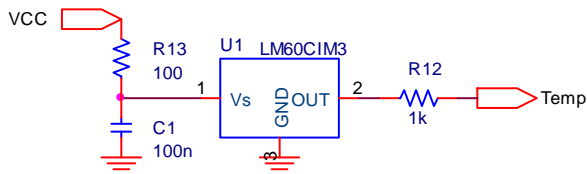


Fig. 3 Temperature monitor – electrical diagram

### 2.5. Current and voltage monitors

This block uses a coulomb counter BQ26231 which measures the voltage drop across a low-value series current sense resistor between the SR1 and SR2 pins using a voltage-to-frequency converter. This information is placed into various internal counter and timer registers. Using information from the BQ26231, the system host can determine the battery state-of-charge, estimate self-discharge, and calculate the average charge and discharge currents. During pack storage periods, the use of an internal

temperature sensor doubles the self-discharge count rate every  $10^{\circ}$  above  $25^{\circ}\text{C}$ .

A register is available to store the calculated offset, allowing current calibration. The offset cancellation register is written by the BQ26231 during pack assembly and is available to the host system to adjust the current measurements. By adding or subtracting the offset value stored in the OFR, the true charge and discharge counts can be calculated to a high degree of certainty.

The RBI input pin is used with a storage capacitor or external supply to provide backup potential to the internal registers when VCC drops below  $2.4\text{V}$ . The maximum discharge current is  $100\text{ nA}$  in this mode. The BQ26231 outputs VCC on RBI when the supply is above  $2.4\text{V}$ ; therefore, a diode is required to isolate an external supply.

The current monitor has a typical current consumption during operation  $80\mu\text{A}$  and  $10\mu\text{A}$  in off mode.

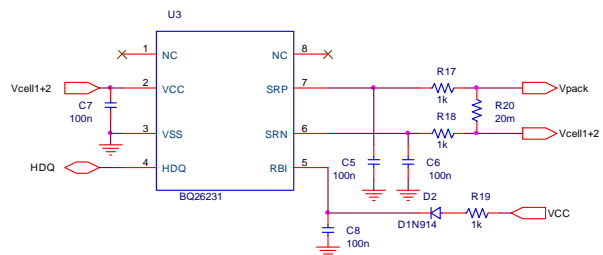


Fig. 4 Current monitor – electrical diagram

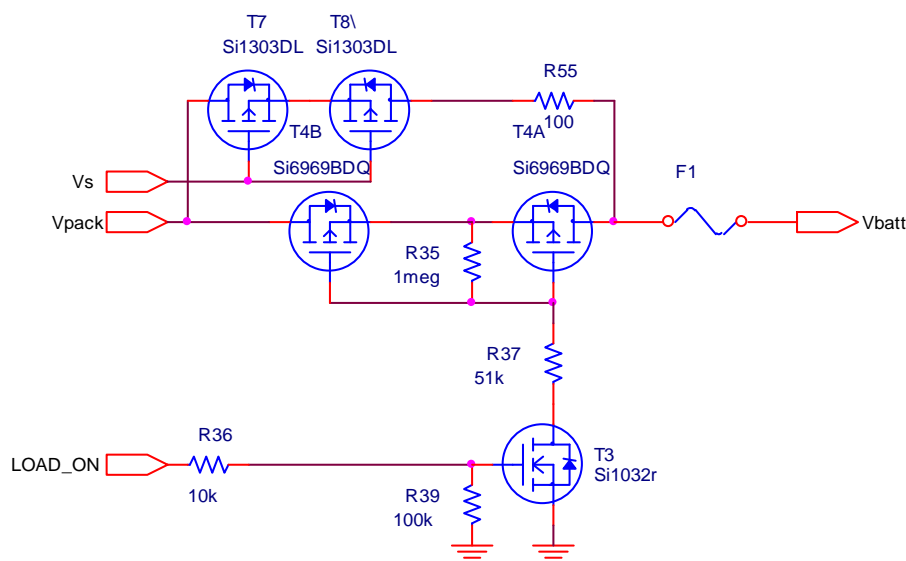


Fig. 5 Load switch – electrical diagram



## 2.6. Supply logic and load detector

The logic part of this system is supplied with 5V by a low dropout regulator that consumes 15µA in shut down mode and has a quiescent current of 50µA.

The circuit for protection of battery cells has an electronic switch with 2 paths:

- when the back-to-back transistors from the lower of Fig.6 are on and the ones from the upper side are off, than the impedance of the switch is below 30mΩ, this is allowed when the current consumed by the load is higher than 5mA (this is the threshold current that triggers the switch), the load detector is off and the MCU is on;
- when the current consumed by the load is bellow 5mA, when the back-to-back transistors from the lower of Fig.6 are off and only the ones from the upper side are on and the load is supplied trough an 100Ω resistor, the load detector is on and the MCU is off.

The load detector is measuring the voltage drop on the 100Ω resistor via one differential amplifier which triggers 2 comparators, the output of this block is combined with the signal PWR\_HOLD that is an output of the MCU, this signal is prioritized towards the output of the comparators.

The minimum current for load detector can be adjusted down to 400µA, bellow this current the load detector becomes not stable.

The current monitor has a typical current consumption during operation 68µA and 1µA in off mode.

## 2.7. Control unit

The core of this system is one PIC16F688I that works at 1MHz. The MCU is supplied as long as there is a load that consumes more than 5mA. To save power this unit enters in sleep mode after each measurement and it wakes up every 60 seconds by an internal timer or by the interrupt of the Coulomb counter.

This unit has to measure the voltage of each cell and the temperature on analog ports. On the digital ports it controls the enable signal of the supply voltage, the electronic switch, the state of the Coulomb counter and receives the data from this subsystem.

The current monitor has a typical current consumption during operation 155µA and 1µA in off mode.

Data from battery manufacturer like: capacity, maximum voltage, maximum load current, maximum number of cycles is written into the EEPROM of the MCU at the beginning of the battery lifetime.

All statistics based on measured data (remaining capacity, used cycles, average current, average temperature during discharging, average temperature during

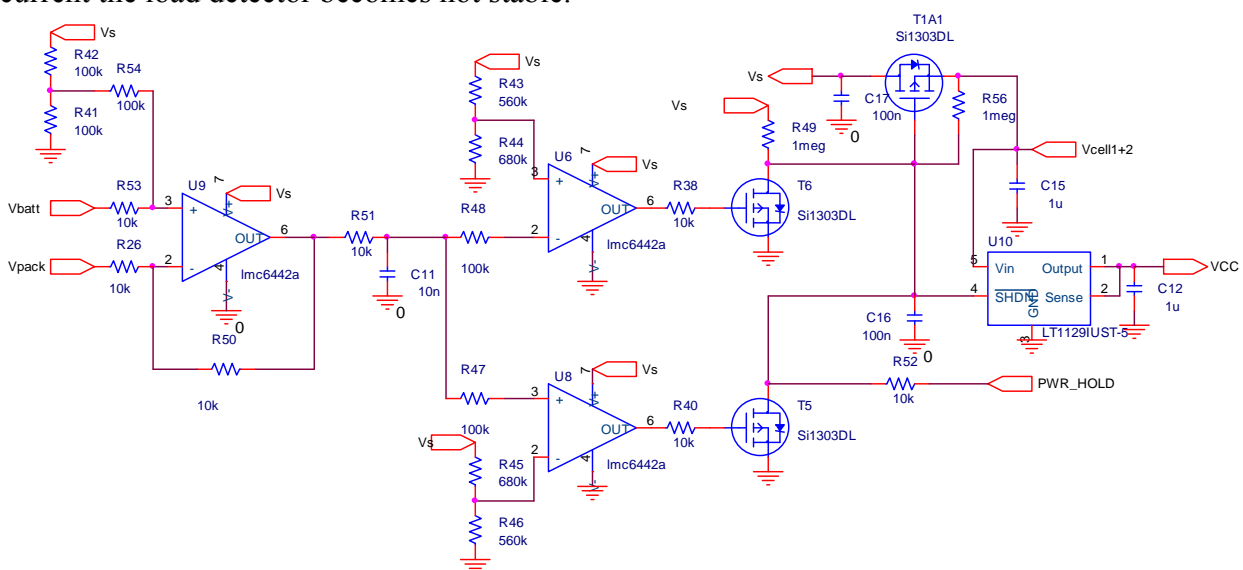


Fig. 6 Current monitor – electrical diagram.

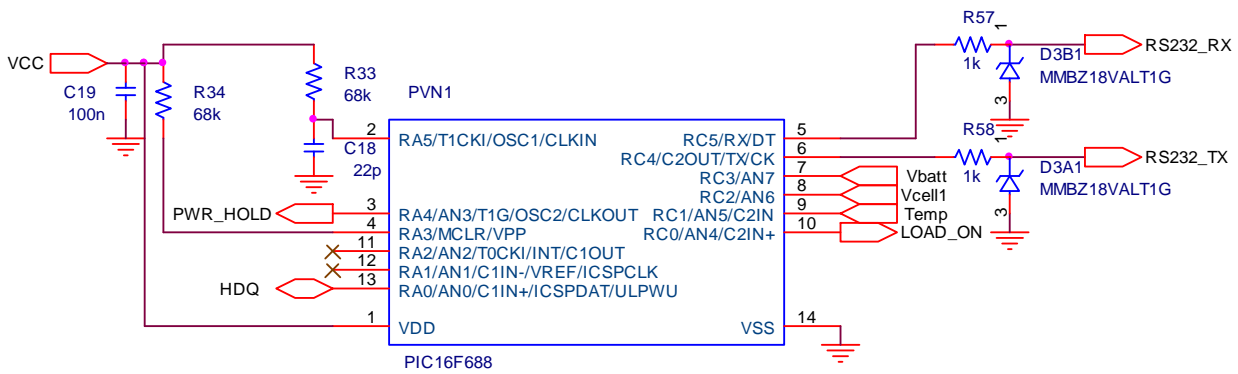


Fig. 7 MCU interface – electrical diagram

charging) by the MCU are updated into EEPROM at the shut down of the load or calculated based on latest measurements when requested via PCC communication interface.

### 3. EXPERIMENTAL RESULTS

The cells used for testing this system are: CGA103450A and CGR18650E from Panasonic.

The system was tested using different modules for monitoring the battery cells and the results presented in Figure 8 are an average of the tests for different temperatures (steps of 10°C) for monitoring the capacity of the 2 type of cells at temperatures between -20°C and +70°C.

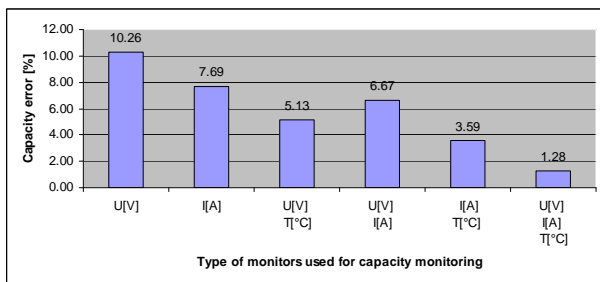


Fig. 8 Capacity error with different monitors – average

The result of the tests indicates that there is a major difference between measuring the capacity with only one type monitor turned and the case when two monitors are used.

Best results are obtained with current and temperature monitors or with all three of them used.

At temperatures above 20°C the differences between the types of used monitors respects almost the values presented in Figure 9.

The major difference between the qualities of the types of monitoring the capacity can be seen at the minimum temperature at which the battery can operate.

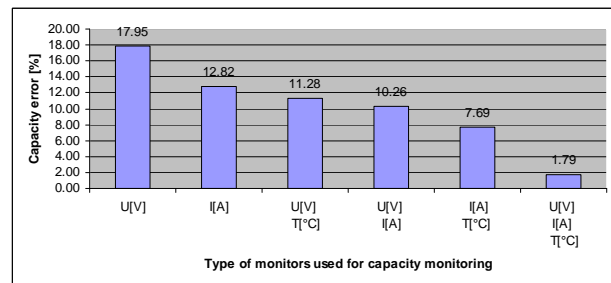


Fig. 9 Capacity error with different monitors at -20°C

The current consumption of this design is 275µA in on mode and 90µA in off mode. The lowest current detected in charging or discharging mode is 400µA.

### 4. CONCLUSIONS

Considering the obtained results the method of capacity calculation in real time is useful for battery monitoring. The device for battery protection is relatively complicated and expensive but it offers a lot of possibilities to improve and expand, meanwhile the circuit for capacity monitoring is cheap and offers a great precision.

A system with almost the same precision as the one proposed can use only a current monitor and a temperature monitor, in this way the average error is around 4% of the capacity.

Because of the costs, dimensions and current consumption this device is intended to be used in designs for large batteries.

This system can be easily implemented on a chip, leaving only a few power components like the transistors serial connected to the batteries, capacitors, the fuse and the shunt resistor on which the current is measured as discrete components to be mounted on the PCB.

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## FLY ASH CAPTURING AND ENVIRONMENTAL ISSUES

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**Abstract:** Fly ash is one of the residues generated in the combustion of coal. Fly ash is generally captured from the chimneys of coal-fired power plants, whereas bottom ash is removed from the bottom of the furnace. In the past, fly ash was generally released into the atmosphere, but pollution control equipment mandated in recent decades now require that it be captured prior to release.

**Key words:** Fly ash, equipment, environmental, pollution.

### 1. INSTRUCTIONS

Fly ashes are finely divided residue resulting from the combustion of ground or powdered coal.

Coal is largely composed of organic matter, but it is the inorganic matter in coal—minerals and trace elements—that have been cited as possible causes of health, environmental, and technological problems associated with the use of coal.

Fly ash is a by-product of pulverized coal blown into a fire furnace at a power generating plant. Coal, ground to the consistency of flour ignites when blown into the furnace and a certain amount of non-burnable material residue remains as either slag or airborne particles, known as fly ash. The airborne particles are removed by mechanical collectors, electrostatic precipitators, or wet scrubbers.

### 2. DESCRIPTION OF THE EQUIPMENT OF FLY ASH CAPTURING

Fly ash is captured and removed from the flue gas by electrostatic precipitators or fabric bag filters (or sometimes both) located at the outlet of the furnace and before the induced draft fan. The fly ash is periodically removed from the collection hoppers below the precipitators or bag filters. Generally, the fly ash is pneumatically transported to storage

silos for subsequent transport by trucks or railroad cars.

Combustion of coal in modern power plants produces some bottom ash, but most of the burnt minerals escape with the flue gases and is called fly ash, (Fig. 1). This ash is subsequently removed from the gas by electrostatic precipitation.

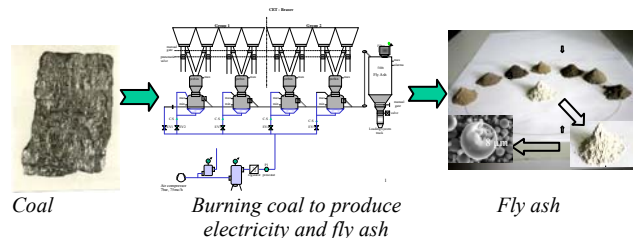


Fig. 1 Combustion of coal in modern power plants

The equipment was built for boiler 1 and 2 (boilers that have functioning alternative). The scheme is presented in Figure 2,3.

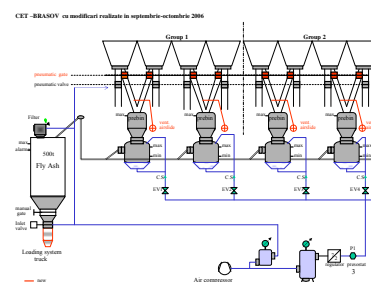


Fig. 2 The equipment to capturing fly ash particles



Fig. 3 Filling fly ash into trucks

At the exit of each tank of electro-filter has mounted a tubing type trousers, that allows the flow ash either through existing pipe  $d = 400$  mm, either through a pipe  $d = 200$  mm to drain.

- Inflatek round valve (DN 200) (Fig. 4) mounted between the container and tanks
- Inflatek round valve (DN 100) mounted on the pipe  $\varnothing 100$  mm that carries ashes to the storage silo.

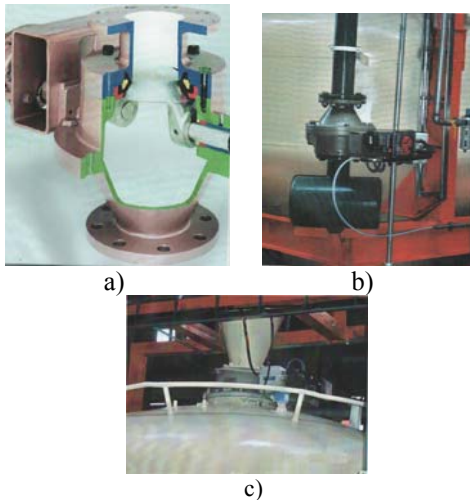


Fig. 4 a) Inflatek Valve; b) Inflatek round valve (DN 100); c) Inflatek round valve (DN 200)

When the electric transducer level (minimum) intimated that the container is empty, is done automatically following stages:

- It's closing round valve  $d = 100$  mm
- It's opening round valve  $d = 200$  mm

In Figure 5 shows an overview of a container ( $v = 7$  mc) with tanks ( $v = 1$  mc).

In the same picture is observed:

- It's opening two tanks  $d = 200$  mm allowing ashes flow by the two trench in tank and in container with  $v = 7$  mc.
  - It's closing two tanks  $d = 400$  mm
- When the electric sensor level (maximum) intimated that the container ( $v = 7$ mc) is full, it automatically creates the following stages:
- It's closing Inflatek round valve (DN 200)
  - It's opening two tanks  $d = 400$  mm
- It's closing two tanks  $d = 200$  mm

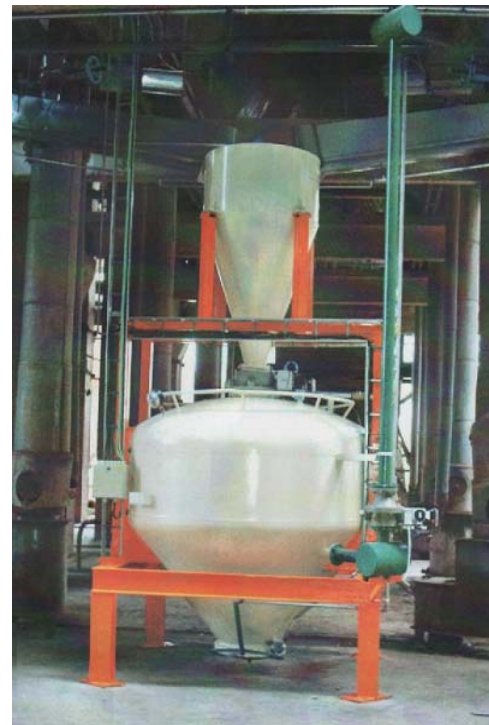


Fig. 5 Overview of a container with pretanks

Fly ash poses a major waste disposal problem in the world. However, when used in blended cements it can reduce greenhouse gas emissions, the cost of concrete and improve the strength, durability and other properties of concrete.

### 3. ENVIRONMENTAL ISSUES

Where fly ash is stored in bulk, it is usually stored wet rather than dry, so as to control a dust hazard. The process of coal combustion results in fly ash.

The problem with fly ash lies in the fact that not only does its disposal require large

quantities of land, water, and energy, its fine particles, if not managed well, by virtue of their weightlessness, can become airborne.

The physical, geotechnical and chemical parameters to characterize fly ash are the same as those for natural soils, e.g., specific gravity, grain size, compaction characteristics, permeability coefficient, shear strength parameters and consolidation parameters. The properties of ash are a function of several variables such as coal source, degree of pulverization, design of boiler unit, loading and firing conditions, handling and storage methods. A change in any of the above factors can result in detectable changes in the properties of the ash produced. The procedures for determination of these parameters are also similar to those for soils.

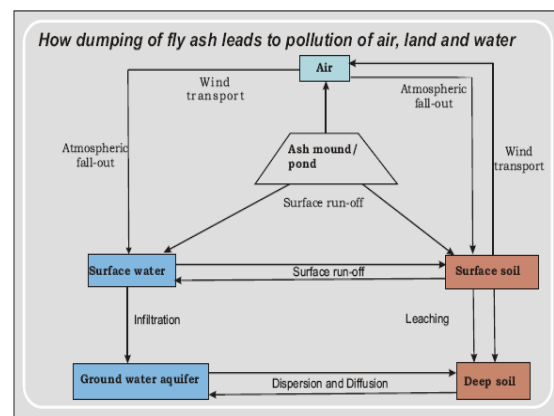
Fly ash contains trace concentrations of heavy metals and other substances that are known to be detrimental to health in sufficient quantities. Potentially toxic trace elements in coal include arsenic, beryllium, cadmium, barium, chromium, copper, lead, mercury, molybdenum, nickel, radium, selenium, thorium, uranium, vanadium, and zinc. Approximately 10 percent of the mass of coals burned in the United States consists of unburnable mineral material that becomes ash, so the concentration of most trace elements in coal ash is approximately 10 times the concentration in the original coal. A 1997 analysis by the U.S. Geological Survey (USGS) found that fly ash typically contained 10 to 30 ppm of uranium, comparable to the levels found in some granitic rocks, phosphate rock, and black shale. In 2000, the United States Environmental Protection Agency (EPA) said that coal fly ash did not need to be regulated as a hazardous waste. Studies by the U.S. Geological Survey and others have concluded that fly ash compares with common soils or rocks and should not be the source of alarm. However, community and environmental organizations have documented numerous environmental contamination and damage concerns. The process of coal combustion results in fly ash. The problem with fly ash lies in the fact that not only does its disposal require large quantities of land, water, and energy, its fine particles, if not

managed well, by virtue of their weightlessness, can become airborne. Currently, 90 million tonnes of fly ash is being generated annually in India, with 65 000 acres of land being occupied by ash ponds. Such a huge quantity does pose challenging problems, in the form of land usage, health hazards, and environmental dangers.

Both in disposal, as well as in utilization, utmost care has to be taken, to safeguard the interest of human life, wild life, and environment. The physical, geotechnical and chemical parameters to characterize fly ash are the same as those for natural soils, e.g., specific gravity, grain size, Atterberg limits, compaction characteristics, permeability coefficient, shear strength parameters and consolidation parameters. The properties of ash are a function of several variables such as coal source, degree of pulverization, design of boiler unit, loading and firing conditions, handling and storage methods. A change in any of the above factors can result in detectable changes in the properties of the ash produced. The procedures for determination of these parameters are also similar to those for soils.

Fly ash is a very fine powder and tends to travel far in the air. When not properly disposed, it is known to pollute air and water, and causes respiratory problems when inhaled. When it settles on leaves and crops in fields around the power plant, it lowers the yield.

The conventional method used to dispose of both fly ash and bottom ash is to convert them into slurry for impounding in ash ponds around the thermal plants. This method entails long-term problems. The severe problems that arise from such dumping are:



#### 4. CONCLUSIONS

Fly ash is one of the residues generated in the combustion of coal. Fly ash is generally captured from the chimneys of coal-fired power plants, whereas bottom ash is removed from the bottom of the furnace. In the past, fly ash was generally released into the atmosphere, but pollution control equipment mandated in recent decades now require that it be captured prior to release. Fly ash material solidifies while suspended in the exhaust gases and is collected by electrostatic precipitators or filter bags. Fly ash contains trace concentrations of heavy metals and other substances that are known to be detrimental to health in sufficient quantities. Where fly ash is stored in bulk, it is usually stored wet rather than dry, so as to control a dust hazard.

Fly ash properties are somewhat unique as an engineering material. Unlike typical soils used for embankment construction, fly ash has a large uniformity coefficient consisting of silt-sized particles. Engineering properties that will affect fly ash's use in embankments include grain size distribution, compaction characteristics, shear strength, compressibility, permeability, and frost susceptibility.

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## STUDY ON THE COMPOSITION AND PROPERTIES OF FLY ASH THERMAL FROM STEAM POWER PLANT

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**Abstract:** *The Fly ash is the non-volatile, incombustible, thermally altered mineral matter that was contained in coal. The principal component of most fly ashes is altered clays reflecting prominence in the dominant mineral phase in coal. Optimum reuse of fly ash can be achieved if the chemical and physical nature of the ash is known, thus allowing its end use to be engineered to the proper end state. The mineralogical and bulk chemical composition of fly ash there are key fundamental properties that the engineer can manipulate. This presentations is being delivered as a tutorial which will highlight the characteristics of fly ash as they pertain to engineering applications and sound environmental utilization.*

**Key words:** fly ash, coal, coal-fired power plants

### 1. INSTRUCTIONS

Fly ash is the non-volatile, incombustible, thermally altered mineral matter that was contained in coal. The principal component of most fly ashes is altered clays reflecting prominence in the dominant mineral phase in coal. Optimum reuse of fly ash can be achieved if the chemical and physical nature of the ash is known, thus allowing its end use to be engineered to the proper end state. The mineralogical and bulk chemical composition of fly ash there are key fundamental properties that the engineer can manipulate. This presentations is being delivered as a tutorial which will highlight the characteristics of fly ash as they pertain to engineering applications and sound environmental utilization.

Fly ash is one of the residues generated in the combustion of coal. Fly ash is generally captured from the chimneys of coal-fired power plants, and is one of two types of ash that jointly are known as coal ash; the other, bottom ash, is removed from the bottom of coal furnaces. Depending upon the source and makeup of the coal being burned, the components of fly ash vary considerably, but all fly ash includes substantial amounts of silicon dioxide ( $\text{SiO}_2$ ) (both amorphous and

crystalline) and calcium oxide ( $\text{CaO}$ ). Toxic constituents include arsenic, beryllium, boron, cadmium, chromium, chromium VI, cobalt, lead, manganese, mercury, molybdenum, selenium, strontium, thallium, and vanadium, along with dioxins.

### 2. CHEMICAL AND MINERALOGICAL COMPOSITION

The only coal combustion products considered in this discussion will be fly ash. Fly ash material solidifies while suspended in the exhaust gases and is collected by electrostatic precipitators or filter bags. Since the particles solidify while suspended in the exhaust gases, fly ash particles are generally spherical in shape and range in size from 0.5  $\mu\text{m}$  to 100  $\mu\text{m}$ .

They consist mostly of silicon dioxide ( $\text{SiO}_2$ ), which is present in two forms: amorphous, which is rounded and smooth, and crystalline, which is sharp, pointed and hazardous; aluminium oxide ( $\text{Al}_2\text{O}_3$ ) and iron oxide ( $\text{Fe}_2\text{O}_3$ ) (Table 1.). Fly ashes are generally highly heterogeneous, consisting of a mixture of glassy particles with various identifiable crystalline phases such as quartz, and various iron oxides.



Table 1. Chemical Composition of fly ash

Component	Bituminous	Subbituminous	Lignite
SiO <sub>2</sub> (%)	20-60	40-60	15-45
Al <sub>2</sub> O <sub>3</sub> (%)	5-35	20-30	20-25
Fe <sub>2</sub> O <sub>3</sub> (%)	10-40	4-10	4-15
CaO (%)	1-12	5-30	15-40
LOI (%)	0-15	0-3	0-5

Fly ash also contains environmental toxins in significant amounts, including arsenic (43.4 ppm); barium (806 ppm); beryllium (5 ppm); boron (311 ppm); cadmium (3.4 ppm); chromium (136 ppm); chromium VI (90 ppm); cobalt (35.9 ppm); copper (112 ppm); fluorine (29 ppm); lead (56 ppm); manganese (250 ppm); nickel (77.6 ppm); selenium (7.7 ppm); strontium (775 ppm); thallium (9 ppm); vanadium (252 ppm); and zinc (178 ppm).

Fly ash is the mineral matter in coal that has been thermally altered as it cycles through the combustion process. Of the one hundred plus minerals that have been reported in coal, the most abundant are: martensite, pyrite, calcite, siderite, gypsum, anhydrite, quartz, and clays. Martensite, pyrite, and siderite alter to form ferrite and hematite phases along with sulfur dioxide and carbon dioxide, respectively. Gypsum dehydrates to anhydrite and the calcium sulfate remains stable above 1400°C.

Quartz passes through the combustion process unaffected chemically but does undergo an alpha/beta phase change at 573°C which can contribute to reducing the particle size of the individual grains. The remaining class of minerals is clays of various forms. These minerals will undergo dehydroxylation in a fluidized bed combustion facility and melt to form glass in a pulverized coal combustion unit.

### 3. CLASIFICATION OF FLY ASH

Fly ash is classified under the standard in two forms.

Class F contains a total of at least 70% of these three oxides and Class C contains greater than 50% of the three oxides.

Class F coal ashes are generally produced by higher rank coals and typically have a lower calcium content.

This fly ash is pozzolanic in nature, and contains less than 10% lime (CaO). Possessing pozzolanic properties, the glassy silica and alumina of Class F fly ash requires a cementing agent, such as Portland cement, quicklime, or hydrated lime, with the presence of water in order to react and produce cementitious compounds. Alternatively, the addition of a chemical activator such as sodium silicate (water glass) to a Class F ash can lead to the formation of a geopolymer.

Table 2 summarizes the average bulk composition of a Class F ash.

Table 2. Average Bulk Composition of a Class F Fly Ash

Oxide	Wt. %/STD
SiO <sub>2</sub>	52.5±9.6
Al <sub>2</sub> O <sub>3</sub>	22.8±5.4
Fe <sub>2</sub> O <sub>3</sub>	7.5±4.3
CaO	4.9±2.9
MgO	1.3±0.7
Na <sub>2</sub> O	1.0±1.0
K <sub>2</sub> O	1.3±0.8
SO <sub>3</sub>	0.6±0.5

The bulk chemical composition of Class F ash dictates the mineralogical constituents of the ash. Quartz, the ferrite phase, and mullite each average less than 10 weight percent of the bulk and in most cases the latter two phases average less than 5 weight percent of the bulk. The most abundant phase in a Class F fly ash is the glass that results from the melting of the clays and subsequent ex-solution of mullite from the melt.

Class C coal ashes are generally produced from the combustion of lower rank coals and contain considerably more calcium in their bulk chemical compositions.

In addition to having pozzolanic properties, this ash has some self-cementing properties. This ash can harden and gain strength in the presence of water alone. In the presence of water, Class C fly ash will harden and gain strength over time. Class C fly ash generally contains more than 20% lime (CaO). Unlike

Class F, self-cementing Class C fly ash does not require an activator. Alkali and sulfate ( $\text{SO}_4$ ) contents are generally higher in Class C fly ashes. Table 3 details the average composition of 97 Class C coal ashes.

Table 3. Average bulk composition of a Class C fly ash.

Oxide	Wt. %/STD
$\text{SiO}_2$	36.9±4.7
$\text{Al}_2\text{O}_3$	17.6±2.7
$\text{Fe}_2\text{O}_3$	6.2±1.1
$\text{CaO}$	25.2±2.8
$\text{MgO}$	5.1±1.0
$\text{Na}_2\text{O}$	1.7±1.2
$\text{K}_2\text{O}$	0.6±0.6
$\text{SO}_3$	2.9±1.8

Because of the higher calcium content of this class of ash, the resulting mineralogical phase assemblage is quite different. Quartz, the ferrite phase, and mullite are present as in the Class F ash. The alteration of the clay content of the coal in the presence of calcium results not in large amounts of glass but rather in a suite of silicate and aluminosilicate and oxide phases. A minor amount of glass is formed in the thermal alteration of this class of coals.

The glass contains a rather high concentration of alumina and is, chemically, extremely reactive. Most notable among the dozen or so phases are lime, di-calcium silicate, and tri-calcium silicate. Additionally, peri-classes and anhydrite/gypsum can be found. As a consequence, Class C fly ash is not pozzolanic and will, in the presence of moisture, hydrate autogenously.

Fly ash is a known carcinogen and is therefore a regulated substance. Processing and transporting fly ash must be accomplished without the release of fugitive dust.

Fly ash which is produced at base loaded electric generating plants is usually very uniform. Base loaded plants are those plants which operate continuously. The only exception to uniformity is in the start-up and the shut-down of these plants. Contamination may occur from using other fuels to start the

plant, and inconsistencies in carbon content occur until the plant reaches full operating efficiency. The ash produced from the start-up and shut-down must be separated from what is produced when the plant is running efficiently. In addition, when sources of coal are changed, it is necessary to separate the two types of fly ashes. Peak load plants are subjected to many start-up and shut-down cycles. Because of this, these plants may not produce much uniform fly ash.

#### 4. APPLICATIONS OF FLY ASH

The reuse of fly ash as an engineering material primarily stems from its pozzolanic nature, spherical shape, and relative uniformity. Fly ash recycling, in descending frequency, includes usage in:

- portland cement concrete
- flowable fill
- structural fills/embankments
- soil improvement, etc.

##### Portland cement concrete

The use of fly ash in portland cement concrete (PCC) has many benefits and improves concrete performance in both the fresh and hardened state. Fly ash use in concrete improves the workability of plastic concrete, and the strength and durability of hardened concrete. Fly ash use is also cost effective. When fly ash is added to concrete, the amount of portland cement may be reduced. The replacement of Portland cement with fly ash is considered by its promoters to reduce the greenhouse gas "footprint" of concrete, as the production of one ton of Portland cement produces approximately one ton of  $\text{CO}_2$  as compared to zero  $\text{CO}_2$  being produced using existing fly ash. New fly ash production, i.e., the burning of coal, produces approximately twenty to thirty tons of  $\text{CO}_2$  per ton of fly ash. Since the worldwide production of Portland cement is expected to reach nearly 2 billion tons by 2010, replacement of any large portion of this cement by fly ash could significantly reduce carbon emissions associated with construction, as long as the comparison takes the production of fly ash as a given.

**Flowable fill**

Fly ash is also used as a component in the production of flowable fill, which is used as self-leveling, self-compacting backfill material in lieu of compacted earth or granular fill. The strength of flowable fill mixes can range from 50 to 1,200 lbf/in<sup>2</sup> (0.3 to 8.3 MPa), depending on the design requirements of the project in question. Flowable fill includes mixtures of Portland cement and filler material, and can contain mineral admixtures. Fly ash can replace either the Portland cement or fine aggregate (in most cases, river sand) as a filler material. High fly ash content mixes contain nearly all fly ash, with a small percentage of Portland cement and enough water to make the mix flowable. Low fly ash content mixes contain a high percentage of filler material, and a low percentage of fly ash, Portland cement, and water. Class F fly ash is best suited for high fly ash content mixes, whereas Class C fly ash is almost always used in low fly ash content mixes.

**Structural fills/embankments**

Specifications for fly ash structural fills and embankments are similar to specifications for engineered soil fills. Proper placement and compaction of fly ash fills is required to achieve the desired strength and compressibility characteristics assumed for design. Fly ash properties are somewhat unique as an engineering material. Unlike typical soils used for embankment construction, fly ash has a large uniformity coefficient consisting of silt-sized particles. Engineering properties that will affect fly ash's use in embankments include grain size distribution, compaction characteristics, shear strength, compressibility, permeability, and frost susceptibility. Nearly all fly ash used in embankments are Class F fly ashes.

**Soil improvement**

Soil stabilization involves the addition of fly ash to improve the engineering performance of a soil. This is typically used for a soft, clayey subgrade beneath a road that will experience many repeated loadings. Improvement can be done with both Class C

and Class F fly ashes. If using a Class F fly ash, an additive (such as lime or cement) is needed whereas the self-cementing nature of Class C fly ash allows it to be used alone.

**5. CONCLUSIONS**

Fly ashes are finely divided residue resulting from the combustion of ground or powdered coal. They are generally finer than cement and consist mainly of glassy-spherical particles as well as residues of hematite and magnetite, char, and some crystalline phases formed during cooling.

Coal combustion products should be considered a mineral resource. They have been successfully used as an engineering material for mineland reclamation and a wide variety of other applications. Fly ash must be considered as a 'material' in this sense. However, to understand the chemical and mineralogical characteristics of these materials will enable expanded and environmentally ethical applications. Like all mineral resources, prudent care should be exercised in the applications of fly ash to avoid potentially replacing one environmental problem with another.

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## CONSIDERATIONS ABOUT MODELLING OF THE AC CIRCUIT WITH SCR

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**Abstract** – This paper is focused on modeling the circuit of the direct AC-AC converter with SCR and resistive-inductive load, using specific computational tools such MathCAD. The ac switching mode process is studied and the article presents a method to establish the mathematical model of the power transfer in circuit. Comparative evaluations of the mathematical model with experimentally determinations are presented. For this must be study power flow on resistive-inductive load in direct AC converter circuit for different firing and phase shifting angles of SCR from converter structure.

**Keywords:** firing angles, phase shifting angles, SCR's turn off angles

### 1. INTRODUCTION

The AC-AC converters are circuits from electronic circuit's family, which allow the power control in AC systems.

The AC-AC converters have the control function of transfer power in different application: control of illumination, heat control, in electrochemistry and electric drive. The power control is made with control of firing angle of SCRs, triacs or power transistors.

The general schematic diagram of AC-AC converters is showed in Fig.1. The waveforms of load voltage to an AC-AC converter with SCRs are presented in Fig.2.

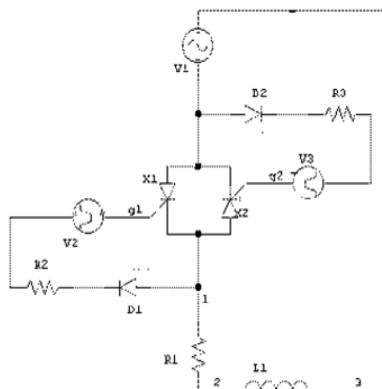


Figure 1: Schematic of ac-ac converter with resistive-inductive load

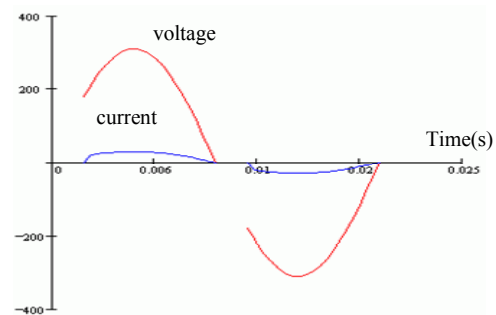


Figure 2: Waveform of voltage and current load for ac-ac converter

### 2. THE MATHCAD MODEL OF POWER TRANSFER

In this paper it is followed to determine the apparent power (volt amps) as a function (linear regression) of firing angles  $\alpha$  and phase shifting angles  $\varphi$  (the values of resistance, R and inductance, L). The study is based on the following algorithm:

1. The calculus of the turn off angles for SCR and its approximations with a mathematical expression.
2. Because the waveforms are not sinusoidal, is necessary the calculus of the Fourier coefficients of the voltage and current.

3. The schematic diagrams of the load voltage and current.
4. The calculus of the volt amps, active and reactive powers.
5. The determination of an approximation for all types of power.
6. The errors calculus between theoretical and experimental results.

The diagram of the algorithm of the power transfer calculus is presented in the Fig. 3.

In the phase angle control, the load voltage and current are not sinusoidal, they are followed by a number of harmonics, and so the mathematical determination of load power will be made with MathCAD functions [1] for an imposed number of harmonics.

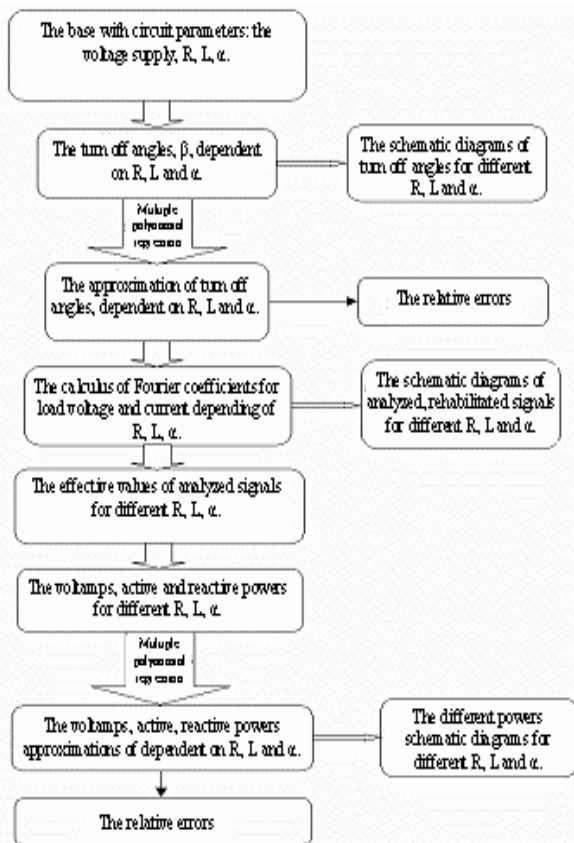


Figure 3 : The algorithm of the power transfer calculus.

To calculate the power transfer in direct AC-AC converters with SCRs it's need a database with SCRs firing angle,  $\alpha$  and phase shifting angle values,  $\phi$ . To obtain a good control of power transfer the angles of AC-AC converters perform the condition:  $\alpha \geq \phi$ .

The phase shifting angles are in matrix  $\Phi$  and the firing angles in  $A0$ .

For the MathCAD calculus, next values are utilized:

$$U := 220\sqrt{2}, \quad R := 10,$$

$$A0 := \begin{pmatrix} 0 \\ 15 \\ 20 \\ 25 \\ 30 \\ 35 \\ 45 \\ 65 \\ 75 \\ 80 \\ 90 \\ 95 \end{pmatrix} \cdot \text{deg}, \quad L := \begin{pmatrix} 0.0005 \\ 0.0010 \\ 0.0025 \\ 0.0035 \\ 0.0045 \\ 0.0060 \\ 0.0065 \\ 0.007 \\ 0.01 \\ 0.020 \\ 0.3 \end{pmatrix}$$

For phase shifting angles:

$$\Phi = a \tan \frac{\omega L}{R} \quad (1)$$

For the power calculus is necessary to know the time period when the power transfer to the load is realized that means the determination of the turn off moment,  $\beta$ , of the SCRs on each pulse. In this order it's determined the function:

$$B(A0, \Phi) = \left[ \sum_{i=0}^n \left[ A0^i \sum_{j=0}^m (A^{(j)})_i \Phi^j \right] \right] \quad (2)$$

where A is coefficients matrix and  $n=3, m=7$ .

$$A = \begin{bmatrix} 3.146 & 0.758 & 2.716 & -9.905 & 17.533 & -15.313 & 6.014 & -0.722 \\ -0.012 & 0.643 & -7.266 & 25.164 & -43.351 & 38.781 & -16.604 & 2.581 \\ 9.366 \cdot 10^{-3} & -0.525 & 5.881 & -18.874 & 30.433 & -26.416 & 11.357 & -1.857 \\ -2.266 \cdot 10^{-3} & 0.127 & -1.388 & 4.002 & -6.002 & 4.997 & -2.112 & 0.347 \end{bmatrix}$$

The expression (2) allows determining the turn off angle without classically approach. To verify the exactitude of the calculus, it presents the waveforms for the load voltage and current in three cases: calculus, experimentally and rehabilitated waveforms.

Because the errors of turn off angle approximation with MathCAD functions are under  $\pm 0.15\%$ , in the next calculus, for Fourier coefficients is utilized the expression (2).

The current and voltage Fourier coefficients are calculated for 45 harmonics.

In fig.4 and fig.5 are presented the waveforms of the calculus, experimentally and rehabilitated signal with Fourier coefficients for the load current and the load voltage.

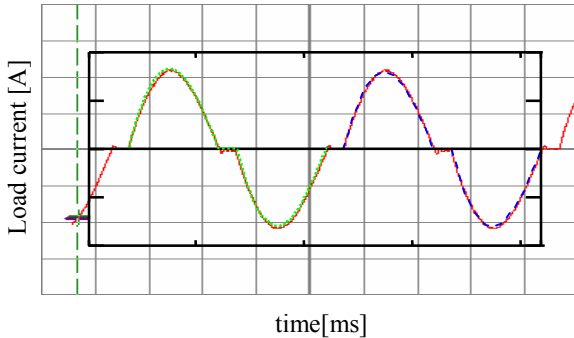


Figure 4: The load current waveform  $\alpha = 65^\circ$ .

— The calculus waveform  
 — The experimentally waveform  
 — The rehabilitated current waveform

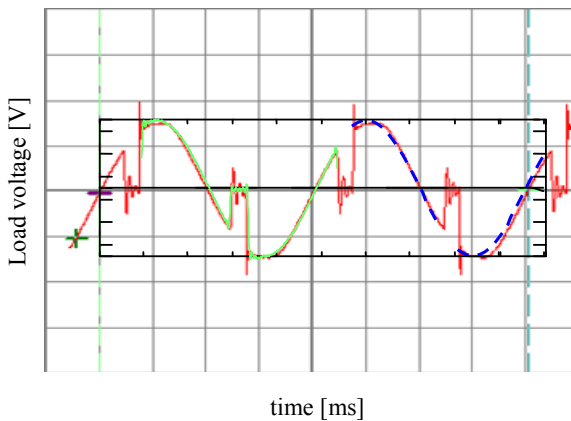


Figure 5: The load voltage waveform  $\alpha = 65^\circ$ .

— The calculus waveform  
 — The experimentally waveform  
 — The rehabilitated voltage waveform

The waveforms are quite identical, so for the calculus of power transfer will be used the rehabilitated signals with Fourier coefficients. Part of the determined load power transferred matrix is shown in Table 1.

In the table 1 the columns represent:  
 column 0: the values of the phase shifting angles;  
 column 1: the values of the firing angle;  
 column 2: the values of the load volt amps;  
 column 3: the values of the load active power;  
 column 4: the values of the load reactive power;

column 5: the values of the load deformed power.

Table 1 Load Power

	0	1	2	3	4	5
0	0.017453293	0.26179939	274.2031	274.13553	4.9333588	3.5655426
1	0.017453293	0.43633231	270.41837	270.3071	5.1726248	5.7797956
2	0.017453293	0.61086524	262.53226	262.36313	5.4774269	7.6661245
3	0.017453293	0.78539816	249.65195	249.41775	5.7761895	9.1388195
4	0.017453293	1.0471976	220.50748	220.17906	6.0557763	10.395173
P = 5	0.017453293	1.134464	208.38347	208.02899	6.0719853	10.523417
6	0.017453293	1.4835299	151.60682	151.19382	5.6316711	9.6612506
7	0.017453293	1.6493361	122.6091	122.20027	5.1297753	8.5889762
8	0.017453293	2.0315632	61.315533	60.991685	3.443133	5.2681791
9	0.017453293	2.1642083	44.117625	43.841701	2.7764868	4.0695429
10	0.017453293	2.6179939	7.6081643	7.5094123	0.79107378	0.93117793
11	0.06981317	0.26179939	274.08869	273.26283	19.400591	8.697883

In the same way like turn off angle polynomial regression we obtain the polynomial regression for all types of load power.

The expression of polynomial regression of load volt amps is (n- number of rows, m-number of column):

$$S(A0, \Phi) = \left[ \sum_{i=0}^n \left[ A0^i \sum_{j=0}^m (\text{CoefS}^{(j)})_i \Phi^j \right] \right] \quad (3)$$

“CoefS” is coefficients matrix with n =5 and m =10.

Table 2

	0	1	2	3	4	5	6	7	8	9
0	252.6	830.6	-1.9·10 <sup>4</sup>	1.8·10 <sup>5</sup>	-8.4·10 <sup>5</sup>	2.2·10 <sup>6</sup>	-3.2·10 <sup>6</sup>	2.7·10 <sup>6</sup>	-1.2·10 <sup>6</sup>	2.1·10 <sup>5</sup>
1	45.9	2.2·10 <sup>3</sup>	-4.4·10 <sup>4</sup>	3.7·10 <sup>5</sup>	-1.5·10 <sup>6</sup>	3.5·10 <sup>6</sup>	-4.6·10 <sup>6</sup>	3.5·10 <sup>6</sup>	-1.4·10 <sup>6</sup>	2.4·10 <sup>5</sup>
2	-75.2	-4.3·10 <sup>3</sup>	8.7·10 <sup>4</sup>	-7.5·10 <sup>5</sup>	3.2·10 <sup>6</sup>	-7.7·10 <sup>6</sup>	1.1·10 <sup>7</sup>	-8.4·10 <sup>6</sup>	3.5·10 <sup>6</sup>	-6·10 <sup>5</sup>
3	-12	2.1·10 <sup>3</sup>	-4.3·10 <sup>4</sup>	3.8·10 <sup>5</sup>	-1.6·10 <sup>6</sup>	3.9·10 <sup>6</sup>	-5.4·10 <sup>6</sup>	4.3·10 <sup>6</sup>	-1.8·10 <sup>6</sup>	3.1·10 <sup>5</sup>
4	7.5	-326	6.6·10 <sup>3</sup>	-5.7·10 <sup>4</sup>	2.5·10 <sup>5</sup>	-6·10 <sup>5</sup>	8.3·10 <sup>5</sup>	-6.6·10 <sup>5</sup>	2.8·10 <sup>5</sup>	-4.8·10 <sup>4</sup>

The expression (3) is valid for all types of power. In fig. 6 is presented the MathCAD modeling of volt amps.

In matrix “ErS” the error between effective calculated power and calculated polynomial regression power is indicated in table 3.

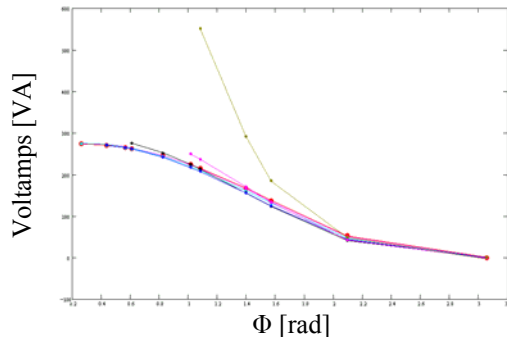


Figure 7: Voltamps for  $\alpha = ct$  and different  $\phi$   
 \_\_\_\_\_ Power with polynomial regression approximation;  
 ..... Direct calculus of power

Table 3

	0	1	2	3	4
ErS = 22	0.122	0.262	274.07	270.021	1.477
23	0.122	0.436	269.782	267.694	0.774
24	0.122	0.565	263.906	261.857	0.776
25	0.122	0.611	261.215	259.035	0.835
26	0.122	0.825	243.747	240.837	1.194
27	0.122	1.016	221.478	218.603	1.298
28	0.122	1.084	212.153	209.548	1.228
29	0.122	1.396	162.381	162.321	0.037
30	0.122	1.571	131.905	133.388	-1.124

column 0: the values of the phase shifting angles;  
 column 1: the values of the firing angle;  
 column 2: the calculated values of the load volt amps;  
 column 3: the values of the load volt amps with polynomial regression;  
 column 4: the error between column 3 and column 4.

The errors are under  $\pm 2\%$ .

The calculus and the curves like that presented for the volt amps, it is possible to realize for all types of power, like active and reactive power, but the degrees of the polynomial regression are different.

### 3. CONCLUSIONS

Power transfer can be controlled with variable phase angle or phase shifting angle values. The approximation of power transfer with polynomial regression is a function of phase angle and phase shifting angle. The algorithm, which was presented, helps us to determine more easily the power in the designing of the AC converter circuit with resistive inductive load. For one asked value of load power, the firing angles and phase shifting angles (the values of resistance, R and inductance, L) of SCRs are determined with the expression (3), without retrace all steps of the algorithm from fig.3.

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## OPTICAL CHANNELS IMPLEMENTATION IN MEASUREMENT AND CONTROL SYSTEMS

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**Abstract:** *Fiber-optic cables, which can consist of several optical fibers, have many advantages over using copper-wire cables. The advantages of fiber optics determine their implementation in communication channels of the complex control systems. The paper presents some consideration about analog and digital fiber-optic communication channel possible to use in real time control systems.*

**Keywords:** *communication, optical fiber, transmitter, receiver*

### 1. INTRODUCTION

One basic function of a process control application is the *communication with the process*.

A challenge in using an optical fiber for a communications channel is to have a flexible, low-loss medium that transfers a light signal over long distances without significant attenuation and distortion. The dielectric properties of optical fibers give them a number of inherent cost and operational advantages over copper wires. Among these are lower weight, smaller size, greater information capacity, and immunity to signal interference.

Optical fiber can handle signals up to 1THz, which allows high speed data transfers up to 10 Gbps. Due to their physical properties, optical fiber is invaluable to the aircraft and submarines industry.

On the other hand, this comes with some increased complexity with respect to handling and connecting the hair-thin fibers.

Optical fiber communications has rapidly become a mature technology and now is ubiquitous in the telecommunications infrastructure. As is the case with any other technology, the challenges to improve performance are never-ending.

A key ingredient for the widespread implementation of optical fiber technology is

an extensive body of test, interface, and system design standards. For example, the TIA has published over 120 fiber optic test standards and specifications for testing the response of fibers, cables, passive devices, and electro optic components to environmental factors and operational conditions.

### 2. FUNDAMENTAL CONCEPTS

An optical fiber is nominally a cylindrical dielectric waveguide that confines and guides light waves along its axis. Basically all fibers used for telecommunication purposes have the same physical structure, which consists of a cylindrical glass core surrounded by a glass cladding. The difference in the core and cladding indices determines how light signals travel along a fiber.

An important physical concept is that only a finite set of light rays that impinge on the core walls at specific angles may propagate along a fiber. These angles are related to a set of electromagnetic wave patterns called *modes*. For a *single-mode fiber*, the core diameter is around 8 to 10  $\mu\text{m}$  (several wavelengths), and only the *fundamental ray* is allowed to propagate. *Multimode fibers* have larger core diameters (e.g., around 50  $\mu\text{m}$ ) and support many modes.



The ITU-T and the TIA/EIA have published standards for both multimode and single-mode optical fibers used in telecommunications. The recommended bounds on fiber parameters (e.g., attenuation, cutoff wavelength, and chromatic dispersion) designated in these standards ensure the users of product capability and consistency.

Multimode fibers are used in LAN environments, storage area networks, and central-office connections, where the distance between buildings is typically 2 km or less. The two principal multimode fiber types have either 50- or 62.5- $\mu\text{m}$  core diameters, and both have 125- $\mu\text{m}$  cladding diameters. For short-reach, low-cost transmission of high-speed Ethernet signals, a 50- $\mu\text{m}$  multimode fiber is available for 10-Gbps operation at 850 nm over distances up to 300 m.

From a simplistic point of view, the function of an optical fiber link is to transport a signal from some piece of electronic equipment (e.g., a computer, telephone, or video device) at one location to corresponding equipment at another location with a high degree of reliability and accuracy. The key sections of an optical fiber communications link are follows:

- *Transmitter*, that consists of a light source and associated electronic circuitry. The source can be a light-emitting diode or a laser diode. The electronics are used for setting the source operating point, controlling the light output stability, and varying the optical output in proportion to an electrically formatted information input signal.

- *Optical fiber*.

- *Receiver*. Inside the receiver is a photodiode that detects the weakened and distorted optical signal emerging from the end of an optical fiber and converts it to an electric signal. The receiver also contains amplification devices and circuitry to restore signal fidelity.

- *Passive devices*.

### 3. ANALOG AND DIGITAL FIBER-OPTIC COMMUNICATION CHANNELS

An analog fiber-optic link converts an electrical signal into light, transmits the light through the fiber cable and converts the light back into an analog signal (fig.1).

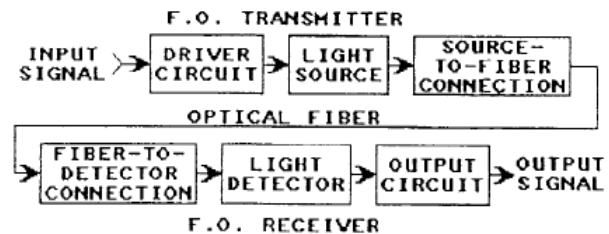


Fig.1 The basic parts of a fiber-optic link.

Figures 2 and 3 show the schematics of the analog transmitter and analog receiver possible to be used. The analog transmitter circuit uses a buffer amplifier in its driver circuit as a voltage-to-current converter. An ac input voltage creates an ac current that modulates the optical output of an LED. Pre-biasing the LED technique allows LED and transistor junction capacitance to charge before the LED is switched on. RC current-peaking circuitry improves driver-circuit bandwidth.

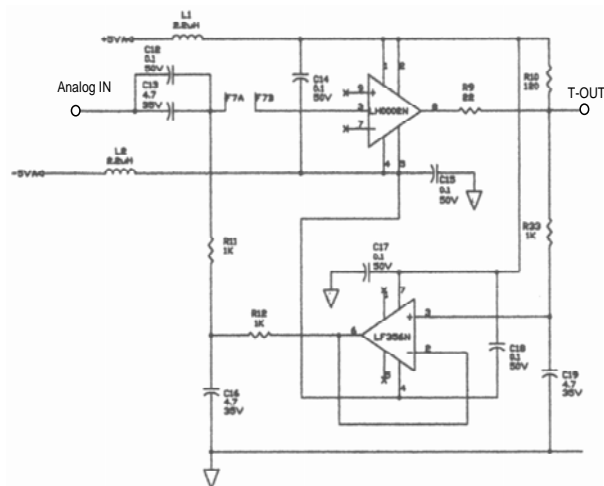


Fig.2 The schematic of the analog transmitter

The low cutoff frequency for the analog transmitter is determined by a high-pass filter consisting of  $C_1$  and  $R_2$  in union with low-pass filter  $C_2$  and  $R_3$ .

$$f_{1,t} = \frac{1}{2\pi R_2 \times C_1} \times 0,8 = 26,2(\text{Hz}) \quad (1)$$

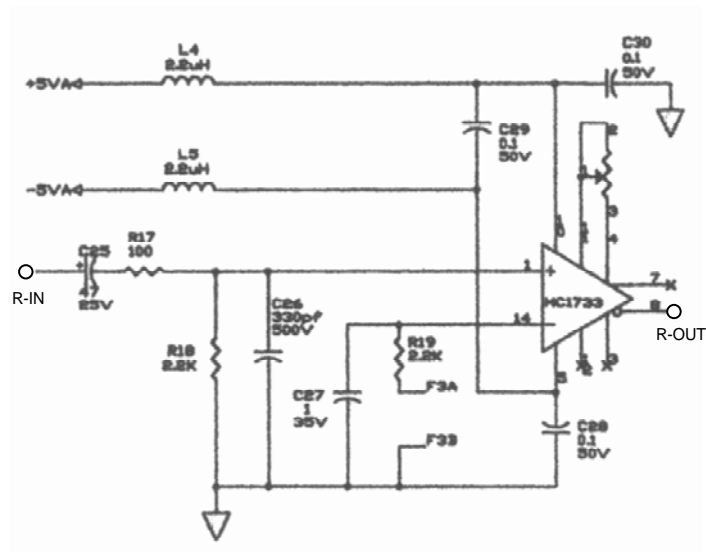


Fig.3 The schematic of the analog receiver.

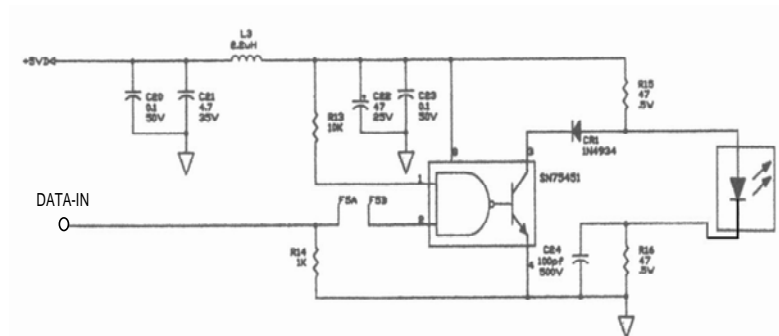


Fig.4 The schematic of the digital transmitter.

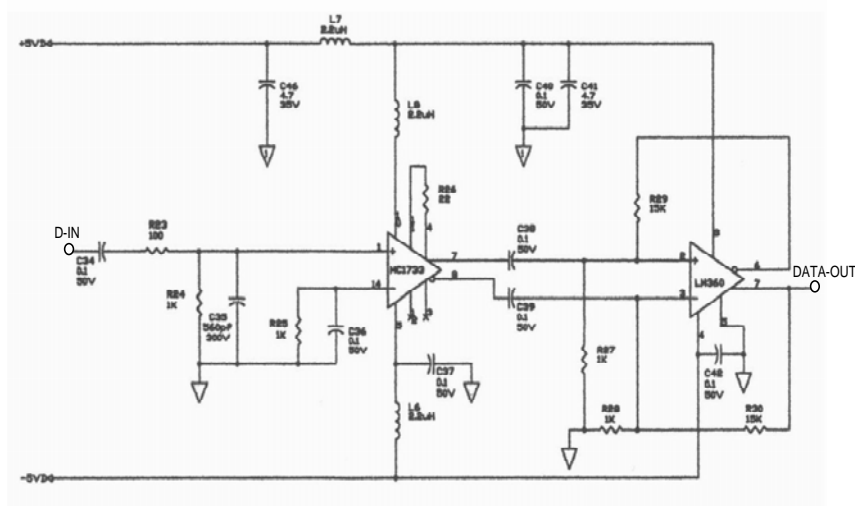


Fig.5 The schematic of the digital receiver.

The low cutoff frequency for the RC input coupling circuit of the analog receiver is:

$$f_{l,r} = \frac{1}{2\pi(R_7 + R_8) \times C_4} = 1.52 \text{ (Hz)} \quad (2)$$

The upper cutoff frequency of the analog output circuit is setting by the components  $R = 100\Omega$ ,  $R = 2.2k\Omega$  and  $C = 330pF$ .

The analog receiver output circuit gain is adjustable to correct for system power losses. The purpose of the receiver output circuit is to

provide system-compatible output; the 15 k $\Omega$  resistors are for hysteresis. The maximum noise floor for this receiver is 0.07 $\mu$ W.

The largest signal that can be input to the analog driver circuit without distorting the optical output from the LED is 2.0V<sub>pk-pk</sub>.

The infrared light source used in experiments (LED) has a peak wavelength of 820nm; its typical spectral bandwidth is 45nm. Due to the typical rise time of the LED of 3ns, the maximum bandwidth is about 1GHz.

The fiber-optic receiver pass band is limited to 5MHz to increase the signal-to-noise ratio at the output of the receiver.

Using a multi-mode glass fiber 62.5/125 (graded index), the maximum fiber length that would insure less than 8dBof attenuation is 2.75km. The error introduced by the connector variations can be total  $\pm 0.5$ dB/m (typical optical connection with ST connector).

Figures 4 shows the schematic of a digital transmitter and figure 5 shows the schematic of a digital receiver - possible to be used.

To reduce noise at the input to the analog and digital receiver output circuit, RC filters are used.

The preamplifier of the digital receiver output circuit increases sensitivity. The voltage comparator uses positive feedback and provides hysteresis.

#### 4. CONCLUSIONS

The design of a communication link involves a series of tradeoffs among the many performance variables of each component

based on the system operating requirements. Thus, the link analyses may require several iterations before they are completed satisfactorily. Since performance and cost constraints are very important factors in a communication link, the designer must choose the components carefully to ensure that the link meets the operational specifications over the expected system lifetime without overstating the component requirements.

The paper presents a simple solution for implementation of an optical communication channel in the measurement and control systems. In order to transfer analog and digital signals, was presented the sections of the optical link.

The budget analysis (optical power & rise time) was confirmed the possibilities of the classical copper channels substitution with optical fiber channels.

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## POLYETHYLENE ELECTRICAL INSULATION MATERIALS UNDER ACCELERATED DEGRADATION

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*Abstract: The structure on dielectric materials is one of the main important parameter, which determines the durability of products. The degradation process runs differently in various types of polyethylene, because the macromolecules present different level of branching, different crystallinity grades, different chemical resistance. The dissimilarities between the resistance on ageing of different sorts of polyethylene are depicted by FTIR analysis, chemiluminescence determinations and the measurement of electrical resistivity. The consequences on the long term service under  $\gamma$ -irradiation degradation are discussed.*

*Key words: polyethylene materials, degradation, FTIR, chemiluminescence, electrical properties*

### 1. INTRODUCTION

Polyethylene is an essential plastic whose manufacture places it on the first position through engineering plastic materials. The several areas of applications (cables and wires, automotive, medical wear, packaging, pipes, miscellaneous) consume enormous amounts of polyethylene due to its excellent features like flexibility, toughness, barrier for diffusion, easy of fabrication. The polyethylene type determines the peculiar use. The dissimilarities between their structural characteristics (branching, crystallinity, physical properties, chemical resistance) are the criteria by which the praxis of polyethylene is based.

A large amount of work can be found in literature devoted to the depiction of material behavior under certain working conditions [1-6]. Polyethylene blends have received special attention due to the alternative possibility of

suitable formulation for certain applications [7-11].

The accelerated degradation promoted by ionizing radiation is an appropriate procedure for characterization of the effects induced by the long term utilization under oxidative environments. The qualification of materials performances directs the customers on the correct way of implementation.

The concomitant reactions occurred during endurance testing run to the modifications in the chemical state of material, which determines the warranty period for hazardous applications like nuclear power stations, aircrafts, automotives, electrical cables, gaskets, and many other key items.

The present investigation presents a comparative study on the polyethylene answer to the degradative action of  $\gamma$ -radiation as the carrier and donor of energy.

### 2. EXPERIMENTAL

Three kinds of polyethylene (two types of HDPE (named HDPE 1 and HDPE 2) and one sort of LDPE) were selected for the characterization of resistance on the hard conditions of usage. These materials were investigated as received products supplied by ARPECHIM Pitești (Romania). Table 1 presents the main features of raw materials.

Table 1. Material input data

Property	HDPE 1	HDPE 2	LDPE
Density @ 23 <sup>0</sup> C (g.cm <sup>-3</sup> )	0.964	0.963	0.925
Melting flow rate (190 <sup>0</sup> C/2.16 kg) (g/10 min)	5.5	0.33	1.63
Crystallinity (%)	68.60	65.07	48.75
Nr. CH <sub>3</sub> /100 C	1.17	0.91	3.55

Each polyethylene sheet (thickness: 0.3 mm) was obtained in an electrical heated press at 150 atm for 10 min. The polyethylene films were also processed by pressing under similar conditions.

The exposure in high energy radiation field was done using an irradiator GAMMATOR M-38-2 (USA) provided with <sup>137</sup>Cs source in air at room temperature. Dose rate was 0.4 kGy/h. This low dose rate simulates the accidental conditions that are really met when electrical and thermal overcharges are attended.

For the characterization of chemical modifications two sensitive procedures were applied: chemiluminescence (equipment: LUMIPOL 3 – SAS, Slovakia). The procedure and data interpretation for chemiluminescence results have been previously reported [12]. FTIR and UV-Viz spectrometric records were carried out on JASCO 4200 with 20 scans and 4 cm<sup>-1</sup> resolution and JASCO V 570 Japan, respectively. Electrical measurements were assured by Keithley 7600A (USA) multimeter coupled with a resistivity test chamber 8009 (Agilent, USA).

Carbonyl and hydroxyl indexes were calculated as the ratios of the absorptions at 1720 cm<sup>-1</sup> and 3350 cm<sup>-1</sup>, respectively, and the absorption at 1475 cm<sup>-1</sup> (reference) [13]. The

values for number of CH<sub>3</sub>/100 carbon atoms were calculated according with ASTM 2238-68.

The samples were subjected to investigations immediately after the end of irradiations.

### 3. RESULTS AND DISCUSSION

The polymers exposed to the action of ionizing radiation are profoundly modified as the consequence of energy transfer onto macromolecules. The random scissions of weaker bonds of macromolecules creating free radicals are the primary chemical events [10,14]. The subsequent reactions in which free radicals are involved become the competitive processes. During  $\gamma$ -exposure to applied low dose rate oxidative degradation is the main process that depletes free radicals. The mechanism of radiation induced oxidation of polymers may be found elsewhere [15,16].

The dissimilar susceptibility of tested polyethylenes to oxidation is described by the evolution in UV-Viz spectra (Fig. 1).

The maxima placed at 220 and 270 nm in the UV spectra of LDPE are ascribed to the presence of ketonic carbonyl groups and conjugated double bonds in polyene structures, respectively [17]. These peaks are shifted towards higher wavelengths in tested HDPEs. This difference arises from the discrepancy in the polymer matrixes. The augmentation in the absorption of carbonyl components is faster than the enhance in the absorption depicting the accumulation of double bonds. The former oxygenated function is the result of the reactions of free radicals with the molecular oxygen diffused from the outer layers of polypropylene and the later peak absorption for unsaturation increases due to the disproportionation reactions. The advance in the – C = C – absorption is smoother than the accumulation of carbonyl moieties because double bonds are consumed by addition or oxidation.

The comparison of UV recorded spectra for the three polyethylenes reveals the advance in the degradation process faster in LDPE than it occurs in HDPE. The explanation is the

branching level of each material, which is directly by the higher number of tertiary carbon atoms in low density polyethylene. The early start of oxidation in LDPE is related either by the direct attack of molecular oxygen on the tertiary carbon positions, or by the formation of peroxy radicals, the promoters of chain process of oxidation, as the intermediates resulting from the reactions  $R \cdot + O_2$ . The present results are in a good agreement with other previous information [1, 18-20]. The exposure to high energy radiation accelerates the formation of free radicals by the formation of *trans*-vinylene structures [21].

The influence of branching on the evolution in the amounts of oxidation products can be explained by the different values in Nr.  $CH_3/100 C$ . The highest figure for this property (3.55) for LDPE illustrates the material tendency to oxidation, because the probability of the scission or oxygen attack on tertiary carbon positions is higher in comparison with HDPEs. The radiation stability order of tested polyethylenes:

HDPE 1 > HDPE 2 >> LDPE

is the opposite sequence of the increase in the number of  $CH_3$  per 100 carbon atoms. The relative increases in the absorbance at 220 nm, ( $A_{D=100}/A_{D=0}$ ) are 0.62, 0.75 and 3.4 for HDPE 1, HDPE 2 and LDPE, respectively. It defines the corresponding augmentation in the oxidation availability on polyethylene macromolecules.

The susceptibility of polyethylene to the generation of unsaturation (absorption at 270 nm) follows the same order as the sequence of oxidation instability. The lower – branched polyethylene withstands better on the low irradiation dose range, which may be assimilated with the condition of accident. Because 1 kGy is equivalent to  $10^3$  J/kg, the radiation – induced modifications occurred for each 1 kGy involves high amount of energy transferred onto material on a short time interval. This energy is enough for the induction of degradation during the encroaching technological limits.

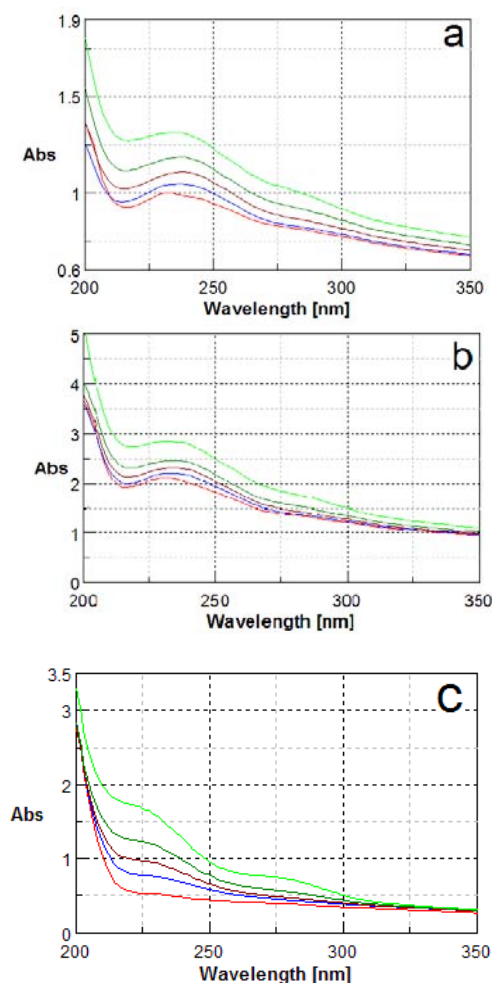


Fig. 1. UV-Viz spectra of different kinds of polyethylene: (a) HDPE 1; (b) HDPE 2; (c) LDPE. (-) 0 kGy; (-) 20 kGy; (-) 40 kGy; (-) 70 kGy; (-) 100 kGy.

FTIR spectra (Fig. 2) describe more detailed the structural modifications occurred in irradiated polyethylenes. The absorption of several peaks is modified displaying the contribution of various reactions of free radicals during the competition between the formation and the decay of these reactive intermediates.

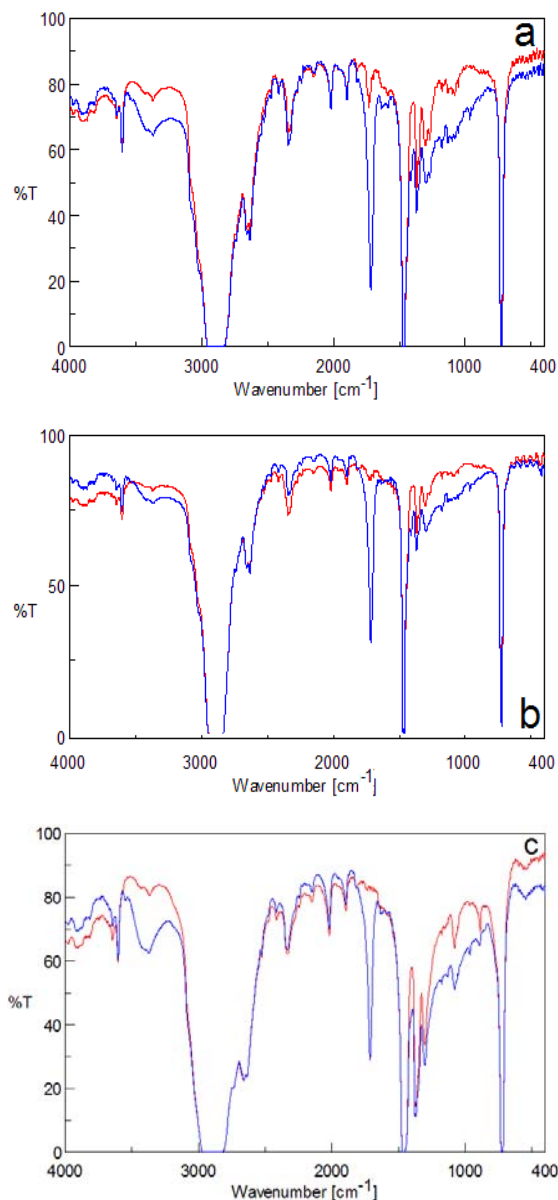


Fig. 2. FTIR spectra of different kinds of polyethylene: (a) HDPE 1; (b) HDPE 2; (c) LDPE. (-) 0 kGy; (---) 100 kGy.

There are three important spectral regions: below  $1000\text{ cm}^{-1}$ , where several unsaturated structures like *trans*-vinylene ( $965\text{ cm}^{-1}$ ), vinyl ( $909\text{ cm}^{-1}$ ) and vinylidene ( $888\text{ cm}^{-1}$ ) appear [22]; the peak around  $1720\text{ cm}^{-1}$  ( $1716\text{ cm}^{-1}$  for acids,  $1722\text{ cm}^{-1}$  for ketones,  $1735\text{ cm}^{-1}$  for aldehydes [23] and  $1746\text{ cm}^{-1}$  for esters [24]) and the last range around  $3350\text{ cm}^{-1}$ , where the hydroperoxides can be determined. All these functions appear as the result of degradation

mechanism through which free radicals react with oxygen forming peroxy intermediates further subjected to intramolecular rearrangements or with macromolecules abstracting proton. These reactions occur predominantly in the amorphous zones, where the movement of reacting entities is much less restricted than it is inside the ordered phase (crystalline component).

The progress in the oxidative degradation of different sorts of polyethylene is well depicted as a self catalyzed process. The most important kinetic characteristics are oxidation induction time and rate of oxidation. The chemiluminescence investigation for the qualification of the resistance to oxidation has revealed the

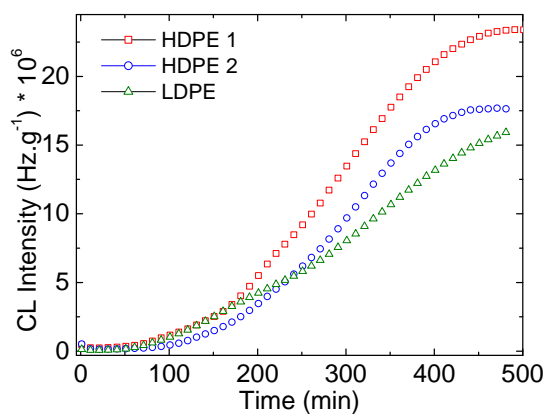


Fig. 3. Dependences of CL intensity on time for studied polyethylenes evaluated at  $170^{\circ}\text{C}$ .

The oxidation induction time is 52 min. for LDPE, while the same parameter attends 154 min. and 188 min. for HDPE 1 and HDPE 2, respectively. Due to the high percentage of crystalline phase, the propagation of oxidation takes place somewhat slower than it was expected for a branched molecule materials.

The advanced degradation obtained in  $\gamma$ -radiation field brought about significant cropping of oxidation induction time (Fig. 4) anticipated by the higher amount of free radicals formed during irradiation. The medallion inserted in Fig. 4 depicts the tendency for oxidation in the case of low density

polyethylene. The same order of radiation resistance is pointed out:

$$\text{HDPE 1} > \text{HDPE 2} > \text{LDPE}$$

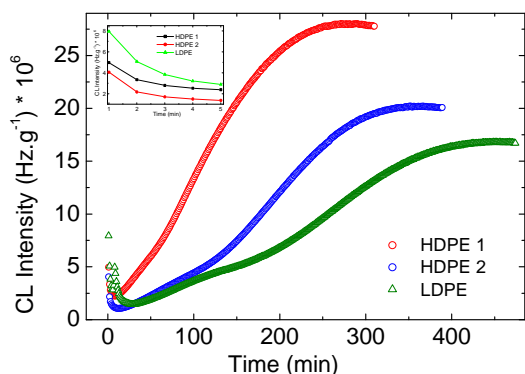


Fig. 4. The CL curves for polyethylenes irradiated at 100 kGy (measurement temperature: 170°C).

Fig. 5 illustrates the results of the competition between degradation and crosslinking. If at the first applied dose (25 kGy) a sharp alteration in the oxidation resistance can be noticed. For higher doses (50, 75 and 100 kGy) a slight amelioration in

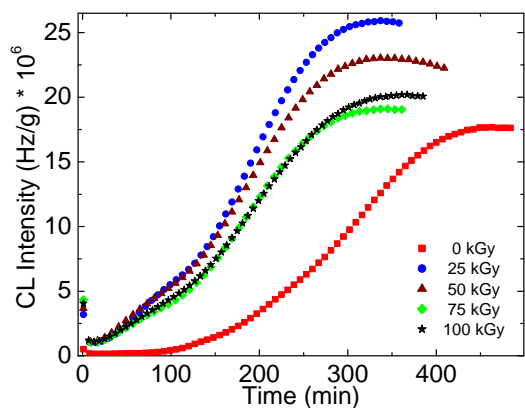


Fig. 5. CL curves recorded for HDPE 1 sample irradiated at various doses.

the oxidation rate may be obtained, but the thermal stability of all irradiated samples is far from the behavior of pristine material. The higher concentration of free radicals generates by radiolysis in the higher dose irradiated polyethylenes allows the recombination of

radicals in a larger extent than in the same material subjected to low irradiation dose.

This comportment was observed for all three types of polyethylene. However, there is a difference between the intake levels of recombination.

The effect of oxidative degradation can be described by the evaluation in electrical properties, because the oxygenated products act as electrical dipoles. If the high energy radiation passes the testing polymer samples,  $\delta$  electrons appear. These charge carriers may be trapped onto electronegative sites like oxygen atoms, double bonds, or even some molecular defects acting as gaps in entanglement configurations [25].

The excellent electrical insulation properties of polyethylene are the result of the

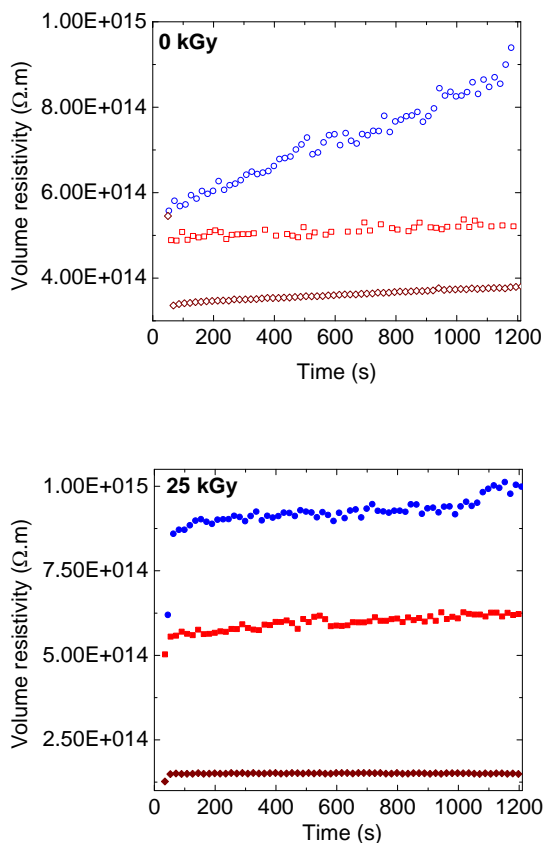


Fig. 5. Evolution of volume resistivity on time (applied tension 50 V)  
 (□, ■) HDPE 1; (○, ●) HDPE 2; (◇, ◆) LDPE



constitution of polyethylene molecule exclusively by non-polar atoms (carbon and hydrogen). The residual conduction measured on pristine samples is the consequence of random scissions which take naturally place by the attack of moderate stressors during handling.

In Fig. 5a (dose 0 kGy) it may be noticed some definable remarks:

- the different values for volume resistivity are obtained characterizing the peculiarity of each type of polyethylene; the most conductive type is low density polyethylene, which is the most susceptible to scission and oxidation; the order based on the increase in the conductivity:



is the same sequence that defines the increase in the values of  $\text{CH}_3$  number per 100 carbon atoms, i. e. the order of the increasing in branching level.

- HDPE 2 presents an ascendant manner in the resistivity values. It may be considered that the electron traps are successively released in the succession of increasing their depths.

In Fig. 5b (dose 25 kGy) the contribution of dipole structures simultaneously with the trapped electrons alters the insulation performances of polyethylenes. The largest difference in resistivity values is displayed by low density polyethylene, due to its noticeable availability for oxidation.

Different dipoles containing oxygen presenting their specific dipole moments are accumulated during  $\gamma$ -exposure and oxygen diffusion [26], whose presence leads to the depreciation of insulating features of PEs.

#### 4. CONCLUSION

The comparative study on the modification in chemical and electrical resistances of three sorts of polyethylene emphasizes the higher susceptibility of low density polyethylene to oxidation due to the lower content of crystalline phase and higher value of  $\text{CH}_3$  number per 100 carbon atoms

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## GENERALIZED GRAPHIC REPRESENTATION OF NOISE MARGINS FOR TTL INTEGRATED CIRCUITS

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**Abstract:** This paper presents the generalized graphic representation of noise margins for the present-day TTL integrated circuits which are connected in the same family or between various families. There are illustrated values of noise margins corresponding to distinct types of connections.

**Keywords:** logic integrated circuit, TTL, logic level, noise voltage, noise margin, graphic representation

### 1. INTRODUCTION

The TTL integrated circuits have evolved fastly towards high performances and increased complexity, becoming the logic integrated circuits with the largest utilization [1] – [4].

There is a diversity of functional parameters which must be considered for their using in apparatus and equipment destined to various applications. The noise margins have a distinct importance for the appreciation of functioning in the presence of electromagnetic disturbances [5] - [31].

It follows the presentation of some theoretical consideration and then, the manner of generalized graphic representations of noise margins for various types of connections between TTL integrated circuits from different families.

### 2. DEFINITION OF NOISE MARGINS

Considering the NAND Gates connected as shown in Figure 1. The input voltage  $V_1$  of the NAND Gate Load is equal with the output voltage  $V_0$  from the NAND Gate Driver, so that

$$V_1 = V_0 \quad (1)$$

If an unwanted voltage called as “noise voltage  $V_N$ ” is induced into conductors between the NAND Gate Driver and the NAND Gate Load, from adjacent current-carrying conductors, as seen in Figure 2, the input voltage  $V_1$  becomes

$$V_1 = V_0 \pm V_N \quad (2)$$

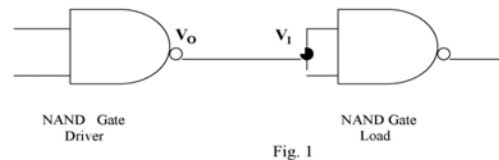


Fig. 1

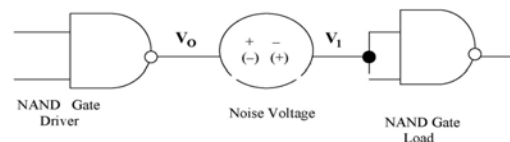


Fig.2

\* Senior Member IEEE

Corresponding to the logic levels L and H, we obtain:

$$V_{IL}=V_{OL} \pm V_{NL} \quad (3)$$

and

$$V_{IH}=V_{OH} \pm V_{NH} \quad (4)$$

respectively.

The worst case values are:

$$V_{IL}=V_{OL}+V_{NL} \quad (5)$$

and

$$V_{IH}=V_{OH}-V_{NH} \quad (6)$$

From Eqs. (5) and (6), we obtain:

$$V_{NL} = V_{IL}-V_{OL} \quad (7)$$

and

$$V_{NH} = V_{OH} -V_{IH} \quad (8)$$

respectively.

The noise voltages  $V_{NL}$  and  $V_{NH}$  are known as "direct current noise margins", being denoted by  $M_{NL}$  and  $M_{NH}$ , respectively.

Considering the Eqs.(7) and (8), the noise margins  $M_{NL}$  and  $M_{NH}$  can be expressed as

$$M_{NL} = V_{IL}-V_{OL} \quad (9)$$

and

$$M_{NH} = V_{OH} -V_{IH} \quad (10)$$

The noise margins  $M_{NL}$  and  $M_{NH}$  can be written into a generalized  $V_{NL}$  and  $V_{NH}$  noise margins, as

$$M_N = (M_{NH}, \text{ if } V_I = V_{IH} \text{ and } V_O = V_{OH}, \\ M_{NL}, \text{ if } V_I = V_{IL} \text{ and } V_O = V_{OL}) \quad (11)$$

The noise margins  $M_{NL}$  and  $M_{NH}$  represent the maximum values of the noise voltages that assure the functioning of the TTL integrated circuits without destroying them and without degradation of L and H voltage levels. They can be calculated by introducing the values of  $V_{IL}$  and  $V_{OL}$  into Eq.(9) and  $V_{OH}$  and  $V_{IH}$ , into Eq.(10), as these are listed in Table 1, both for the TTL NAND 7400 used in all commercial applications and TTL NAND 5400 used for military applications.

Table 1 Values of input and output voltages for TTL NAND 74/5400

Voltage	Measure	Family /Year of appearance							
		(TTL)	L	H	S	LS	F	ALS	AS
		1964	1967	1967	1969	1971	1979	1980	1982
$V_{IL}$	V	0.8	0.7	0.8	0.8	0.7	0.8	0.8	0.8
$V_{IH}$	V	2	2	2	2	2	2	2	2
$V_{OL}$	V	0.4	0.3	0.4	0.5	0.5	0.5	0.5	0.5
$V_{OH}$	V	2.4	2.4	2.4	2.7	2.7	2.7	2.7	2.7

### 3. GENERALIZED GRAPHIC REPRESENTATION OF NOISE MARGINS

The values of noise margins  $M_{NL}$  and  $M_{NH}$  have been presented in a tabular form in a previous paper[19]. The graphic representation of noise margins at TTL integrated circuits

connected from the same family and for those connected from various families, have been presented in [27] and [29] respectively. The general graphic representation of  $M_{NL}$  and  $M_{NH}$  noise margins have been presented in [31].

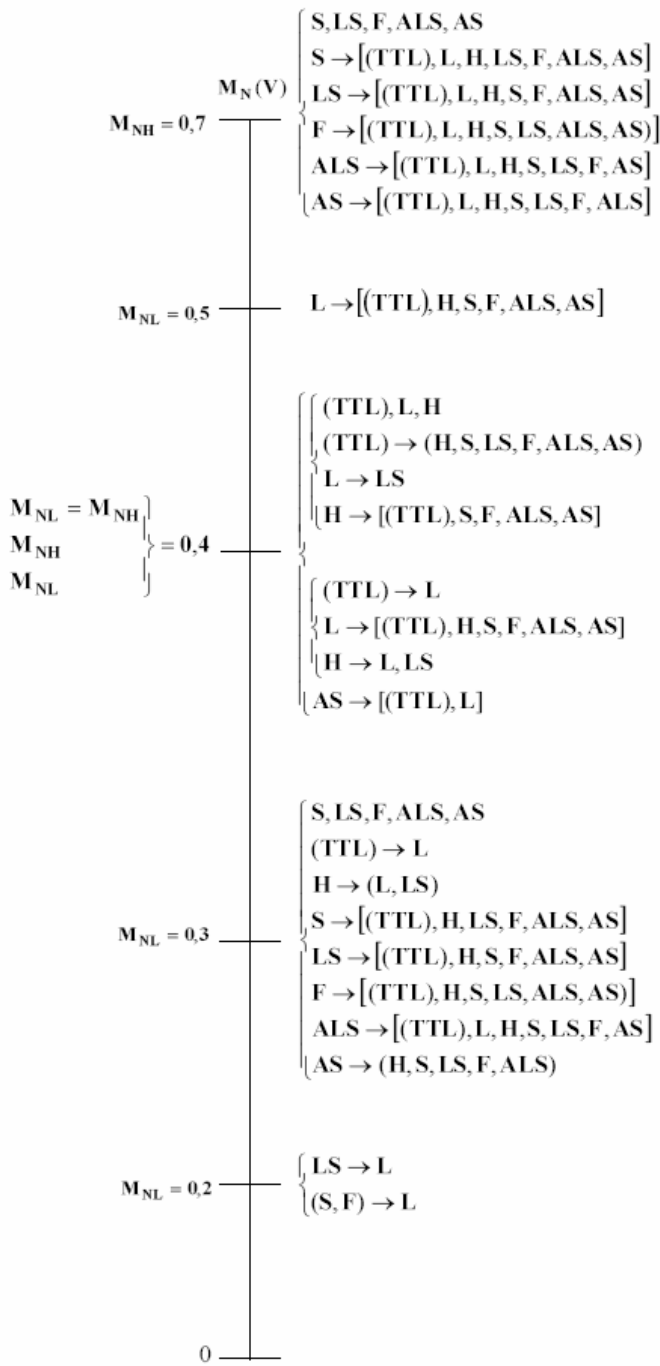


Fig. 3

With these graphic representations, we can obtain the generalized graphic representations of the noise margin  $M_N$ , containing both  $M_{NL}$  and  $M_{NH}$ , as is shown in Figure 3. The arrows shown the families to be connected.

#### 4. CONCLUSION

The noise margins have a distinct importance for digital integrated circuits with the propose of appreciation the functioning in the presence of electromagnetic disturbances. Their values must be considered both in the choosing as in the using of TTL integrated circuits in apparatus and equipment destined for various applications.

The paper has presented the manner of generalized graphic representation so that to be possible both the fast selection of the desired noise margin and the corresponding TTL integrated circuits.

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## ENERGETICAL MONITORING OF THE STORAGE DEVICES BY USING SENSORS NETWORK PLACED INSIDE THE MOBILE SYSTEMS

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**Abstract:** *The goal of the paper is to identify the characteristics (voltage variation in time) and the comportment of the storage devices while they are exposed at extreme temperatures. The temperature variations simulated the impact of the AC system from a vehicle set at different temperatures (AC-heating, AC-cooling) on the storage devices.*

**Key words:** *super capacitor, battery, air conditioning, monitoring, mobile vehicle, sensors, energy storage, characteristics.*

### 1. INTRODUCTION

Nowadays, the protection of the environment became a major problem which affects our daily life. Because of this, the environment problem is taken in consideration by many groups of researchers. The finite resources of the energy, the pollution generated by our activities, inclusively by the transportation systems, became a major motor factor for many research programs having as goal to save and to make more efficient the usage of the energy [1].

The energy density level of the fossil fuels is very high, impossible, for the moment, to be reached by other solutions. The transitory regimes involve, in general, a loss of energy transformed in heat (e.g. the breaking process of the vehicles, the transient regime of all automatically processes govern by "climatronic" regulators or even the voltage regulator used for charging the batteries existing on vehicles. Starting to this idea it is essential to introduce on vehicle some rapid release storage elements able to store or to absorb very fast the transitory component of the power flow. More that, it will be an interest to study the dimensioning algorithms and also the topology and locality of these

elements placed inside the vehicle. Another extremely important aspect is related to the energetic system response function of the environment temperature. For example, at low temperatures, some functions as starting the ICE (Internal Combustion Engine) or the heating process of the vehicle's habitat request a lot of energy consumed that can stress the classical batteries that endow actually the vehicles [2].

The experiments showed that only an integral view for the concept of modern vehicles can bring us a new level of energy efficiency that also means to take into account all the detailed characteristics of the elements involved in the energetic vehicle's sub-system [3].

The goal of the paper is to determine how storage devices placed in a vehicle can be influenced by the temperature and humidity fluctuations while they are exposed at extreme temperatures, thus simulating the real conditions that can appear inside of a vehicle environment in our daily life. Also, the charge/discharge characteristics of the storage devices have to be raised in order to be able to interpret them and to determine the optimally place of them inside the vehicle.

## 2. VEHICLE'S HVAC SYSTEM

Over the last years, with the trends of reducing costs and carrying weight, the interest in ensuring an optimal efficiency in a large sense (energy efficiency, comfort, dynamicity and performances - including reliability and availability) in vehicles has increased. Constructions of vehicles have developed from simplistic to modern cars, integrating the last hour technologies, organized on functional and aesthetic criteria, which ensure the passengers' comfort, ergonomics, safety and also high energy efficiency of the transportation systems [4].

The starting idea is the existence of two scenarios that could appear while the vehicle is functioning: hot versus cold habitat temperature that impose two reactions from the temperature regulator system (HVAC - Heating Ventilating and Air Conditioning) existing on vehicle: cooling and respectively heating the habitat. In both cases it is necessary to take in consideration two periods: (i) the transitory period that means the time to reach the set temperature and (ii) the period of stationary regime when the limits of temperature variation are very strictly controlled. Thinking about the power/energy sources able to provide these services it were identified the ICE and the batteries as primary sources of energy and the supercapacitors as rapid release and storage device.

The primary purpose of the AC system (Air Conditioning) is to assure the comfort of the passengers inside a vehicle and to permanently circulate a thermal treated air flow.

Thermal comfort is influenced by a combination of physical, physiological and psychological factors. ASHRAE standard 55 defines thermal comfort as "that state of mind which expresses satisfaction with the thermal environment" [5]. Models of thermal comfort that can be used to predict subjective comfort assessment have been developed. These models have been validated making human subject studies. The most notable figure of the thermal comfort analysis was P.O. Fanger, with his studies "Thermal Comfort" [6].

A vehicle represents a "moderate" thermal environment described by Fanger's equation (most widely used in automotive thermal comfort research). The environment of the vehicle is non-uniform and dynamic and most of the occupants will experience this comfort for more than one source simultaneously, like: external temperature, solar radiation, glazing (transmittance, reflectance and absorption).

Inside the vehicle it exist two major factors that dramatically affect the vehicle's environment: HVAC system and windows [7]. The HVAC systems were developed especially to increase the passengers' comfort.

In Fig. 1 is presented a typical HVAC system with interior air flow repartition tubes.

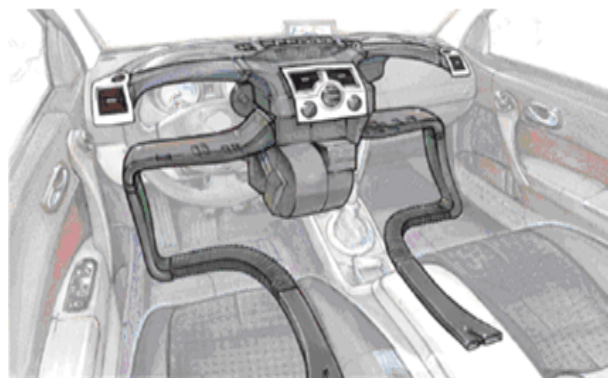


Fig. 1 Air flow repartition inside the vehicle

The optimal comfort rate can be obtained only with automatically air conditioning systems. At the automatic HVAC system, the passenger sets the desired temperature and the system's role is to maintain it constantly by using temperature and humidity sensors placed in key points inside the vehicle. In order to maintain the temperature and humidity in a strictly range, the energy and fuel consumption are increased. The storage devices characteristics were made by simulating a vehicle environment having an automatic HVAC system.

A big interest in the hybrid vehicles research is focused on determining the optimally place of the energetically storage devices inside the vehicles. In order to assume that, studies about voltage variation with temperature in time were made, these temperature variations simulating the AC impact on the storage devices' characteristics.

As a case study, it can be considered an AC system, a 14V/40F supercapacitor and a 12V/77Ah battery as devices under test.

The studies made by ADEME for summer conditions showed that the fuel consumption of a vehicle is increased with 25-35% when using the AC system in towns and with 10-20% when the AC system is used outside the town. As an average, ADEME affirms that the fuel consumption is annually increased with 5% [8].

The energy provided by the supercapacitor reaches 3920 Ws and its extraction factor is 50% [9]. That means the supercapacitor can assure 1960 Ws. The battery has high energy density, but only 15% of its energy can be delivered to the system (138.6 Wh).

The AC systems have to work properly in extreme situations. For example, in summer, while the vehicle is stationing at high temperatures, the attracted solar energy can reach  $1000\text{W/m}^2$  and thus, the interior temperature can easily reach  $60\text{-}65^\circ\text{C}$ . In such situations, the AC system has to provide in a short time high cooling energy (e.g. 10kW). Having 1960 Ws, 5 supercapacitors connected in parallel can provide this cooling energy in 1 second. Instead of connecting in parallel 5 supercapacitors, a battery and a supercapacitor connected together are preferred because the damaging current spike it appears only at the starting AC switch on process. At switching on, the AC system will be supplied from the supercapacitor thus assuring the load smoothing and the rest of the necessary energy will be provided by the battery.

In Fig. 2 is presented the flow diagram that can be used for the AC switching on process. Firstly, the supercapacitor is charged from the battery until its voltage ( $V_{SC}$ ) reaches the set threshold voltage ( $V_{Th}$ ). The supercapacitor's charging process is made in a specified period of time. After the system reached time out ( $T_{Time\ out}$ ) it starts the supply process for the AC from the supercapacitor. When the voltage from the supercapacitor reaches the second set threshold ( $V_{Th2}$ ), the supplying process is switched on the battery and both of the devices are charged from the alternator.

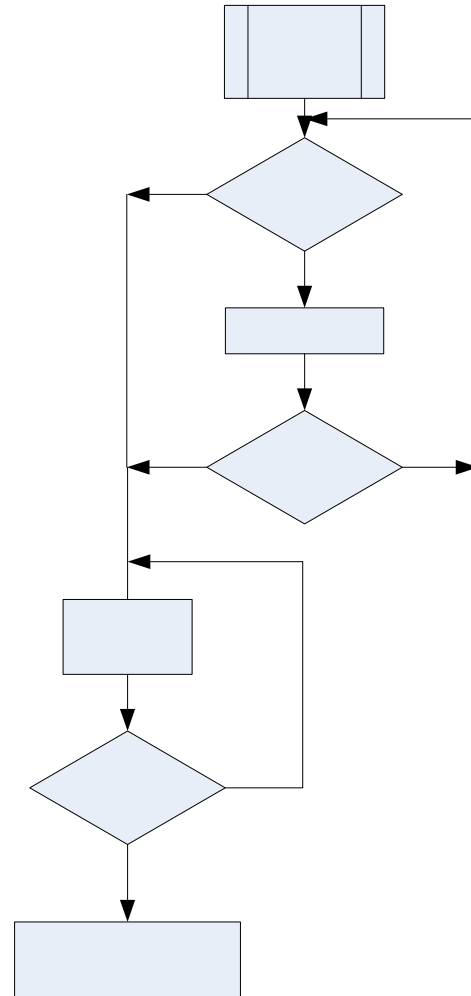


Fig. 2 Flow diagram for AC switching on

### 3. DEVICES' DESCRIPTION

The landscape of the storage devices is complex and actually incomplete known.

Batteries and supercapacitors are electrochemical energy systems carefully designed and fabricated which offer together high power and energy density.

Batteries are combinations of one or more electrochemical galvanic cells which store, with high energy density, chemical energy in contrast with supercapacitors which are electrochemical capacitors that assure high power density.

The supercapacitor technology became an open topic nowadays and is receiving considerable research interest in both academia and industry, due to the wide range of its potential applications, like high power density and high peak power requirements. Supercapacitors are used in order to increase

the system's performance, safety, availability, efficiency and fiability. Also, supercapacitors assure backup power for mobile applications, cut pulse current noises, enhance load balancing when used in parallel with a battery, reduce battery's size, extend battery's life cycle by covering the power pulses, minimize space requirements and can be rapidly recharged from any energy sources.

Supercapacitors don't intend to replace batteries; their aim is to fill the gap between capacitors and batteries. Thus, a combination of both devices (batteries and supercapacitors), as presented in Fig. 3, where batteries are designed to offer the steady state energy and super capacitors to supply or to absorb the transitory energy transferred in case of the vehicles applications, is preferred [10].

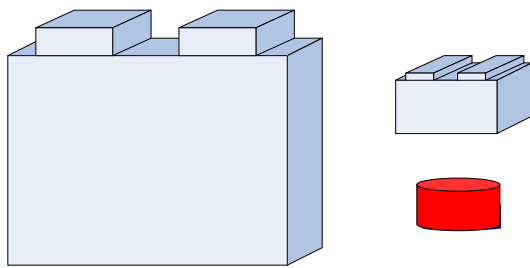


Fig. 3 SC reduces battery's size [9]

Nanotechnology improved the supercapacitors' characteristics, their parameters, their life cycle and power density, made them ultra small, very scalable and their performance scales with size and weight.

Devices' life cycle is defined as the number of complete charge-discharge cycles. For batteries, as high energy density devices, the deepness of the discharge is better to be limited at maximum 15-20% of their capacity in order to prevent the unattended fails [11]. Other influence factors of the battery's life time are: (i) the active materials used for electrodes, (ii) physical factors such as: temperature, humidity and pressure, (iii) electrical factors such as: over and under voltage, current variation in time (peak current).

Regarding the life time, if a battery has between 500 and 1200 life-cycles, then a super capacitor virtually has unlimited life cycle – can be cycled millions of time. Having

complementary performance seems to be suitable to use for high reliable transportation applications [12].

In Fig. 4 is presented a comparative view between supercapacitors' and batteries' energy/power densities [9].

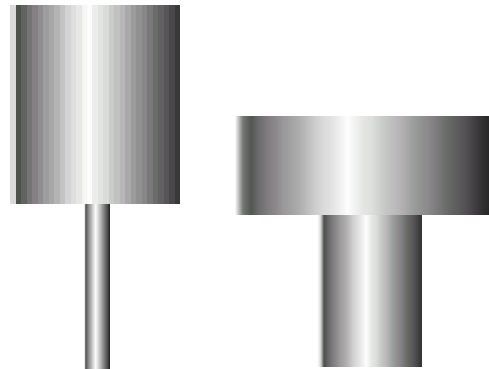


Fig. 4 Energy/Power densities for SC and battery

Supercapacitors have the largest area on the Ragone diagram (Fig. 5), they have high cycling stability, rapid charging and discharging times and temperature stability, as it also can be seen from the experiments. By contrast, batteries have high energy density but they have limited number of cycling, the charging and discharging processes are not stable with temperature, as it can also be seen from experiments.

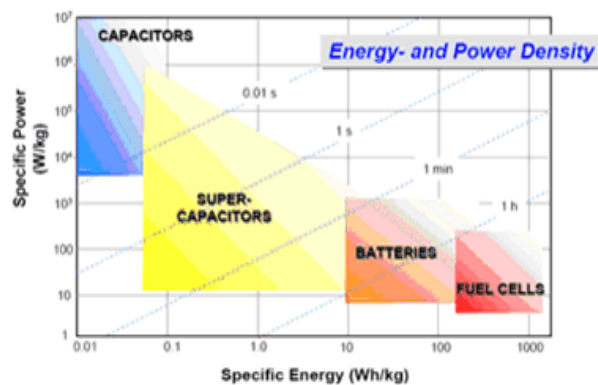


Fig. 5 Ragone diagram [13]

For batteries, their features such as nominal capacity, state of charge (SoC), state of health (SoH) and also the span life need more precision in definition. The type of the active cycle applied on batteries, the deepness of the

Battery

Vs.

+

SC

discharge processes and the temperature have a crucial influence on their life time.

The development of the widespread applications of the supercapacitor technology will only be possible when appropriate high-voltage supercapacitor solutions will be developed to fulfill requirements such as voltage level, maximum current requested by transportation applications, cost, reliability, operating temperature range and environmental concerns [14].

#### 4. MEASURING METHODS AND TEST BENCH IMPLEMENTATION

At present, there are implemented multiple methods for devices health monitoring like:

- (i) discharge test - it is made off line and it is time consuming;
- (ii) measurement of the electrolyte's physical properties;
- (iii) open circuit voltage - it requires long rest period before making the measurements;
- (iv) internal resistance - it can be made at very small time interval (<10ms);
- (v) alternative current impedance spectroscopy - it is non-destructive.

Unfortunately, these methods are not designed for continuously monitoring and, in this case, long periods of charging and discharging are missed while the devices' health can be degraded.

A model for a supercapacitor with two components (first order conduction and second order conduction) is presented in Fig. 6.

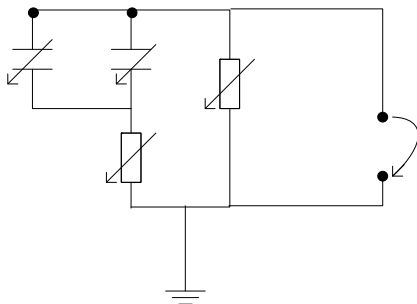


Fig. 6 Supercapacitor basic model

Supercapacitors' and batteries' charge/discharge rate and thermal comfort depend on temperature and humidity. In order to simulate the impact of the air conditioning system (AC) from a vehicle on the storage devices, temperature was varied, the storage devices' characteristics were obtained and thus it was determined how quickly the storage device will lose its energy at different temperatures and constant load. To measure these characteristics, a test bench that can measure online the important parameters was implemented. Having a 2A load, the devices' voltage is monitored at different temperatures. The characteristic voltage/time is obtained on line by using a Fluke 1998B scope meter, a HP 34401A multimeter, a laptop and a data acquisition system (DAQ). All the data are stored in the scope meter's memory and also, are simultaneously transmitted via Bluetooth to the laptop. The stored data are processed in Matlab tool.

For supercapacitors it is necessary to analyze and measure their voltage characteristics function of temperature variation, the type of the active cycle, the electrode materials and the electrolyte in order to optimally integrate them into composed storage systems placed in vehicles.

In order to correctly characterize a storage device it is necessary to include at least the following topics: voltage variation, energy density, power density, inner resistance, temperature range of operation, geometry of the elementary cells, type of package, aging, and environmental effects (relating to operation and end- of-life disposal).

To achieve this goal, we developed first a test bench system used to determine the characteristics of the supercapacitors/batteries and to raise their voltage characteristics.

The developed test bench presented in Fig. 7 consists of a 12V Rombat Pilot Diesel Hybrid battery, 77Ah, a 14V/40F ECONDO LTD PSCAP supercapacitor, a heating Carbolite camera, type PF120 (200) and a cooling Derby camera, DK 9620 Alestrup, type F26LT, voltage and current sensors (placed on the storage devices), temperature and humidity sensors (placed inside the heating/cooling camera) and a ATmega128

microcontroller based acquisition system, all of these submitted to the interior environment variations (simulating the AC-heating, AC-cooling).

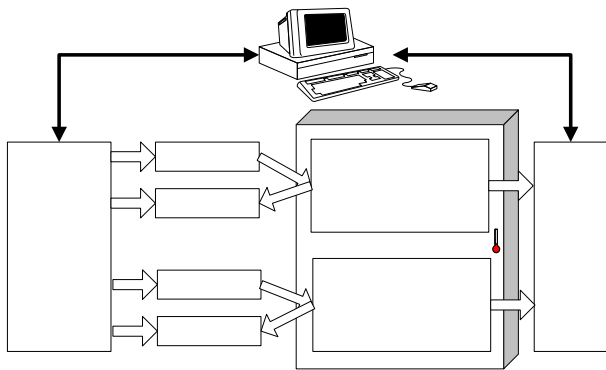


Fig. 7 Test bench implementation

In Fig. 8 it is presented in detail the test bench implementation. The test bench is composed by a switch for selecting the charge/discharge process and a switch for selecting the device under test (battery and supercapacitor). The control commands are given by using an ATmega128 microcontroller.

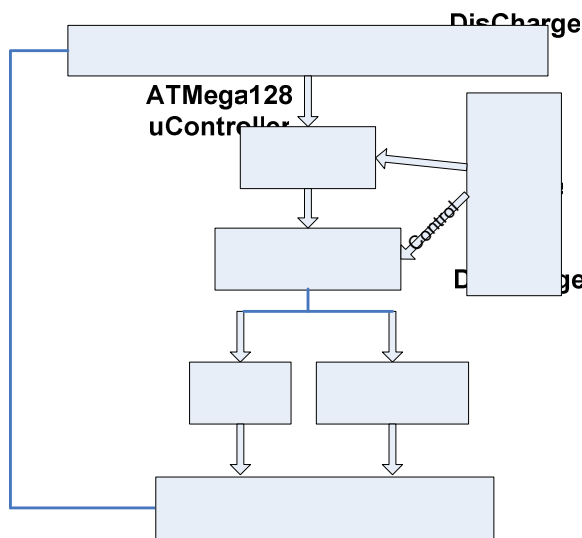


Fig. 8 Detailed test bench implementation

### 5. Experiments and results

In order to optimally integrate the storage devices in a system, experimental data were accumulated and the results were interpreted.

While at batteries the capacitance variation with temperature is pronounced, at supercapacitors, the capacitance variation with

temperature is reduced also having a reduced ESR (Electrical Series Resistance).

The chemical reactions of the batteries are dependent with temperature and thus, the battery's performance is deteriorating while exposing it at extreme temperatures. In the supercapacitor case, because there are not complicated reactions while normal functioning, its performance remains approximately the same in a wide range of temperature (-40<sup>0</sup> C;+70<sup>0</sup>C), as it is illustrated in the experimental graphics (Fig. 10 a, b and Fig. 12 a, b).

To acquire the experimental data it was used the test bench described above.

The Relative Humidity (RH) and Dew Point variation function of temperature measured by the help of the SHT11xx sensor were:

Table 1 Experimental data

Temperature [°C]	Humidity [%]	Dew Point [%]
-40	9.5	-58.08
-25	10.74	-47.06
0	35	2.9
20	8.78	4.1
60	15.93	15.93

Th - Rh

DAQ

The experimental results for the supercapacitor are presented in Fig. 10 (a, b).

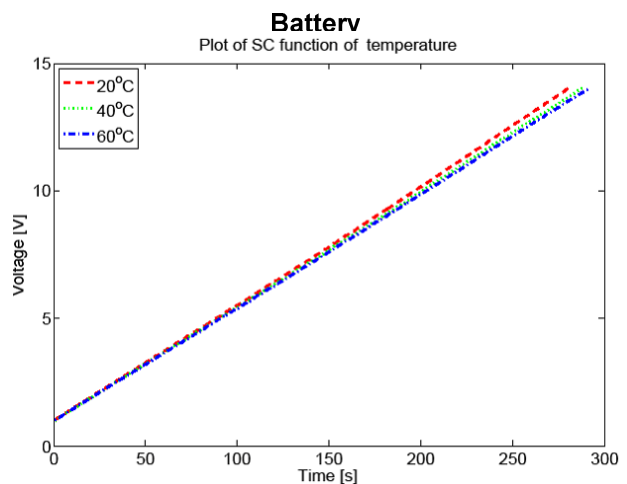


Fig. 9 a Supercapacitor's voltage variation function of temperature variation having 2A constant load

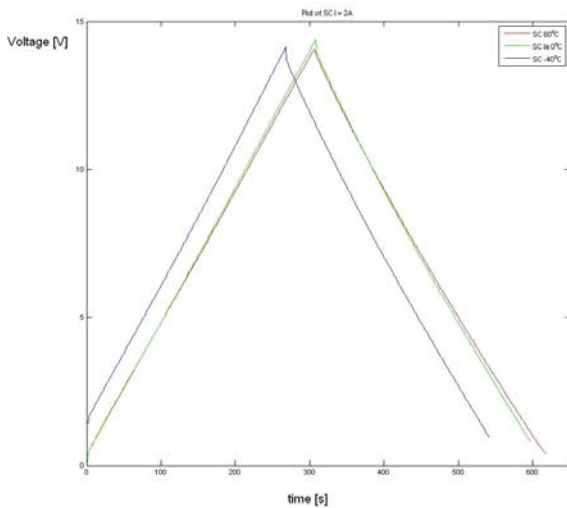


Fig. 10 b Supercapacitor's voltage variation function of temperature variation having 2A constant load

The supercapacitor's parameters dependent on temperature are ESR and the second order capacity conduction.

As it can be seen in Fig. 10 (a, b), the comportment of the supercapacitor it is not considerably influenced by the temperature and humidity variation, the charging and discharging time having approximately the same value at  $-40^{\circ}\text{C}$  and at  $60^{\circ}\text{C}$ .

Because the implemented test bench had a 2A active constant load connected in series with the supercapacitor's loses resistance, the variation of the ESR and of the second order capacity conduction function of temperature are insignificant compared with the first order capacity's conduction variation with voltage.

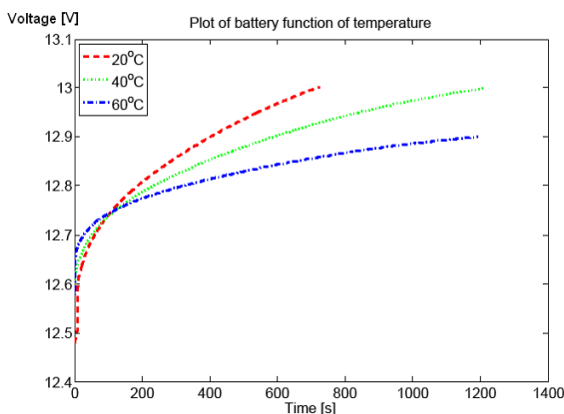


Fig. 11 a Battery's voltage variation function of temperature variation having 2A constant load

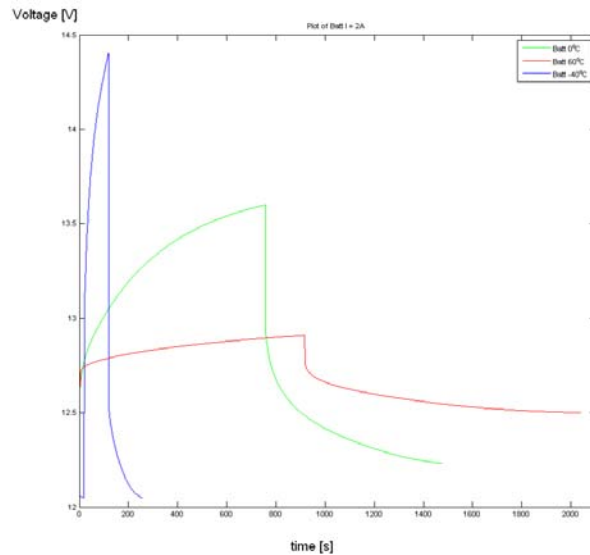


Fig. 12 b Battery's voltage variation function of temperature variation having 2A constant load

It can be seen in Fig. 12 (a, b) that batteries have a considerably dependency with temperature variations.

Thus, in the batteries case, as higher is the temperature, as slower are the charging and discharging process and as lower is the temperature as faster are the charging and also the discharging process.

As it can be seen in Fig. 12 (a, b), at low temperatures the charging process (from 12.2V to 14.4V) and discharging process (from 14.4V to 12.2V) are made in less than 350 seconds. Because there is not enough time to complete the battery's chemical reactions its state of charge is affected and its life time is considerably reduced. For example, at low temperatures, some functions as starting the ICE or starting the heating process of the vehicle's habitat stress the battery because of the huge amount of requested energy which can be provided only for a small period of time.

For this reason, supercapacitors used in combination with batteries can bring a new level of energy efficiency and, concomitantly, can improve the battery's life time.

## 6. CONCLUSIONS

As it was presented in the present paper, the thermal treated air flow influences both the thermal comfort of the passengers in a vehicle

environment and the voltage characteristics of the storage devices (battery and supercapacitor). Also, the actual storage device's (battery) compartment proved to be affected by a rapid variation between extreme temperatures.

The experiments showed that the compartment of a supercapacitor is considerably stable with temperature and humidity variation in a wide range of temperature (-40°C; 60°C) in contrast to a battery, which proved to be not stable at all in the same range of operating temperature. For this reason, a supercapacitor used in combination with a battery not only improves the battery's life time but it also offers a good stability with a wide range of temperature and humidity.

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## SYNTHESIS OF THE MAGNETIC COMPENSATION WRAP AROUND FOR A SHIP UNDER CONSTRUCTION

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**Abstract:** *We have chosen as a model a ship with a ferromagnetic hull provided with a wrap around magnetic compensation. The ship chosen like a model needs to have the same disposal of the ferromagnetic masses, onboard, similar to the ships under construction.*

**Key words:** *The main stages of the synthesis of the magnetic compensation wrap around are as follows: Adopting the system of magnetic protection; Imposing performances of magnetic compensation; Choosing the model ship, from the same class as the ship under construction; Measuring the magnetic field of the model ship; The magnetic calculation the compensation wrap around.*

*We adopt an automatic system of compensation with ferrous gauge, of internal production, to be found in ship gear [6,3]. The system is destined to the automatic adjustment of the current intensity in magnetic compensation wrap around PL, OD, VD. As translator for the measurement of the terrestrial magnetic field compounds ZT, XT, YT we use an inductive translator of a Ferro-gauge type, sensitive to constant or slow variable magnetic fields.*

### 1. MOLDING USAGE FOR THE SYNTHESIS OF MAGNETIC COMPENSATION WRAP AROUND

The molding method may be applied, for the same class of ships, in two variants: either the magnetic molding of the ship and of the compensation wrap around or single molding of the wrap around. The first variant can be applied when we are provided with the ship project and the second variant can be applied when the ship is executed physically [1, 2, 3].

a) The magnetic molding of the ship and the compensation wrap around

We build the geometrical model of the projected ship. We proceed to modeling the hull with all her components. The ferromagnetic masses from the inside of the ship, scale modeled, must have the same magnetic properties like the others to be used in the ship construction, ensuring therefore the criteria identity  $\pi_1$  and  $\pi_2$ , [2].

We determine the measurement depth for the model with reference to the scale [2]. Inside the model we place the compensation wrap around divided into sections. All the compensation sections shall be supplied in derivation in order to allow an easy adjustment of solenation for each section.

At the measuring depth of the model we measure the magnetic field and we adjust solenations aiming at an accurate compensation of the magnetic field created by the model ship.

By means of experimental measurements we determine for each compensation wrap around the number of sections, the required solenations and the optimal position for the wrap around.

As follow up, taking into account the molding coefficients we determine the real compensation wrap around of the ship.

This synthesis method of the compensation wrap around presents special difficulties, and the results are not so reliable because, on the one hand, we do not achieve, by means of using a model, a perfect embodiment

of the ship under construction, and, on the other hand, the ferromagnetic materials used for ship construction are not delivered as magnetic materials, consequently we remain completely ignorant of their precise magnetic characteristics and of their ability to be reproduced on the model accurately. Moreover, for ship construction the ferromagnetic materials are put through mechanic and thermal solicitation which lead to an alteration in their magnetic properties to an extent which cannot be approximated.

b) Modeling magnetic compensation wraps around

This variant applies for the case when we are provided with the ship which is going to undergo the compensation wrap around procedure. The order of the steps to be taken is the following [2, 4, 5]: we perform the measurement of the magnetic field of the ship; knowing the ship dimensions and her magnetic field we perform the model of compensation wrap around, in the open, on wood carcasses, real life size; we measure the field produced by the compensation wrap around procedure and we adjust the solenations of the sections in order to obtain a field equal and opposed to the one of the ship.

Given the fact that measurements are performed in the open, when determining the field created thereby we shall take into account the influence of iron, just like in the case of wrap around performed onboard ship. This influence of the iron shall be considered adopting an influence coefficient of the iron equal to the average value of the iron influence coefficients for ships with a ferromagnetic hull, having also magnetic compensation wrap around.

The suggested variants suppose a great amount of physical and experimental procedures for the synthesis of magnetic compensation wrap around. In practice, we make use of another method, a simpler one, which leads to proper results. In this case, for the synthesis of compensation wrap around we adopt as a model an existing ship already having onboard wrap around of magnetic compensation. The real ship

considered as a model imitates much better the ship under construction since she is made of ferromagnetic materials of the same type, undergoing the same thermal and mechanic solicitations. Similarly, the molding scale is reduced which leads to an augmentation of the calculation accuracy.

## 2. MAIN CHARACTERISTICS OF THE SHIP UNDER CONSTRUCTION

The main characteristics of the ship under construction are:

- maximum length:  $L = 54,0$  m;
- maximum breadth:  $B = 11,3$  m;
- average draft:  $T = 2,10$  m;
- height of the freeboard:  $hb = 5,50$  m;
- the distance between the plans of two successive couples:  $\lambda x = 0,6$ m.

Based on the above mentioned we calculate the depth of the measurement plan:

- according to the first criterion:  

$$h = (0,6 - 0,8)B = 0,6 \cdot 11,3 = 6,78 \text{ m} \quad (1)$$

- according to the second criterion  

$$h = \alpha B + T = 0,4 \cdot 11,3 + 2,1 = 6,62 \text{ m} \quad (2)$$

We adopt the depth of the measurement plan:  $h = 6,78$ m.

The distance from the keel to the measurement plan is:

$$hk = h - T = 4,68 \text{ m} \quad (3)$$

As follows, we work out the ratios:

$$\frac{B}{L} = \frac{11,3}{54} = 0,209 \quad ; \quad \frac{h_b}{B} = \frac{5,5}{11,3} = 0,486 \quad ;$$

$$\frac{h_k}{B} = \frac{4,68}{11,3} = 0,414 \quad (4)$$

The main characteristics of the model ship are:

- maximum length:  $L' = 38,8$  m;
- maximum breadth:  $B' = 8,6$ m;
- average draft:  $T' = 1,80$  m;
- height of the freeboard:  $h'b = 4,05$  m;
- the distance between the plans of two successive couples:  $\lambda'x = 0,60$  m.

We calculate the depth of the measurement plan:

- according to the first criterion:  

$$h' = (0,6 - 0,8)B' = 0,6 \cdot 8,06 = 5,16 \text{ m} \quad (5)$$

- according to the second criterion:  

$$h' = \alpha' B' + T' = 0,4 \cdot 8,6 + 1,8 = 5,24 \text{ m}$$

(6)

We adopt the depth of the measurement plan  $h' = 5,20$  m.

The distance from the keel to the measurement plan is:

$$h'_k = h' - T' = 3,40 \text{ m} \quad (7)$$

We calculate the ratios:

$$\frac{B'}{L} = \frac{8,6}{38,8} = 0,221 \quad ; \quad \frac{h'_b}{B'} = \frac{4,05}{8,6} = 0,47$$

$$\frac{h'_k}{B'} = \frac{3,40}{8,60} = 0,393 \quad (8)$$

The difference between the relative measurement depths:

$$\frac{h'_k}{B} - \frac{h'_k}{B'} = 0,414 - 0,393 = 0,032 \quad (9)$$

Does not exceed 10% of  $h'_k/\beta$ , meaning that it does not exceed the value of 0,0414. The vertical field of the ship under construction is considered to be equal to the vertical field of the model ship, in the measurement section.

The coordinates for the points which define the rectangular sections of the magnetic compensation wrap around are calculated in the system of coordinates used for the ship shape project.

### 3. THE MAIN WRAP AROUND OF LATITUDE (PL), THE HORIZONTAL WRAP AROUND OF ROUTE (OD), THE VERTICAL WRAP AROUND OF ROUTE (VD) OF THE MODEL SHIP

The main wrap around of latitude PL is made up of two contours, the upper contour (PLs) and the upper contour (PLj).

The contour PLs is made up of 9 sections displayed between the timber C43 and the ship stern.

We should bear in mind the fact that the section between timbers C43-C8 has only one spire made of the serial cables of the upper section contour. Precisely for this reason, for the sections between timbers C43-C8 we add another spire taking into account for this matter the contribution of section 1 to the creation of the stationary magnetic field of compensation. The contour PLs is displayed in the floating angle of the

ship under the main bridge, in the floating angle  $z=4,00$  m.

The contour PLj contains 4 sections displayed between the timbers C38-C14. Section 1 displayed between the timbers C38-C25 is made up of serial cables of the lower contour sections. And in this case, for the sections between timbers C38-C25 another spire shall be added.

The lower contour PLj is assembled as low as possible, at the height of the double bottom, in the floating angle  $z=0,50$ m.

The horizontal wrap around of the route (OD) is made up of 9 sections displayed between the timbers C48 and the stern.

The wrap around OD is assembled on the same level as the PLs contour and the sections of the wrap around are identically displayed with the sections of the PLs contour. The coordinates of the points defining the sections of the OD wrap around are identical to the ones mentioned for the PLs contour. The sections differ according to the number of sections.

Section number 1 is a spire made up of the feeding cables for the serial wrap around of the sections and is displayed between timbers C48-C8, in order to comply with the contribution of section 1 to the production of the magnetic field.

The vertical wrap around for the route (VD) is structured into two identical contours symmetrically displayed as to the diametrical plan of the ship (PD) inside the two brims and every contour contains 4 sections.

The maximal compensation errors, of the vertical components of the magnetic field created onboard the ship, depend on the class of the ship, meaning on their main destination. The following performances are to be desired [3] :

- the maximal admissible error of compensation of the vertical component of the transversal inductive magnetization:

$$\Delta Z_{iy} \leq \pm 3 \text{ mOe} \quad (10)$$

- the maximal admissible error of compensation of the vertical component of the longitudinal inductive magnetization:

$$\Delta Z_{ix} \leq \pm 2 \text{ mOe} \quad (11)$$

- the maximal admissible error of compensation of the vertical component  $Z_z = Z_{pz} + Z_{iz}$ :

$$\Delta Z_z \leq \pm 7 \text{ mOe} \quad (12)$$

A ship is geared with an installation of magnetic protection provided with 3 channels (systems):

- the channel of VD wrap around which is a tracking device destined to the compensation of the vertical component of the transversal inductive magnetization  $Z_{iy}$
- the channel of the OD wrap around which is a tracking device destined to the compensation of the vertical component of the longitudinal inductive magnetization  $Z_{iy}$
- the channel of the PL wrap around which is a stabilizing system of the current intensity, in the area of adopted latitude, for the compensation of the vertical components  $Z_z = Z_{pz} + Z_{iz}$ .

#### 4. CONCLUSIONS

In the synthesis of magnetic compensation wrap around we have adopted from the very beginning the system of magnetic protection and depending on the particulars of the latter we get an outcome for the types of wrap around and the ensuing performances.

Given the fact that the model ship is of a small length, for the accuracy of the calculations we have established the distance between two successive measuring points, at full length of the ship, equal to the distance between the plans of four successive timbers.

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## NEW SOLUTIONS FOR THE MAGNETIC PROTECTION OF SHIPS

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*Abstract: The means and methods of magnetic protection always depend on the destination of the ship. Ship classification is made depending on the criterion of magnetic imprint and their specific destination. Our analysis aims at two classes of ships: specialized ships and ships with high mechanical performances.*

### 1. INTRODUCTION

In the world there is an intense activity of scientific research, having as an objective the reduction of the magnetic imprint of specialized ships, activity which involves institutes of scientific research as well as firms specializing in ship construction and naval equipment.

The methods of reducing the magnetic imprint, used at present (compensation, magnetic treatment, weak magnetic construction) are complementary and are adopted depending on the magnetic performances imposed to the ship.

A major stress is laid on the usage of non-magnetic materials for the construction of specialized ships. This framework distinguishes two directions:

- using non-magnetic materials for the construction of the hull;
- the construction of the ship equipment using a high percentage of non-magnetic materials.

The main sources of magnetic field are displayed on the main deck of the ship, in specially designed berths, enhancing therefore the distance of the field source to the plan situated at a safety depth. Such a display of the main mechanisms, installations and equipments leads to a worsening of the ship stability.

In the case of ships with a wood hull or plastic with spun glass, a difficult

problem is the creation of an equipotential surface, extended on the entire plating of the ship, for the grounding of the equipments.

The above mentioned measures lead to diminished values of the magnetic field in the safety plan. Yet, we estimate that the distribution of the magnetic field in the measurement plan is not acceptable because we obtain high values for the field gradients. For these ships the dominant performance parameter, which sets the characteristics for the distribution of the field intensity in the safety plan, is precisely the field gradient. Efforts have been made in design and technology to obtain longitudinal magnetic characteristics, of the field created by the set ship- wrap around compensation, in the shape of an oblate curve. To this aim we resort to local and global wrap around compensations.

We have worked out the design algorithm for the sources of compensating magnetic field for the concrete case of a naval Diesel engine in a weak magnetic construction, made of a hard aluminium hull provided with the necessary gear for an upgrade of the resistance to corrosion.

We have presented two variants:

- the synthesis of a couple of wrap around made up of rectangular shaped coils;
- the synthesis of a solenoid behaving like a magnetic dipole, in the safety plan, for the compensation of the components  $Z_{px}$  și  $Z_{ix}$ .

With a view to achieving local compensation, the rectangular shaped coils are

used onboard certain types of ships, and the solenoid behaving like a magnetic dipole, in the safety plan, is used onboard other types of ships.

For the optimal solution to be applied, from the point of view of the minimal compensation errors and technologic simplicity, the maximal value for the compensated vertical magnetic field represents 22,159 % of the maximal value for the intensity of the vertical magnetic field created by the Diesel engine magnetically non-compensated on the Nm road.

As far as local magnetic compensation is concerned we must stress the following novelty aspects:

- for the magnetic calculus of the sources of compensating field we have considered the design plan for a ship and the arrangement plan;

- as a result of the studies undergone, for the first time we impose performances regarding maximal compensation errors:

$$\begin{aligned} |\Delta Z_{jz}| &\leq 2,00 \text{ mOe}; & |\Delta Z_{jx}| &\leq 2,00 \text{ mOe}; \\ |\Delta Z_{jy}| &\leq 1,00 \text{ mOe}, & j &= p, i \end{aligned}$$

We have not imposed restrictions regarding the magnetic field gradients because the local compensation, judged upon as correctional, imposes the usage of global compensation which aims at reducing field gradients, in the safety plan.

With a view to measuring the intensity of the magnetic field created by the various mechanisms and equipments which the ship is going to be fitted with, we perform special measurement polygons. Within such polygons, after moulding local wrap around, we measure the magnetic field created by the set mechanism-compensating source, establishing clearly whether the imposed performances are complied with, and if necessary we corrections are made.

Usually, within these polygons, we are able to demagnetize various mechanisms, made up of ferromagnetic materials, which shall equip the ship.

For the first time we have conceived a computer program and we have established the material magnetic parameters for steel shell plating for ships.

The material samples (the steel shell plating heat laminated of high resistance used for the construction of hulls) were preleased form ships with various degrees of exploitation. The chemical composition of naval steel contains a maximal carbon percentage between 0,18%...0,23%.

For ships with high mechanical performances, irrespective of displacement and missions, aiming at a reduction in the magnetic imprint we make use of the magnetic treatment methods (demagnetization) and the global magnetic compensation.

## 2. METHODS FOR THE SYNTHESIS OF GLOBAL MAGNETIC COMPENSATION WRAP AROUND

We use two methods, as follows:

- the simplified, used to the present;
- the shaping method, used within the program.

The simplified method provides satisfactory outcome for all classes of ships, with a steel shell plating, whose ratio  $B_{max} / L_{max}$  ranges between the limits of 0,09...0,12. With a low precision rate it may be used for ships with  $B_{max} / L_{max}=0,12...0,15$ . The method does not imply the procedure of measure taking. According to this method we achieve the compensation of components  $Z_z$ ,  $Z_{ix}$ ,  $Z_{iy}$ , therefore allowing the synthesis of wrap arounds PL, OD, VD.

According to this method, for various values of the ratio  $B_{max} / L_{max}$  we mention, in a table form, the maximal values of the components  $Z_{zmax}$ ,  $Z_{ixmax}$ ,  $Z_{iymax}$  corresponding to maximal iso-dynamos of C.M.T.  $Z_T=600 \text{ mOe}$  și  $H_T=400 \text{ mOe}$ , as well as the normal measuring depth  $h$ .

If the maximal iso-dynamos of the imposed navigation field are lower, then the values for the components  $Z_{zmax}$ ,  $Z_{ixmax}$ ,  $Z_{iymax}$  are recalculated, with the already known relations. Similarly, if the relative measurement depth of a ship under construction differs from the one in the table, this is to be recalculated. The specificity of this method resides in the fact that we allot the repartition to the specific solenation, in the safety plan, for the three compensation wrap arounds PL, OD, VD. For each wrap around we work out a

transfer coefficient (KPL, KOD, KVD) of p transition from the specific solenations to real solenations, with the help of some empirical relations.

Knowing the allotment of the real solenation, in the safety plan, we adopt a number of sections in the wrap around. This method imposes the usage of an automatization gear provided with three channels destined to the wrap around PL, OD, VD.

In the practice of magnetic compensation, in our country, we use the universal current regulator with three channels (PL, OD, VD).

From the above mentioned we infer that by using the universal current regulator we do not ensure the compensation of the components

$Z_{px}$  și  $Z_{py}$ . With a view to compensating the vertical components  $Z_{px}$  și  $Z_{py}$  we use a main adjustment wrap around (PA) and accordingly an automated system of stability for the current intensity in this wrap around (IPA=ct.). The PA wrap around is calculated in such a way the maximal compensation error for the components  $Z_{px}$  și  $Z_{py}$  may not exceed 10 mOe ( $|\Delta Z_{PA}| \leq 10,00$  mOe).

We notice that for the compensation of all vertical components ( $Z_z$ ,  $Z_{ix}$ ,  $Z_{px}$ ,  $Z_{iy}$ ,  $Z_{py}$ ) four wrap arounds are necessary (PL, OD, VD, PA) and four automatic adjustment systems. We highlight the link between the synthesis method and the automatization equipment.

The method presented here, associated with the automatisation equipment of the type of the universal current regulator, displays the following disadvantages:

- the wrap arounds PL, OD, VD are oversized due to the recommended high values of the components  $Z_{zmax}$ ,  $Z_{ixmax}$ ,  $Z_{iymax}$  ;
- the number of ships which range within the recommended ratios  $B_{max} / L_{max}$  , is low;
- the values of specific solenations, given graphically, are high and practically correspond to liners (with a slender architecture);

- the usage of four wrap arounds (PL, OD, VD, PA) properly correlated with the automatization gear lead to material investigation, great technological and financial hardships, consequently the solution is inappropriate from an economic point of view;

- the compensation systems with a universal current regulator do not ensure the removal of any influence of ship vascillation or the diurnal variations, micropulsations and magnetic storms ovre the inductive magnetism. The values of the current intensity in the wrap arounds PL, OD, VD, for each area of magnetic latitude they are determined by calculation.

For the magnetic calculation of global compensation wrap arounds we used the method of physical moulding based on the preservation of the geometrical resemblance of the two ships (the model ship and the ship under construction) and the satisfying of a similitude criterion for the stationary magnetic field.

We have adopted an automatic compensation system with a ferrous-gauge like translator with three channels existent in the ship gear. In this case the specific wraparound compensates both for the inductive vertical as well as for the permanent vertical component of the respective magnetization.

We have analyzed the maximal compensation errors for several ships, we have set the maximal compensation errors in the case of using the system with mast gauge, for the components  $Z_x = Z_{px} + Z_{ix}$  și  $Z_y = Z_{py} + Z_{iy}$ , and the maximal compensation error for the component  $Z_z = Z_{pz} + Z_{iz}$  stays the same.

The design algo-rhythm contains novelty aspects, thus:

- we calculate the intensity of the electric current, for each wrap around, necessary for the compensation of the inductive vertical component and respectively for the compensation of the permanent component, instead of measurements. These values are necessary in order to be introduced in the automatization gear of the mast ferrous-gauge compensation system, in every channel.

The mentioned values simplify, essentially, the effort undergone by specialists in the measurement polygon, for the adjustment and check-up of the resulting vertical field of the ship. Based on the resulting measurements we

set up a technical chart with the magnetic performances of the ship. Similarly, we set if a demagnetization of the ship is needed.

Because the method requires the measurement of the magnetic vertical field of the model ship, for the first time we present the organization of the measures in the polygon. The correct organization of measurements with the model ship displayed along the cardinal magnetic roads, having the compensation wrap arounds electrified or disconnected wrap arounds respectively, have ensured the initial data for design.

From the studies performed regarding the model ship we have reached the conclusion that this is not supposed to be introduced in the measurement polygon, an aspect that is determined by the low frequency of the ship magnetization. In this situation, the solenation reserve allows the obtaining of magnetic performances imposed on a ship under construction without being demagnetized after each mission that requires the usage of armament system or after the exit from the shipyard.

### **3. CONCLUSIONS**

1) An important aspect is the full setting of the elements in the magnetic field created by ships and the appropriate selection of these elements, which may be performance indices in evaluating the magnetic field of the ship. We point out the following novelty aspects:

- Introducing the transversal and vertical magnetic characteristics, together with the longitudinal ones. This was necessary for the description of the allotment of the magnetic field components in various plans and directions of interests;
- We perform a correlation of movement parameters of the ship with the frequency and the amplitude of the first serial Fourier development harmonics of the transition characteristics;
- Establishing the magnetic performances of the ship: the admissible compensation errors and the magnetic field gradients in the case of global magnetic compensation and the

admissible compensation errors in the case of local magnetic compensation;

- Establishing the criteria used in the synthesis of local compensation wrap arounds: the criterion of form coefficients and the criterion of compensation error;

2) The contribution of researchers regarding the calculus of the stationary magnetic field created by the electric circuits form the composition of local and global magnetic compensation wrap arounds resides in the following:

- The adequate selection of calculation methods for the description of the stationary field in extended spatial fields;
- Presenting mathematical models in a unitary form, generalized by expressing the geometrical dimensions of the circuits and the spatial coordinates in relative measures. This allows the expansion of calculation results, based on the similitude criteria, to any electric circuit or system of electric circuits;
- Introducing new types of wrap around for global compensation, displayed on the floating areas of the ship. These wrap around are specific for ships specialized in mine fighting and represent optimal solutions in the synthesis of global compensation wrap around. On the basis of set mathematical systems we have performed the calculus of the stationary magnetic field, created by an electric circuit displayed on the plating shell of the mine layer ship. The suggested solution presents the advantage of correlating the magnetic calculation of the wrap around with the shaping plan, used to build the ship;
- Setting criteria according to which we can set rectangular shaped electric circuits, equivalent form the point of view of the stationary magnetic field with the electric circuits displayed on the shell plating of the ship. This leads to an essential reduction in the calculation effort of the stationary magnetic field, in the synthesis of wrap arounds exemplifying the adequate naval mechanisms for every electric circuit aiming at local compensation.

Highlighting the fact that the symmetry properties of the magnetic fields created by the circuits destined to magnetic compensation are identical.



#### **4. DESIGN METHODOLOGIES**

The program presents the following design methodologies:

- the methodology of designing field sources in the shape of rectangular coils and solenoid behaving like a magnetic;
- the methodology of designing field sources in the shape of rectangular coils and solenoid behaving like a magnetic dipole, in the safety plan, aiming at specific compensation;
- the methodology of designing global compensation wrap around, using the method of physical modelling.

The success in obtaining a ship with high standard magnetic performances depends on the experience of the ship designers and the naval equipment available.

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## THE MECHANISM OF RADIATION DEGRADATION OF SPACE SOLAR CELLS

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**Abstract:** This paper presents the investigation of the mechanism of Radiation Degradation of Space Solar Cells (SSC) on the base of Si, GaAs, InP, InGaP/GaAs published experimental results of NASDA Engineering Test Satellite –V(ETS-V), Solar Cell Monitor (SCM) and our results. The SSC on the base of  $A^3B^5$  semiconductors (GaAs, InP and InGaP/GaAs) have higher radiation-resistance. Normalized efficiency directly depends of bandgap energy, damage coefficient for minority-carrier diffusion length and optical absorption coefficients. Reliability is higher as higher is bandgap energy of materials. The maximum reliability have SSC from InP and semiconductor compounds concerning indium (In) and phosphorous (P) as component. On the base of this experimental results we discussed different mechanism of SSC degradation and is proposed the model of Solar Cells Degradation including degradation of carrier lifetime, electron and hole concentration and parameters of  $n^+p-p^+$  structures.

**Keywords:** space solar cells, radiation, degradation, reliability, defects

### 1. INTRODUCTION

This paper presents the review of investigations of the mechanism of Radiation Degradation of Space Solar Cells (SSC) based on experimental results of NASDA Engineering Test Satellite–V (ETS-V) Solar Cell Monitor (SCM), JAERI - SCM and other results published in different papers and reviews, including our results. Have been investigated the space solar cells on the base of Si, GaAs, InP, GaAs/Ge, InGaP/GaAs and GaInP/GaInAs/Ge.

The space influence factors: Large light spectrum, Proton and electron radiation, UV radiation, Higher temperature of Solar Cells emitter.

The requested characteristics of Space Solar Cells: higher efficiency, small weight, higher reliability and low cost.

Majority of satellites operate on Low-Earth Orbit (LEO), other on Geosynchronous Orbits (GEO) and very small number in Middle Orbits (MEO). The high-energy electron and proton

irradiation can produce atomic displacements in semiconductor materials and generate different lattice defects which enhanced process of solar cells degradation.

### 2. DYNAMICS OF DEVELOPMENT OF THE SOLAR CELLS POWER AND EFFICIENCY

The first Si- SC have been produced in 1954 and the first Space Application have been realized in 1958 when Vanguard I was launched.

In period of 1960 – 2008 have been obtained excellence results: 12% - 16% (Si) and 16% - 29% (Si higher performance), 50% (Si Tandem 6j cell), 21% - 24% (GaAs/Ge, 2j cell), 23% - 34% (GaInP/GaAs/Ge, 3j cell), 30% - 45% ( $A^3B^5$  under 500 (1000)) concentration. More important semiconductors for SSC: Si-monocrystalline, Si- polycrystalline and  $\alpha$ - Si, GaAs, GaAs/Ge, AlGaAs/GaAs, InP, GaInP/GaAs, GaInP/GaAs/Ge, GaInP/GaInAs/Ge multi-junctions cells, Tandem Systems [1-3]. The largest application in the Space have Si-SSC [4-6].

### 3. THE SPACE RADIATION DEGRADATION OF SILICON SOLAR CELLS

The Space Radiation degradation of Si-SSC, Light degradation of Si-SSC and Electron-proton degradation of Si-SSC have been investigated by authors [7-12].

#### 3.1. Space Radiation degradation of Si-SSC

The experimental results of NASDA Engineering Test Satellite-V (ETS-V) Solar Cell Monitoring for 10 years (August 27, 1989 – September 12, 1997) are used for understanding of the mechanism of Space Radiation Degradation of Si-SSC [7].

In accordance with SCM results for 10 years in space radiation environment the Si – SSC degraded by approximately 2% each year and GaAs –SSC by approximately 1.5% in dependence of the cell thickness, cell structure, cover-glass thickness, difference of electrodes. Other experiments demonstrated that Si-SSC doped with higher concentration of bromine and oxygen degraded more intensive than samples with lower concentration; Si-SSC doped with Ge are more stable. For the Si-SSC with base field reflection (BSFR) rate of degradation is more than for Si –SSC without base field (BSR).

The investigations in the frame of Project-Thermal Radiation as an Engineering Measurement (DTREM) as a part of the Apollo Lunar Surface Experimental Package (ALSEP) demonstrated that degradation is faster in the first 6 months, degradation is slowly in next 5 years; for the Cells, radiated previously by electrons, degradation is faster; the motivation of degradation on the lunar surface is in radiation defects and UV light [8].

#### 3.2. Degradation of Si Solar Cells under light irradiation

Many authors demonstrated the role of oxygen content and impurity species in radiation defects formation and Si-SSC degradation under light irradiation [9]. The results show the linear dependence of defect concentration and concentration of  $O_i$  and  $B_i$ . It is important to mention that minority charge life time depends not only of oxygen content and impurity

species, but also of regime of temperature treatment of silicon

#### 3.3. Degradation of Silicon Solar Cells under electron and proton irradiation

In these experiments the authors [7] have been studied degradation of Si BSFR solar cells under 1 MeV electron irradiation. The structure of Si-BSFR ( $n^+p-p^+$ ) with p- base layer resistivity of around  $10\Omega\text{cm}$ , junction depth of  $0.15\mu\text{m}$  and cell thickness  $50\mu\text{m}$ .

There are three steps of degradation: 1- gradual degradation under lower fluency irradiation ( $10^{14} - 10^{16} \text{ cm}^{-2}$ ), 2 – an anomalous increase of short-circuit current  $I_{sc}$  ( $2 \times 10^{16} - 5 \times 10^{16} \text{ cm}^{-2}$ ), and 3- abrupt decrease in  $I_{sc}$  and failure of Si cells under higher fluency irradiation about  $5 \times 10^{16} \text{ cm}^{-2}$ .

This results are explicated by the model including changes in minority-carrier diffusion length (for 1-the gradual degradation), carrier concentration (for 3-abrupt decrease in  $I_{sc}$ ) and depletion layer broadening (for 2 – an anomalous increase of short-circuit current  $I_{sc}$ ) [7,8]. But an anomalous increase of short-circuit current  $I_{sc}$  (2) has been motivated and by conduction-type conversion of cell base from p-type to n-type. The structure n-p-p has been converted to n-p. This is confirmed by spectral response. After cells fluency the quantum efficiency at shorter wavelengths becomes almost zero but a weak response is observed at longer wavelengths. This weak response can be as result of conversion of cell structure from  $n^+p-p^+$  to structure n-n-p<sup>+</sup> which has also been confirmed using the electron beam-induced current method [7-9].

#### 3.4. Radiation-induced defects in Si and Si-solar cells

Radiation-induced defects in Si and Si-SC have been studied in many works and are presented in different reviews (Watkins, Boltaks, Corbett, Kimmerling, Bourgoin, Milvidski, Shishiyanu, Smirnov [9]. The explication of the Si-SC degradation is presented by M.Yamaguchi [10,11].

A large concentration of a minority carrier traps with an activation energy of about  $0.18\text{eV}$ , as well as the majority carrier traps around  $E_v + 0.18\text{eV}$  and  $E_v + 0.36\text{eV}$ . The defects at  $E_v +$

0.18eV ( $\sigma \cong 9 \times 10^{-17} \text{ cm}^2$ ) and  $E_v + 0.36\text{eV}$  ( $\sigma \cong 7 \times 10^{-16} \text{ cm}^2$ ) have previously been identified as the bi-vacancy [10,11],  $V-V^+$ , ( $E_v + 0.18-0.23\text{eV}$ ), and interstitial-carbon-interstitial-oxygen complex C-O [12], ( $E + 0.36\text{eV}$ ). The electron trap at  $E_c - 0.18\text{eV}$  is similar to the interstitial-boron-interstitial-oxygen complex B-O [13], ( $E_c - 0.23\text{eV}$ ). The total concentration of these majority-carrier traps and the minority-carrier traps around  $E_c - 0.18\text{eV}$  have been found to be nearly equal to the charge in carrier concentrations. This means that a large concentration of  $E_c - 0.18\text{eV}$  is thought to be responsible for most of the observed compensation as a deep center in Si (conversion of n-p-p in n-n-p SC-structure). The  $E + 0.36\text{eV}$  majority-carrier trap center is thought to also act as a recombination center that decreases minority-carrier diffusion length.

Two step degradation, gradual at low fluence and steep at higher fluence in photoconductivity of bulk Si and solar cells have been investigated by authors [14]. A simultaneous rapid decrease in photocarrier lifetime and the carrier exhaustion is the cause of steep degradation. The drop of lifetime is explained in terms of Fermi-level-dependent recombination cross-section of induced deep centers.

The mechanism of anomalous degradation of  $n^+ - p - p^+$  is discussed in [15]. It has been shown that anomalous increase and abrupt decrease of short - circuit current are caused by corresponding changes of the minority carrier lifetime and conversion of conductivity type from "p" to "n". This is a result of the radiation-induced deep donors.

Authors [16] investigated neutron radiation degradation of polycrystalline silicon solar cells with energy of 2.2 MeV and fluencies  $10^{11}$ ,  $10^{12}$ ,  $10^{13}$  and  $10^{14} \text{ H/cm}^2$ . Have been demonstrated that the polycrystalline silicon solar cells radiation degrade slowly in comparison with mono-crystalline solar cells. This is because the lattice defects serves as getters for radiation defects.

### 3.5. The improvement of the radiation resistance of Si-SSC

The improvement of the radiation resistance and efficiency of space SC is still of great importance. The application of nitrogen-doped

diamond-like carbon (DLC) as fluorescent antireflection layer and protective coatings significant increase the efficiency and proton radiation resistance of SC [17]. The films DLC (a-C:H:N) possess high transparency (low extinction coefficient), high radiation stability, low internal mechanical stresses, high optical band gap (up to 4.0 eV) and can be obtained with very small thickness (50-1500nm). In these experiments has been used proton implantation with energy of 50-150 keV and dose of  $3.3 \cdot 10 \times 10^{15} \text{ cm}^{-2}$  [17].

No degradation of efficiency ( $\eta$ ) and fill factor (FF) for Si-SC with protective film after proton irradiation with energy of 50 and 100 keV and proton fluency  $10^{14} - 10^{16} \text{ cm}^{-2}$ . Degradation is observed for proton energy of 150 keV.

The current-voltage characteristics of Si-SC with two-layer DLC antireflection coatings (measurements at AM1.5 conditions) have been improved- short-current ( $I_{sc}$ ), open-circuit voltage ( $V_{oc}$ ) and fill factor (FF). Authors [17] consider that the SC efficiency improvement after DLC films deposition is related not only with the antireflection effect. The improvement of all parameters can be supported and by passivation of recombination active centers on the SC surface during DLC film deposition and, possibly, by gettering of the defects and impurities from the SC volume.

## 4. RADIATION DEGRADATION OF $A^3B^5$ - SOLAR CELLS

### 4.1. Radiation degradation of $A^3B^5$ - compounds solar cells

The  $A^3B^5$  - Solar Cells have the higher conversion efficiency and better radiation resistance than Si-SC. Therefore solar cells on the base of semiconductors AB (GaAs, InP, GaSb, InGaAs, InGaP, AlInP, InGaAsP etc) are the best for space used- satellite systems, communication, etc. Now the widely use in the space have GaAs-Ge - solar cells, but in the future more perspective for the space use will be two-, three and multi- junction solar cells on the base of the semiconductor compounds [10,11,15,17,18,19]: GaAs, InP, GaSb, InGaAs, InGaP, AlInP, InGaAsP, CuInSe<sub>2</sub> etc.

Differences of radiation resistance of AlGaAs, GaAs and InGaAs cells are found to

be explained by band-gap energy effects on solar cell properties. The surface – layer current density in the solar cells degrades more than base-layer current density in the solar cells made by the lower band-gap energy materials compared to those with the higher band-gap materials. Superior radiation resistance of CuInSe<sub>2</sub> cells found to be explained by higher optical absorption coefficient ( $\alpha$ ) of CuInSe<sub>2</sub>. Better radiation resistance of GaAs and GaSb cells compared to Si cells is related to their higher optical absorption coefficients than that of Si. Superior radiation resistance of InP solar cells is explained by the lower damage constant ( $K_L$ ) of InP compared to other material.

#### 4.2. Superior radiation-resistant properties of InP-related materials and solar cells

The superiority and unique radiation-resistant properties of InP solar cells have been demonstrated by many authors: Yamaguchi, Sibille, Weinberg, Walters, Summers and others [10,11].

Have been demonstrated a superior and unique radiation-resistant properties of InP solar cells compared to Si and GaAs cells [10,11]. Moreover, the unique radiation-resistant properties of InP cells has been found to be further improved under light illumination condition. Light illumination – forward bias-enhanced recovery phenomena of InP solar cells is thought to be attributed to minority-carrier injection-enhanced annealing of radiation-induced defects in InP.

The major defect state introduced by electron irradiation into p-InP is the 0.37eV hole-trap H4, which has been confirmed to be a recombination centers. This defect center in InP is completely annealed out at 190K under minority- carrier injection condition and is thermally annealed out around 100°C.

The major defect centers in GaAs are stable up to 250°C and their main injection-enhanced annealing phenomena are caused in the higher temperature range of 150-200°C compared to those in InP. This shows that superior radiation-resistance of InP solar cells is associated with lower migration (diffusion) energy (1eV) of major radiation-induced defects in InP compared to that (1.75eV) in GaAs [10,11].

Defect center H4 in InP is associated with a point defect such as phosphorous vacancy ( $V_p$ ) because (i) density of H4 defect is independent of carrier (impurity) concentration [10,11], (ii) its threshold electron energy for displacement is about 100keV (atomic displacement energy of 8.8eV) and (iii) the thermal annealing activation energy of 1.02eV for H4 center is close to the migration energy of 1.2eV for nearest-neighbor hopping of phosphorous vacancy  $V_p$ . Other defects as indium vacancy  $V_{In}$  and indium interstitial In which can be annealed at around 150K because the migration energy is very small, 0.26eV [10].

Injection and thermal energies for InP (0.13eV and 1.02eV) are smaller than for GaAs (0.98eV and 1.75eV) and the total defect introduction rate (0.3–2.5 cm<sup>-1</sup>) in InP is smaller than (5.5cm<sup>-1</sup>) in GaAs.

#### 4.3. Radiation degradation of solar cells made from InP- related materials

Radiation resistance of solar cells made with InP-related materials (ternary-InGaP, quaternary-InGaAsP ) is higher than for Si and GaAs [7,10,11,18,19].

It is illustrated that the radiation resistance of solar cells concerning InP-related materials such as InP, InGaP and InGaAsP, measured after 1MeV electron irradiation, is higher in comparison with that of GaAs. This radiation resistance superiority is explained also by lower damage constants of InP-based materials. In our experiments have been reduced of radiation defect concentration and improved of SC reliability by light and photothermal annealing.

#### 4.4. Radiation degradation of A<sup>3</sup>B<sup>5</sup>- multi-junction solar cells

The A<sup>3</sup>B<sup>5</sup> - multi-junction solar cells are characterized as the more superior space solar cells with highest efficiency and radiation resistance [7,10,11,18,19]. The great interest presents the InGaP/GaAs tandem cells with high conversion efficiency of over 30% and 27.5% efficiency InGaP/InGaAs/Ge advanced triple junction space solar cells for high volume manufacturing [15]. The advanced triple-junction has benefited from an improved “blue” response in Ge sub-cell, the addition of indium to the middle cell, and better bulk InGaP quality in the top sub-cell [20].

Authors [21] proposed the method of modeling solar cells degradation in space and the method predicting solar cells degradation in space radiation environment.

Our experiments demonstrated that photothermal processing technology is very important for solar cells efficiency and reliability improvement. By combination of photothermal processing with gettering and precipitation is possible to reduce the radiation defect concentration, improve the electron lifetime and efficiency of solar cells after radiation degradation.

## 5. CONCLUSIONS

The methods of improving of solar cells resistivity to radiation degradation:

1. Initial highest quality of SC – materials, contacts, coating;
2. Doping and purification of materials (Si): O<sub>i</sub>, B, Li, Ge;
3. New composition of the materials: Si +Ge, GaAs +In, Compounds + InP;
4. InP has the highest radiation resistance;
5. InGaP/InGaAs/Ge is in application;
6. Radiation defects and reducing electron lifetime is the cause of SC degradation;
7. Coating improves radiation resistance; the DLC film-Si structures has the highest resistance to radiation degradation;
8. Thermal and photothermal treatment can improve the electron-hole lifetime, the efficiency and reliability of solar cells.

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## CONSIDERATIONS ABOUT OF THE RC LOADED, SINGLE PHASED TRANSFORMER IN PERIODICAL a.c. SWITCHING MODE

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**Abstract** – This is a synthetic paper, presenting the periodical switching of a transformer with RC parallel, working in the steady state. The operation of the transformer is studied using its following models: the T equivalent diagram, the linear magnetization curve and the non-linear magnetization curve (no hysteresis). In the paper are presented the resulted theoretical waveforms, compared with the experimental ones. The study was performed for several (capacitive) load circuits and turn-on angles. The mathematical support was MathCAD PLUS 6.0

**Keywords:** transformer, numerical methods, periodical switching

### 1. INTRODUCTION

The circuit (using a thyristor as switch) is presented in Fig.1.

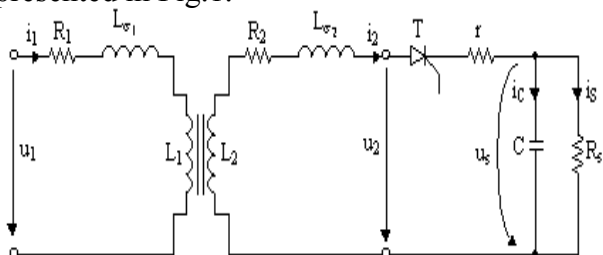


Figure 1: The voltage rectifier

In this study a comparative presentation of the circuit steady state waveforms (obtained using several transformer models) is performed. Experimental and theoretical waveforms were subjects of the comparisons.

The models are the following:

the T series equivalent diagram [1];

the linear transformer (i.e. the core is characterized by a linear magnetization curve) [2];

transformer with a core characterized by a non-linear magnetization curve, without hysteresis cycle [3];

The method used in [1], [2] and [3] consists in: writing the circuit equations, according to each working regime of the switch;

1. writing and solving the corresponding operational equations;
2. determination of the time (original) expressions, corresponding to the operational ones.

The quantities above-mentioned are characterized by the following initial conditions:

- $\alpha_0$  - SCR turn-on (firing) angle;  $\alpha_p$  : natural turn-on angle;  $\beta$  : turn-off angle;
- $I_{S\alpha_p}$  : load current in the  $\alpha_p$  moment;  $I_{S\alpha_0}$  : primary current in the turn-on moment;  $I_{S\beta}$  : load current in the diode turn-off moment;

Mathematical determination of  $\alpha_p$  and  $\beta$  impose to solve transcendental equations. For this reason numerical methods were used. The resulted algorithms were implemented as MathCAD functions. When the difference between two initial conditions consecutive values is less than the imposed accuracy,  $\varepsilon$ , the circuit is considered to be in the steady state regime. The studies were performed in the following conditions:

- the R, L and C are characterized by linear and ideal characteristics;
- the semiconductor elements are ideal;
- the bias voltage is sinusoidal and no



reactance (infinite power);

the transformer is non-saturated (the work empty of the transformer is non-saturated).

The quantities characterizing the transformer models were previously experimentally determined, and the values of the load circuit (RC) and the SCR firing angles that are the input data for the study are the same with the ones used in the measuring circuits.

## 2. THEORETICAL AND EXPERIMENTAL RESULTS AND COMPARISONS

In this section the most important studied quantities. All of them are determined for the three transformer models and will be inserted accompanied by their experimental values.

### 2.1. Angles ( $\alpha_p$ and $\beta$ )

The three theoretical models provided very low error levels, comparing to their experimental values. The  $\alpha_p$  ( $\beta$ ) variation, as a function of  $\alpha_0$  and load  $R_s$  are the following:

The  $\alpha_p$  ( $\beta$ ) angle is an increasing (decreasing) function of the load, for the same value of  $\alpha_0$ ;

The  $\alpha_p$  ( $\beta$ ) angle is a decreasing (increasing) function of  $\alpha_0$ , for the same value of the load.

A SCR type switch can be either a thyristor or a diode. Both cases were studied, providing the following results, in concordance with the

experimental ones: 
$$\begin{cases} \beta_{\text{Thyristor}} > \beta_{\text{Diode}} \\ \alpha_{p\text{Thyristor}} < \alpha_{p\text{Diode}} \end{cases}$$

Taking in account that the circuit operates only respecting the constraint  $\alpha_{p\text{Thyristor}} < \alpha_0$ , the firing angle setting is the result of the diode case, imposing a stronger constraint  $\alpha_{p\text{Diode}} < \alpha_0$ . Results that it is necessary to find first the  $\alpha_{p\text{Diode}}$  value, so diode is not the thyristor particularly case  $\alpha_0 = 0$ .

### 2.2. The primary current

Theoretical waveforms presenting the primary current corresponding to the three transformer models, function of firing angle and load, are shown in Fig.2, 3 and 4.

The study were performed for:

a)  $i_1 = f(\omega t) \Big|_{R; \alpha_0 = \frac{4\pi}{9}}$ ;

b)  $i_1 = f(\omega t) \Big|_{\alpha_0; R=33\Omega}$

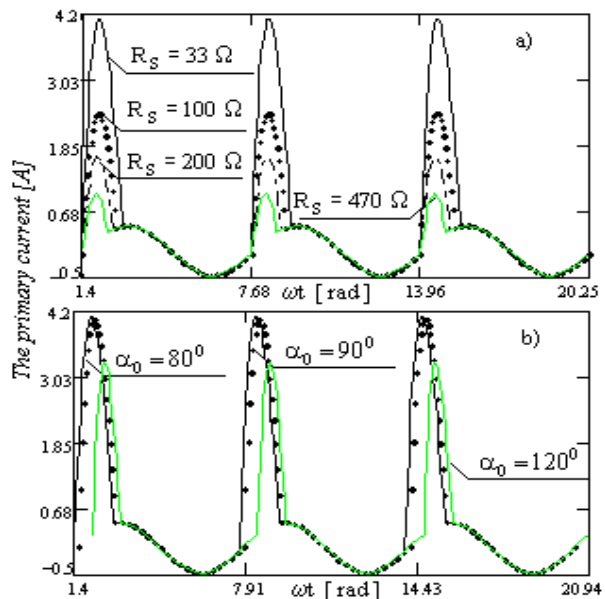


Figure 2 : Variation of the  $i_1$ , resulted by modelling the transformer with the T series diagram

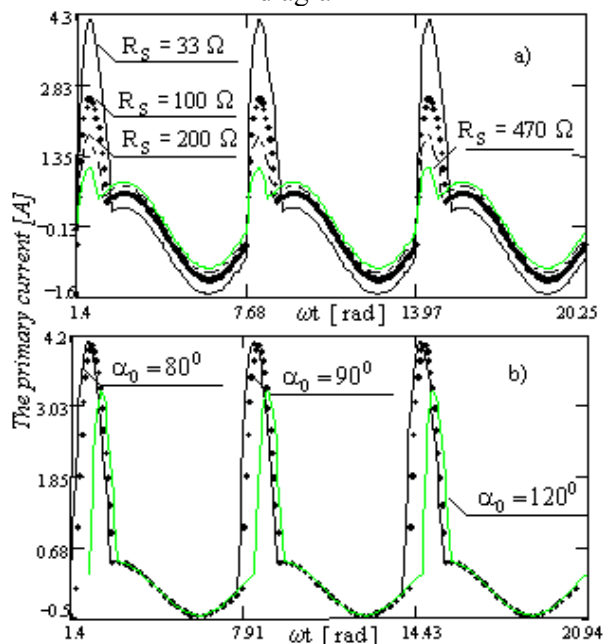


Figure 3 : Variation of the  $i_1$ , resulted by modelling the transformer with the linear model

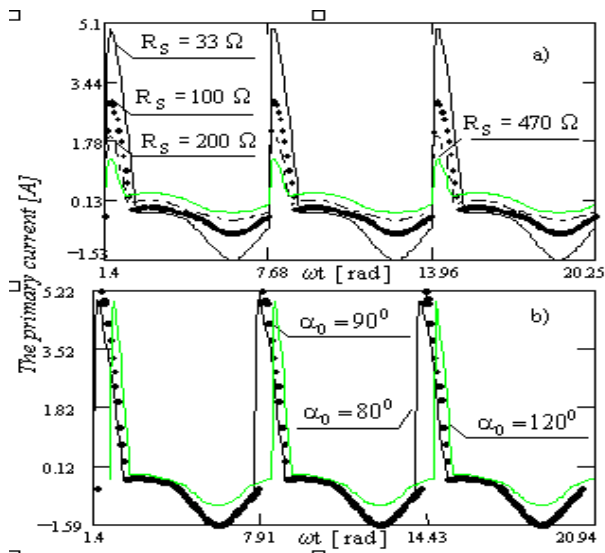


Figure 4 : Variation of the  $i_1$ , resulted by modelling the transformer with the non-linear model

Comparative (theoretical and experimental) waveforms (also for all transformer models studied), corresponding to a selection of firing angles and loads, are shown in Fig. 5, 6 and 7.

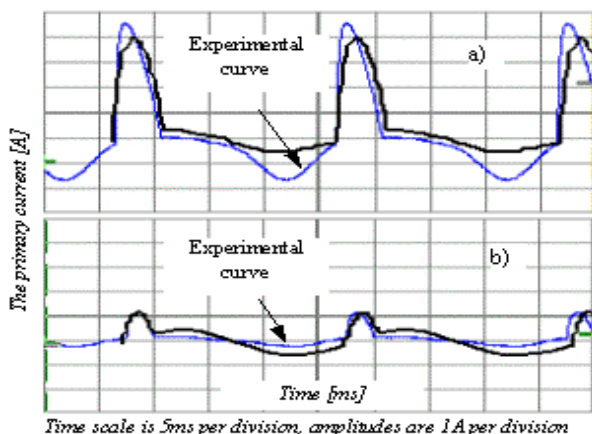


Figure 5 : Comparison of  $i_1$ , resulted by modelling the transformer with the **T series diagram**, and the experimental one

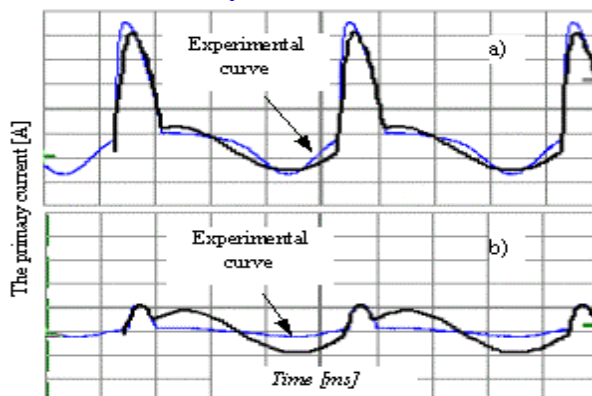


Figure 6 : Comparison of  $i_1$ , resulted by modelling the transformer with the **linear parameters**, and the experimental one

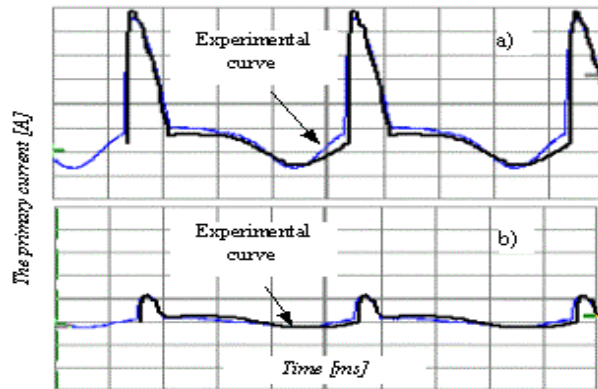


Figure 7 : Comparison of  $i_1$ , resulted by modelling the transformer with the **non-linear parameters**, and the experimental one

The following observation can be derived:

**For T series equivalent diagram:**

the theoretical and experimental waveforms are similar, but the relative error level is very high (specially in the SCR turn-off period, because this model is insensitive to the load variation);

the theoretical extreme values variation, function of load (R) and firing angle  $\alpha_0$  is not the same with the experimentally determined one.

**For the linear transformer:**

the theoretical and experimental waveforms are similar, but the relative error level is high enough (specially in the SCR turn-off period, this model being however more sensitive to the load variation during this time than the previous one);

the theoretical extreme values variation, function of load (R) and firing angle  $\alpha_0$  is the same with the experimentally determined one.

**For the transformer with a core characterized by a non-linear magnetization curve, (without hysteresis cycle):**

the theoretical and experimental waveforms are quite identical, and the relative error level is at least acceptable;

the theoretical extreme values variation, function of load (R) and firing angle  $\alpha_0$  is the same with the experimentally determined one

**2.3. The secondary current**

Theoretical waveforms presenting the secondary current corresponding to the three transformer models, function of firing angle and load, are shown in Fig. 8, 9 and 10.

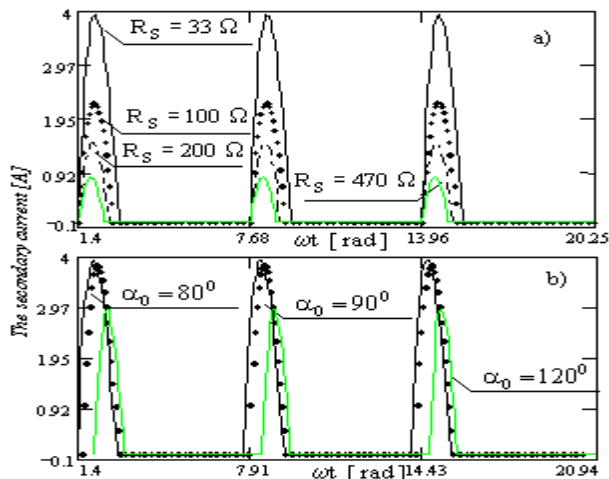


Figure 8 : Variation of the  $i_2$ , resulted by modelling the transformer with the T series diagram

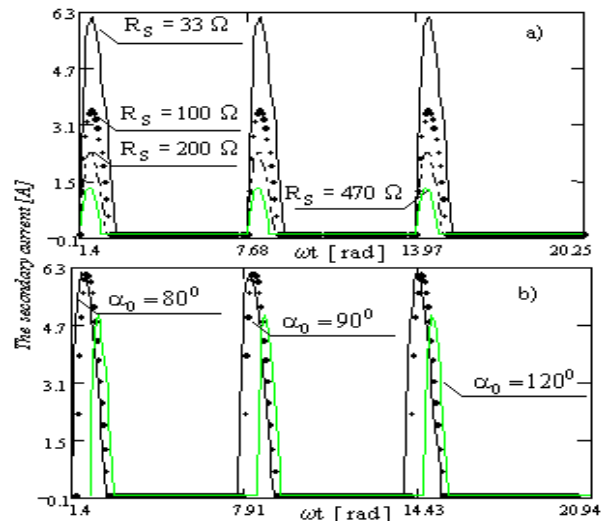


Figure 9 : Variation of the  $i_2$ , resulted by modelling the transformer with the linear model

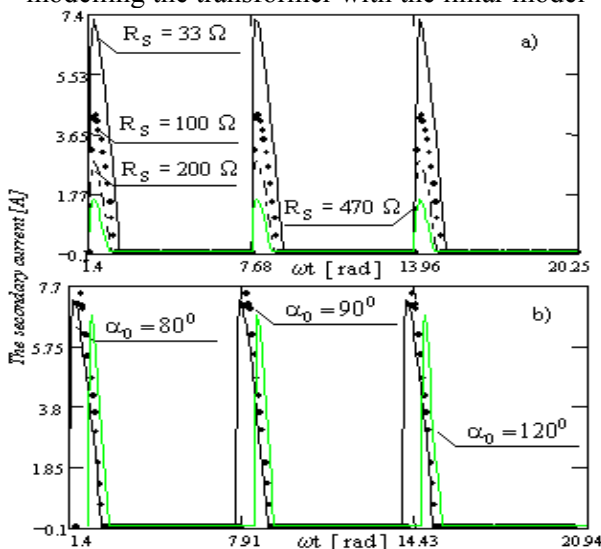


Figure 10 : Variation of the  $i_2$ , resulted by modelling the transformer with the non-linear model

Comparative (theoretical and experimental) waveforms, corresponding to a selection of firing angles and loads, are shown in Fig 11, 12 and 13.

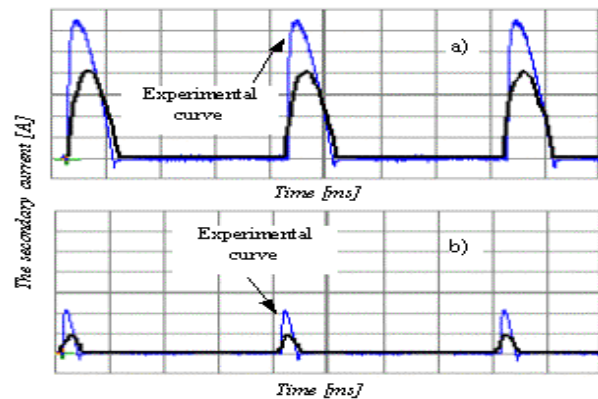


Figure 11 : Comparison of  $i_2$ , resulted by modelling the transformer with the T series diagram, and the experimental one

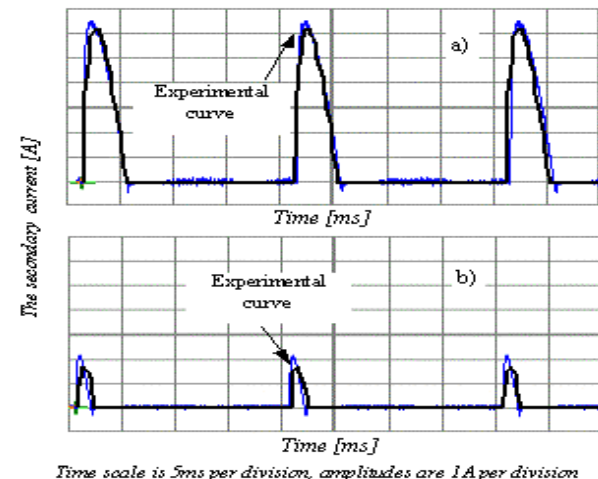


Figure 12 : Comparison of  $i_2$ , resulted by modelling the transformer with the linear parameters, and the experimental one

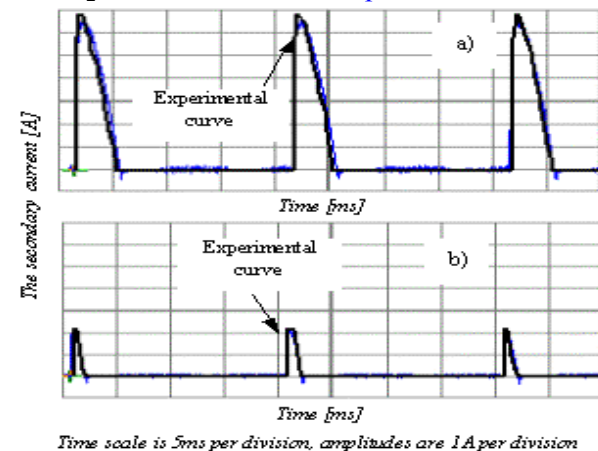


Figure 13 : Comparison of  $i_2$ , resulted by modelling the transformer with the non-linear parameters, and the experimental one

The following observation can be derived:

The theoretical secondary current waveforms and the experimental ones are similar for the T series diagram and identical for the others;

The relative error level is high for the T series diagram model and at least acceptable for the linear and non-linear transformer;

The theoretical peak values variation, function of load (R) and firing angle is the same with the experimentally one only for the non-linear transformer.

#### 2.4. The load voltage

Theoretical waveforms presenting the load voltage corresponding to the non-linear transformer model, function of firing angle and load, are shown in Fig. 14.

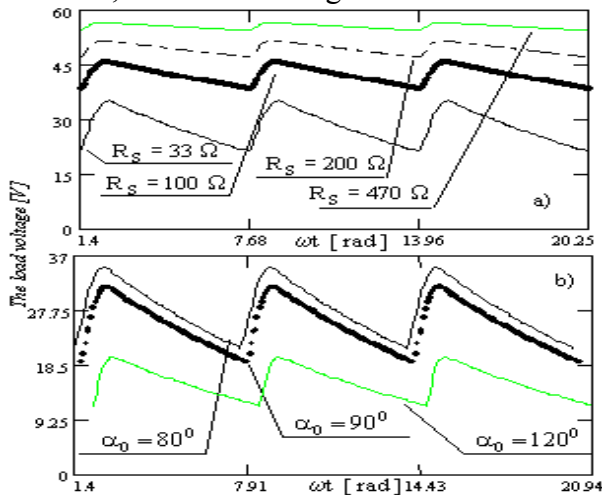
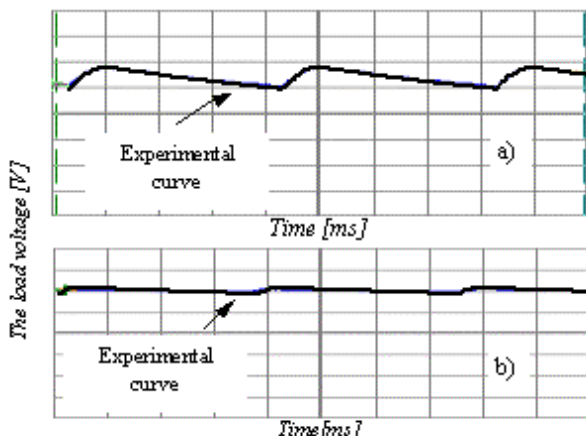


Figure 14 : Variation of the  $u_s$ , resulted by modelling the transformer with the non-linear model



Time scale is 5ms per division, amplitudes are 20 V per division

Figure 15 : Comparison of  $u_s$ , resulted by modelling the transformer with the **non-linear parameters**, and the **experimental** one

Comparative (theoretical and experimental) waveforms (for the non-linear transformer model), corresponding to a selection of firing angles and loads, are shown in Fig. 15.

All the three transformer models provide theoretical load voltage waveforms identical with the experimental ones and a very low error level. It is a confirmation of the statement saying that a transformer can be considered as an a.c. voltage source from the load circuit point of view.

### 3. CONCLUSIONS

As a conclusion the following observation can be derived: the periodical acswitching mode study of the transformer using the non-linear model, provides signals whose shape and values are close enough to the ones obtained by laboratory experiments.

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## BROADBAND MICROWAVE ANTENNAS

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***Abstract:** The paper is focused on the problem of designing and measuring microwave planar antennas intended to be used in personnel communication systems. More explicit, the authors, working under the umbrella of a Ministry of Education scientific project (SCIEP), are in the way to find a solution to the problem of making antennas suited for functioning in the 400 MHz-2500 MHz frequency range, in the wearable conception, to be integrated in the soldier protection equipment. There are presented some solutions, the corresponding measurements, dealing mainly with the CPW antennas, which have been proved to be more adapted to the application.*

### 1. INTRODUCTION

Individual protection equipments and/or clothes are a special part of our personal environment.

Incorporating intelligence into the clothes / individual protection equipment, by making electronic devices and systems to be part of the clothes (i.e. to be “distributed” into the clothes), makes the access to the electronics easier, resulting a friendlier and more efficient man-machine interaction, compared to the use of the “concentrated” communication systems. On the other hand, developing the possibilities to integrate communication systems into the individual protection equipment (clothes, generally speaking) is a major interest direction in order to increase security, masking and maneuver capacities of the individuals accomplishing dangerous missions (tactical space operating troops, workers dealing to isolated or critical environments, saving personnel, etc.).

All these situations necessitate existence and maintaining the communication capabilities at the highest possible level, which is vital form real-time mission accomplishment, with the lowest possible level of affecting or interfering the main individual effort.

One very important part of any communication systems, wearable or not, is the antenna (or, very often, the antenna system). In this field,

the development of wireless personal communications systems and services has caused a great demand in designing multi-band and/or broad band antennas that has operate, according to specific requirements, including hard environmental conditions.

### 2. ANTENNA SYSTEM REQUIREMENTS

The antennas presented in this paper were firstly developed in the frame of an MoD/METRA project and, after gaining some experience, in the frame of the multiyear Ministry of Education project, namely SCIEP (i.e. CSIPE - Communication System Integrated in the Protection Equipment), begun last year.

A very important issue is the co-operation between METRA and IRCTR from TUDelft, is the WiSE project, developed at IRCTR, and sharing with METRA’s past and present above mentioned projects a very important common scientific frame and specific tools.

The general objective of the SCIEP project is to develop an antenna system for satellite, GPS and radio- communications, at tactical level, to be easily integrated in different parts of the soldier (fighter) individual protection equipment

According to the SCIEP project documents, the antenna system has to meet the following requirements:

- antenna system structure has to insure spatial coverage characteristic to the omni-directional or quasi-omni-directional systems:
  - vertical and horizontal coverage angle (at 3 dB, power): max 120°;
  - gain: max 3 dBi;
- to be integrated in the individual ballistic protection equipment (helmet, bullet-proof, other parts of equipment, etc.) in order to reduce the weight and the size of the antenna systems which are in present use and to make possible a better masking of the individual communication systems;
- to operate simultaneously in the following frequency bands, used by the tactical space communication systems:
  - 225 - 400 MHz (UHF band – for tactical space acquiring systems);
  - 1227,60 MHz  $\pm$  5 MHz (satellite communications for GPS PPC coding system);
  - 2480 - 2530 MHz (multimedia communication system needed for transmitting complex information about fight space);
  - other ISM bands (5800 MHz  $\pm$  75 MHz);
- voltage standing wave ratio (VSWR) of max 2:1.
- to establish the types of elementary radiators which can be used in wearable-like applications, including those ones supposing special environmental conditions;
- practical realization of those elementary radiators which have resulted to be possibly used in wearable-like applications;
- to establish the optimized wearable antenna networks;
- to realize a wearable, conformal, electronic scanning, broadband antenna system, in at least two variants;
- to realize a technological demonstrator for a wearable communication system, integrated into the individual protection equipment.

### **3. PRESENT PROJECT ACHIEVEMENTS**

In order to develop a wearable antenna system, METRA established a consortium with INCDFM (National Institute for Material Physics) and STIMPEX (individual ballistic protection equipment developer and producer). Up to now, the SCIEP project team has accomplished some important phases

- studies on antenna (viewed as elementary radiators) which can be integrated in the individual protection equipment
- design and practical realization of some radiators

From above mentioned studies and many simulations and analysis, two different elementary radiators seemed to be good candidates for being practically realized

- narrow-band / multiple frequencies elementary radiator;
- wide-band elementary radiator.

The antennas are presented in fig. 1:

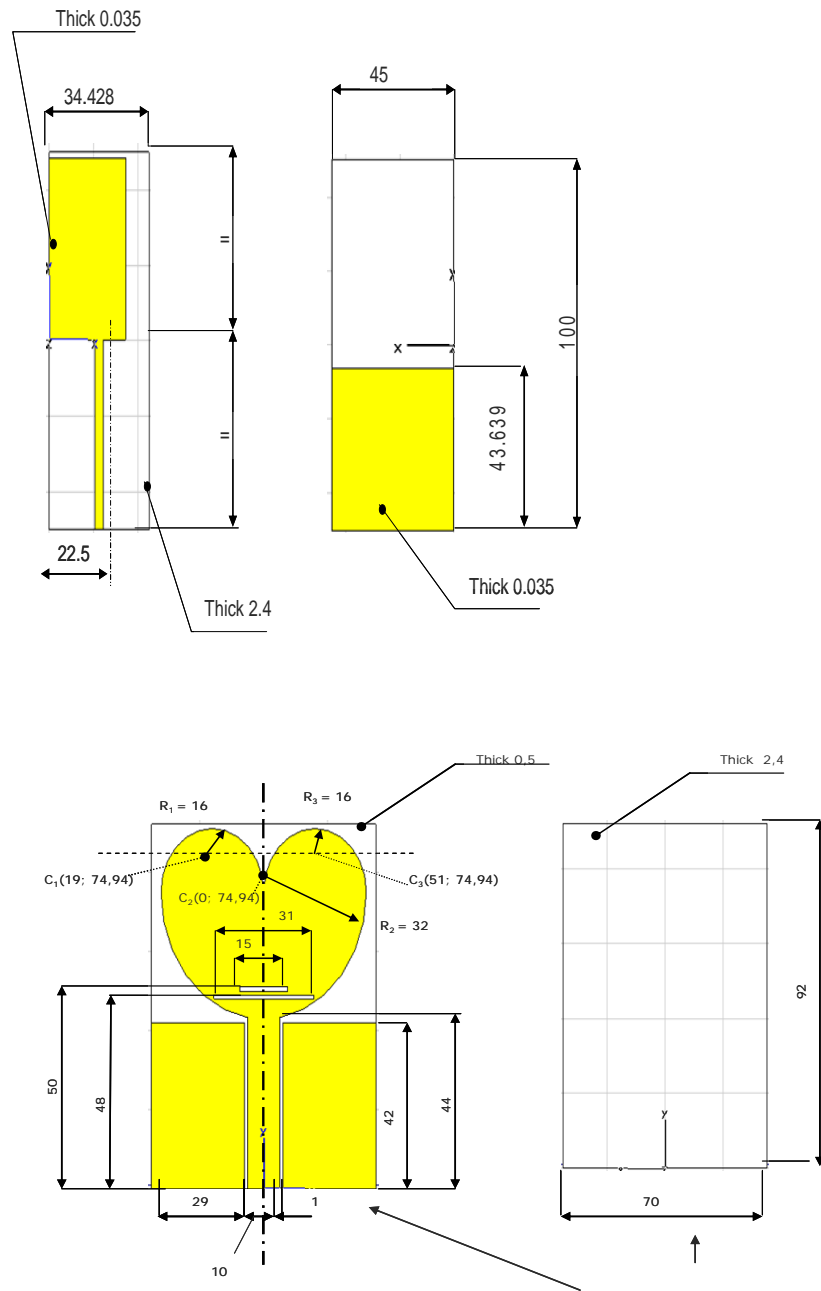
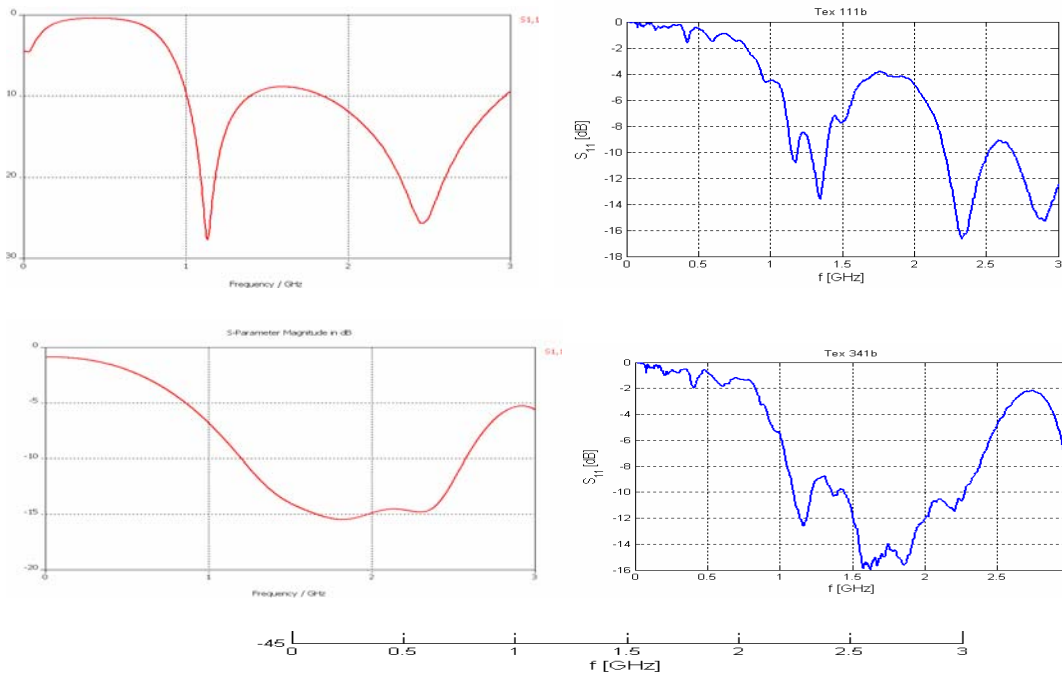


Fig. 1 Proposed antennas: main drawings and final aspect

## Results and discussion

The presented antennas were tested through a measurement campaign, deployed at TUDelft/IRCTR, using the DUCAT (Delft University Chamber Antenna Test) facilities. Evaluation is still in progress, but some preliminary work is available, as presented (partially) in fig. 2:



**Fig. 2** Proposed antennas: simulations and measurements results ( $S_{11}$ )

The results, even partially, show a relatively good agreement between simulations and measurements.

The existing differences are due to the fact that, in the process of simulation, some factors were neglected (connections) or not fully taken into consideration (dielectric anisotropy, algorithm accuracy, etc.).

On the other hand, the narrow-band antenna was designed only for two of the four required bands, the main problem, the coverage of the lower band (around 300 MHz) being yet opened.

#### 4. CONCLUSIONS

As one can easily see, there is some degree of agreement between design and measurements. However, things are quite far from being solved.

That's why, based on the designer gained experience, and by co-operation with the other members of the IRCTR WiSE team, we are designing a new elementary radiator, to fully accomplish the projects requirements.

Another important issue is to test the wearability of the proposed antennas. One approach is to simply apply them on some of

pieces of the ballistic protection equipment. There is also, another approach, namely re-designing the antennas using as a substrate the material for ballistic protection. The project team is already acting in this direction, but more complex measurements on material electrical characteristics have to be carried out; also, designing the antenna on a high losses and anisotropic material will be, in our opinion, a major challenge, but also, the conformal character of the final antennas and the influence of the human body and of the EMC factors.

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## EVALUATION OF THE SHIELDING EFFECTIVENESS OF A MULTIMODE METALLIC CAVITY

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***Abstract:** Electronic equipment can be effectively shielded by the use of a conductive barrier placed between the source of electromagnetic waves and the equipment to be shielded. This paper describes a work, which is part of a collaborative program between METRA (Military Equipment Technology & Research Agency) and NIMP (National Institute for Materials Physics), and covers some aspects of the design optimization, from the EMC point of view, of a shield for a portable computer.*

### 1. INTRODUCTION. SHIELDING EFFECTIVENESS EVALUATION

Shielding is an essential part of an EMC design. Commonly, a shield is regarded as an enclosure containing a number of circuits, power supplies and printed circuit boards. The shield can be viewed, also, as the last obstacle to internally generated emissions before they are released into the external environment, and the first obstacle to external interference preventing it from reaching the internal circuits.

A common idea among EMC specialists is that excessive shielding is an indication of inadequate attention being paid to other aspects of EMC design and that it is therefore an admission of defeat. Circuits must be designed to minimize emissions and maximize their immunity to interference. However, in practice, one can't be sure that a product will not experience excessive interference either as a result of unexpected circumstances (such as accidental changing of static or dynamic operating regime of some electronic components or circuits), or due to the

negligence of others. Designing a good shield therefore provides a means of controlling interference which is under the designer's control and is relatively immune to external factors.

There are several mechanisms which make a shield less than perfect:

- a. diffusion through the shield wall
- b. coupling through wires penetrating the shield
- c. penetration through apertures

For a highly conducting shield, mechanism (a) is not significant when (b) and/or (c) are present, except at low-frequencies and for magnetic fields. Mechanism (b) is significant but is less dependent on shield design than on filtering and bonding at the entry point. Mechanism (c) is significant and strongly influenced by shield design and it is thus the focus of this presentation.

Electronic equipment can be effectively shielded by the use of a conductive barrier placed between the source of electromagnetic waves and the equipment to be shielded as shown in Figure 1.

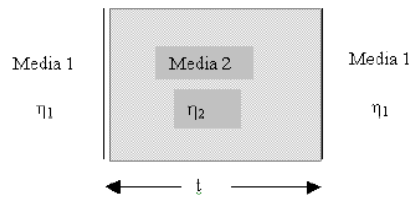


Fig. 1 General representation of an electromagnetic shield

The shielding effectiveness (SE) factor may be expressed as the ratio of the transmitted field magnitude to the incident field magnitude. The shielding effectiveness figure may be expressed as:

$$SE = 20 \log \left( \frac{E_0}{E_s} \right), \quad \langle dB \rangle \quad (1)$$

Magnetic shielding effectiveness is similarly defined.

A good conductor is where  $\sigma \gg \omega\epsilon$  (conduction current > displacement current), a good dielectric is where  $\omega\epsilon \gg \sigma$  (displacement current > conduction current), a perfect conductor is where  $\sigma \rightarrow \infty$  but  $\epsilon$  and  $\mu$  are finite and all time-varying fields are zero, a lossless medium is where  $\sigma = 0$  (perfect dielectric) but  $\epsilon$  and  $\mu$  are finite. In free space  $\mu = \mu_0$ ,  $\epsilon = \epsilon_0$ ,  $\rho = 0$  and  $J = 0$  (the free current density).

Considering the situation shown in Figure 1, respectively a shield (Media 2) inserted in some media (Media 1), if media 1 is the air, the permeability, permittivity and conductivity can be taken to be approximately the same as that of free space.

## 2. NUMERICAL MODELING OF AN ELECTROMAGNETIC SHIELD SEEN AS A MULTIMODE CAVITY

The main purpose of our work, presented in this paper, was to estimate the shielding performances of a metallic box, designed to protect, both TEMPEST and EMC, a personal portable computer, based on simulations carried out using a derivation of FDTD general method.

Simulations were carried out in order to make an evaluation of some really occurring situations, including the existence of both some accidental discontinuities (mainly rectangular, or quasi-rectangular slots) - which can be eliminated by use of proper technology and unavoidable discontinuities (mainly holes) having various destinations (technological, heating / ventilation, etc.)

Each one of the above mentioned discontinuities has some degree of influence on the magnitude and directional characteristics of the parasitic (unwanted) field radiated by the shield, influence that were evaluated through simulations.

The shielding box, used for simulations purposes, has the shape and dimensions presented in figure 2.

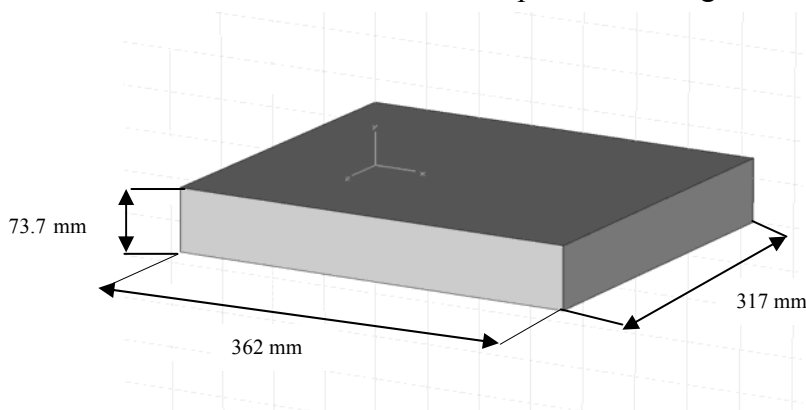
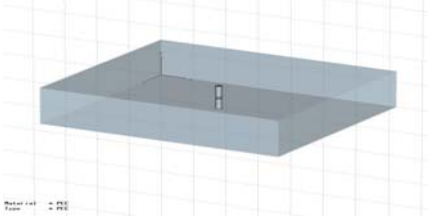
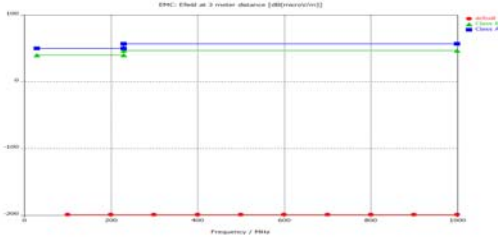
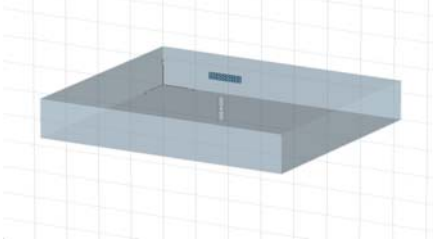
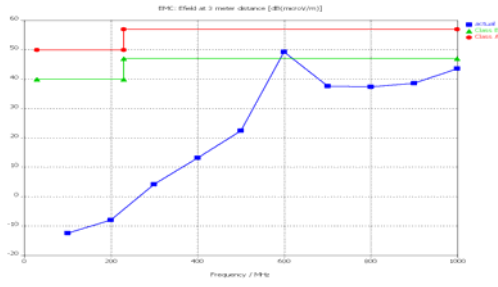
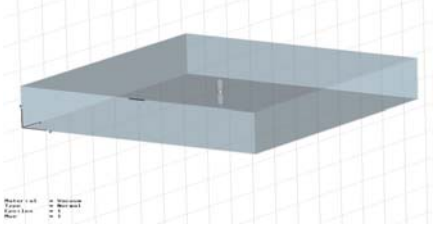
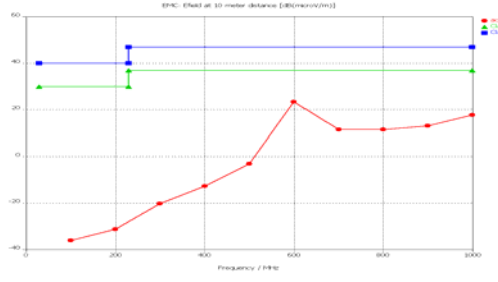
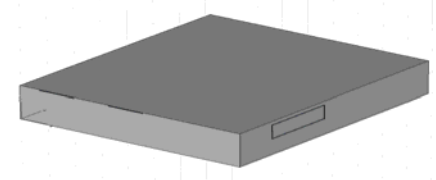
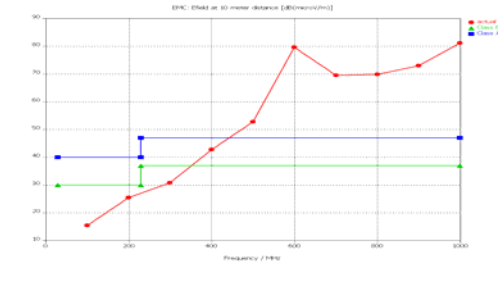


Fig. 2 The shielding box used for EMC and TEMPEST protection of a laptop: shape and dimensions

The results of the simulations, carried out by a software based on the FDTD method, are synthesized in table 3.

Table 3

The shielding box (in different situations)	$f_0$ (shield res. freq., MHz)	The radiated field at 3 m (E component)
 <p>Ideal shield</p>	615.6	
 <p>33 holes, having 2 mm diameter each, on three rows</p>	615.02	
 <p>one slot</p>	615.02	
 <p>two slots plus a continuous slot acting as a DVD contour</p>	612,99	

### 3. CONCLUSIONS

This paper describes a work that covers some aspects of the design optimization, from the EMC point of view, of a shield for a portable computer.

There are several mechanisms which make a shield less than perfect:

- a. diffusion through the shield wall
- b. coupling through wires penetrating the shield
- c. penetration through apertures

Simulations which results were presented in the paper were carried out in order to make an evaluation of some really occurring situations, including the existence of both some accidental discontinuities (mainly rectangular, or quasi-rectangular slots) - which can be eliminated by use of proper technology and unavoidable discontinuities (mainly holes) having various destinations (technological, heating / ventilation, etc.).

Based on the presented simulations, one can see that the shielding structure has an own resonance frequency, the value of it is important to be known, in conjunction with the frequency of the signals existing and propagating into the electronic equipment

shielded, in order to take the appropriate measures in the design and implementation of the shield and the electronic equipment shielded, viewed as an assembly.

The simulations pointed out the fact that, when slots and holes are present in the shield, the shielding box - with the electronic equipment in it - has a radiating behaviour, acting like an antenna.

The level of the radiating electromagnetic field can be controlled, in order to be maintained below the limits from both EMC and TEMPEST standards, by proper use of radiofrequency and microwave simulation techniques and by a good design and technology.

# DESIGN AND IMPLEMENT OF DIGITAL ASYNCHRONOUS SYSTEMS USING VERILOG HDL

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**Abstract:** In present paper, the author propose a mehod for design and implement of asynchronous digital systems using Verilog HDL (Hardware Description Language). In the design of the system are used different types of logic components as D type latches, logic gates. which are implemented using the Verilog HDL, gate level description.

**Keywords:** Digital logic, Finite State Machine, Fluence Graph, D Latch, Transition Table, FPGA – Field Programable Gates Array, Verilog HDL.

## 1. INTRODUCTION

Driving an asynchronous digital system is a such complex task instead synchronous systems. The author propose a method for synthesis of the asynchronous digital systems using Verilog HDL – Hardware description language, [4,5,6]. The proposed method presented in this paper has many features like:

- execution speed much better;
- maximize the combinational/sequential digital logic
- maximize the design performances (speed, low power, size)

A such of system is presented in figure 1. It contains the combinational logic modules, D type latches, input signals named input1,input2...inputN, output signals named output1,output2.....outputM, state variables named s1,s2...sk. The combinational system which implements an internal drive in signal, it is used for controll the states of the digital system, disposal the hazard phenomenon from the digital systems. The entire system transit into a new state driving by the input signals which need to be stabile a period of time before changed and by the present states of the system, [1,2,3].

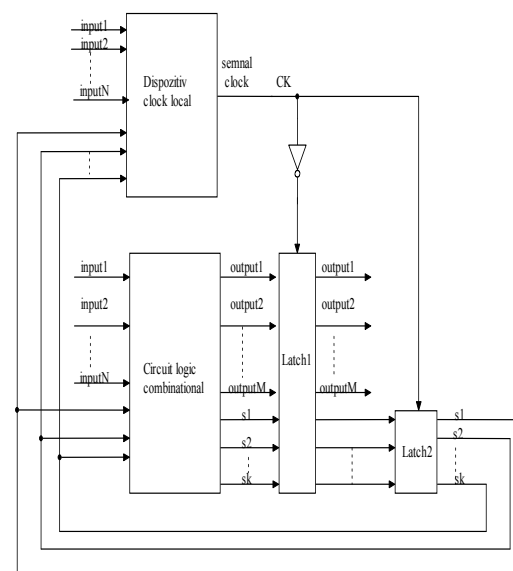


Fig.1. Digital Asynchronous System

In figure 1 it's shown the consist modules of the digital system:

- drive in signal device;
- combinational system who implements the system states equation ;
- D type latch1, latch2 are used to memorise the state of the system and also the outputs of the system;



```

input x1,x0,y1,y0;
output CK;
wire CK,x1_n,x0_n,y0_n;
wire ck1,ck2,ck3;

not(x1_n,x1);
not(x0_n,x0);
not(y0_n,y0);

and(ck1,x1_n,y0);
and(ck2,x1,y0_n);
and(ck3,x0_n,y1,y0_n);
or(CK,ck1,ck2,ck3);

endmodule

//D latch - no RESET (D – data intrare, Q-
stare)
module D_latch_noRST(D,Q);
input D;
output Q;
wire Q;
wire D_n,H_n,Q_n;

not(H_n,H);
not(D_n,D);
nor(Q,Q_n,D_n);
nor(Q_n,Q,D);

endmodule

//delay D latch-----modul nesintetizabil (H-
variabila clock, RST –reset, Q_H - stare)
module d_delay_latch (H,RST,Q_H);
input H,RST;
output Q_H;
wire Q_H;

D_latch_noRST ddnorst(.D(H),.Q(Q_H));
if Q_H=1 then after 20ns RST=1;
specify
if(Q_H)
(RST=>Q_H)=20;
endspecify

endmodule

//CLC D1z module (x1,x0 – variabile intrare,
y1,y0 – codificare stari, D1z-iesirea z1)
module CLC_D1z(x1,x0,y1,y0,D1z);
input x1,x0,y1,y0;
output D1z;
wire D1z,x1_n,x0_n,y1_n;

not(x1_n,x1);
not(x0_n,x0);
not(y1_n,y1);

and(D1z,y1_n,y0,x1_n,x0_n);

endmodule

//CLC D0z module (x1,x0 – variabile intrare,
y1,y0 – codificare stari, D0z-iesirea z0)
module CLC_D0z(x0,y1,y0,D0z);
input x0,y1,y0;
output D0z;
wire x0_n,y0_n,D0z;

not(x0_n,x0);
not(y0_n,y0);

and(D0z,x0_n,y1,y0_n);

endmodule

//CLC input latch D1_m (x1,x0 – variabile
intrare, y1,y0 – codificare stari, MD1z-iesirea
latch //D1_m)
module CLC_MD1(x1,x0,y1,y0,MD1);
input x1,x0,y1,y0;
output MD1;
wire MD1,x0_n,y0_n,p1,p2,p3;

not(x0_n,x0);
not(y0_n,y0);

or(p2,x1,x0);
and(p1,y1,p2);
and(p3,x1,x0_n,y0_n);
or(MD1,p1,p3);

endmodule

//Full system design
module full_lc_system(R,x1,x0,z1,z0);
input R,x1,x0;
output z1,z0;
wire z1,z0;
wire
Q_H_n,D1z,D0z,MD1,MD0,z1_n,z0_n,y1,y1_
n,y0,y0_n,q1,q0;

```

```
//call CLC CK module
CLC_CK Hck(x1,x0,y1,y0,H);

//call d_delay_latch module
d_delay_latch d_delay(H,RST,Q_H);

//call CLC D1z module
//CLC_D1z(x1,x0,y1,y0,D1z)
CLC_D1z
d1z(.x1(x1),.x0(x0),.y1(y1),.y0(y0),.D1z(D1z)
);

//call CLC D0z module
//CLC_D0z(x1,x0,y1,y0,D0z)
CLC_D0z
d0z(.x0(x0),.y1(y1),.y0(y0),.D0z(D0z));

//call CLC D1_m latch
//CLC_MD1(x1,x0,y1,y0,MD1)
CLC_MD1
md1(.x1(x1),.x0(x0),.y1(y1),.y0(y0),.MD1(M
D1));

//call CLC D0_m latch
assign MD0=x1;
not(Q_H_n,Q_H);
//not(z1_n,z1);
//not(z0_n,z0);
//not(y1_n,y1);
//not(y0_n,y0);
//latchD(R,D,CK,Q,Q_n);
//Q_H => clock signal with delay
latchD
dd1z(.R(R),.D(D1z),.CK(Q_H_n),.Q(z1),.Q_n
(z1_n));
latchD
dd0z(.R(R),.D(D0z),.CK(Q_H_n),.Q(z0),.Q_n
(z0_n));
latchD
ddm1(.R(R),.D(MD1),.CK(Q_H_n),.Q(q1),.Q
_n(q1_n));
latchD
ddm0(.R(R),.D(MD0),.CK(Q_H_n),.Q(q0),.Q
_n(q0_n));

latchD
dds1(.R(R),.D(q1),.CK(Q_H),.Q(y1),.Q_n(y1_
n));
```

```
latchD
dds0(.R(R),.D(q0),.CK(Q_H),.Q(y0),.Q_n(y0_
n));
endmodule
```

### 3. CONCLUSIONS

- The drive in signal and the output signals must be free of logic hazard in order to meet the system run concordant with the specifications;
- The minimum propagation delay of drive in signal through the combinational system must be greater than the maximum propagation delay for every logic circuit which implements the input/output signals.
- The digital asynchronous system can be implemented using Verilog HDL language.

### 4. REFERENCES

- [1] Steven Mark Nowick . Automatic Synthesis of Burst-Mode Asynchronous Controllers. Technical Report, December 1995.
- [2] C. Roth. Principles of Fundamental Logic Design. New York, 1995.
- [3] Chris J. Myers. Asynchronous Circuit Design. John and Soons, Inc. 1995.
- [4] Alexandru Valachi, Radu Silion, Mihai Timiș . Improvement of FSM Synthesis using MSI and LSI circuits. 8<sup>th</sup> International Symposium on Automatic Control and Computer Science, Iasi, 2004.
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## SYNTHESIS OF THE ASYNCHRONOUS DIGITAL SYSTEMS USING RECONFIGURABLE DEVICES

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**Abstract:** In present paper, the authors propose a method for synthesis of the asynchronous digital systems using FPGA (Field Programmable Gates Arrays) reconfigurable devices.

**Keywords:** Digital logic, FSM, Fluence Graph, D Latch, Transition Table, FPGA – Field Programable Gates Array, Verilog HDL, ChipScope Pro, JTAG, Xilinx ISE.

### 1. INTRODUCTION

Driving an asynchronous digital system is a such complex task instead synchronous systems. The authors propose a method for synthesis of the asynchronous digital systems using Verilog HDL, and implement them into FPGA devices, [1,2,3]. The proposed method presented in this paper has many features like:

- execution speed much better;
- maximize the combinational/sequential digital logic
- maximize the design performances (speed, low power, size)

A such of system is presented in figure 1. It contains the combinational logic modules, D type latches, input signals named input1,input2...inputN, output signals named output1,output2.....outputM, state variables named s1,s2...sk. The combinational system which implements an internal drive in signal, it is used for controll the states of the digital system, disposal the hazard phenomenon from the digital systems. The entire system transit into a new state driving by the input signals which need to be stabile a period of time

before changed and by the present states of the system.

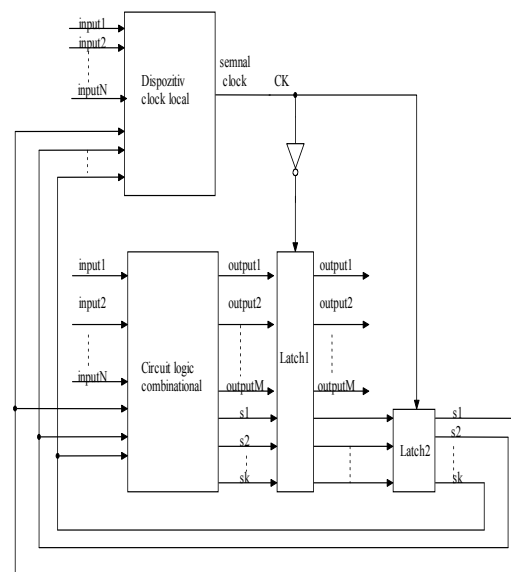


Fig.1. Digital Asynchronous System

In figure 1 it's shown the consist modules of the digital system:

- drive in signal device;
- combinational system who implements the system states equation ;



- 9-pin RS-232 Serial Port;
- DB9 9-pin conector (DCE conector);
- RS-232 transceiver/level translator;

Figure 4 presents the developing board which has loaded into FPGA chip the design of the asynchronous digital system.

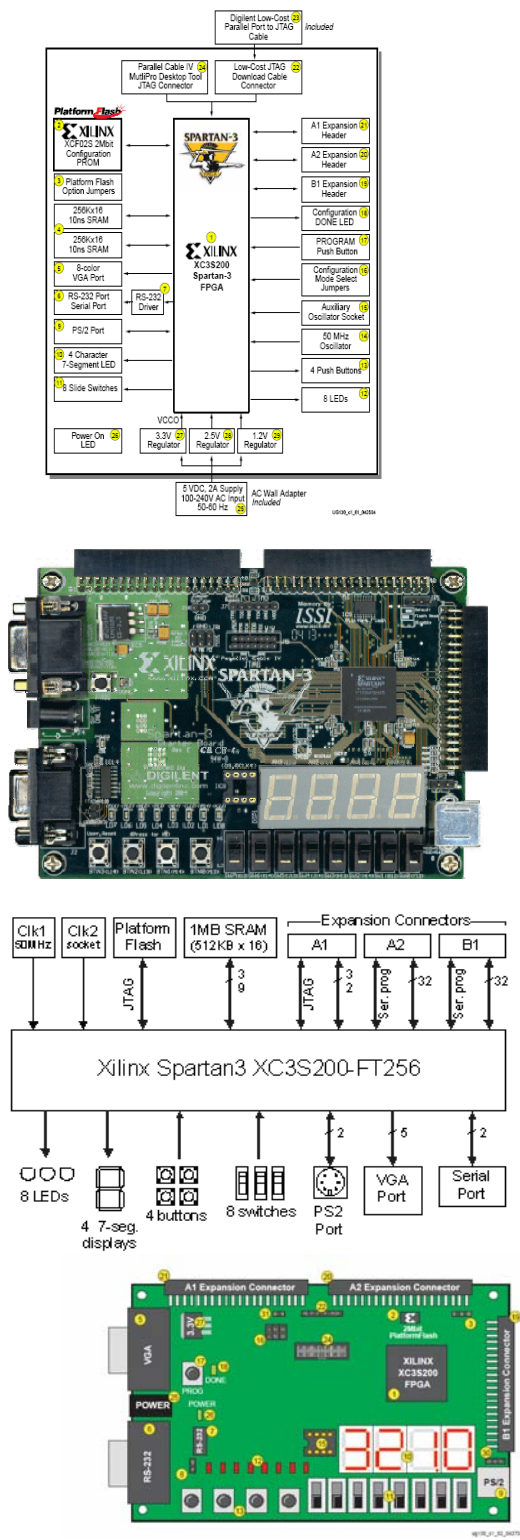


Fig. 3. Spartan 3E bord

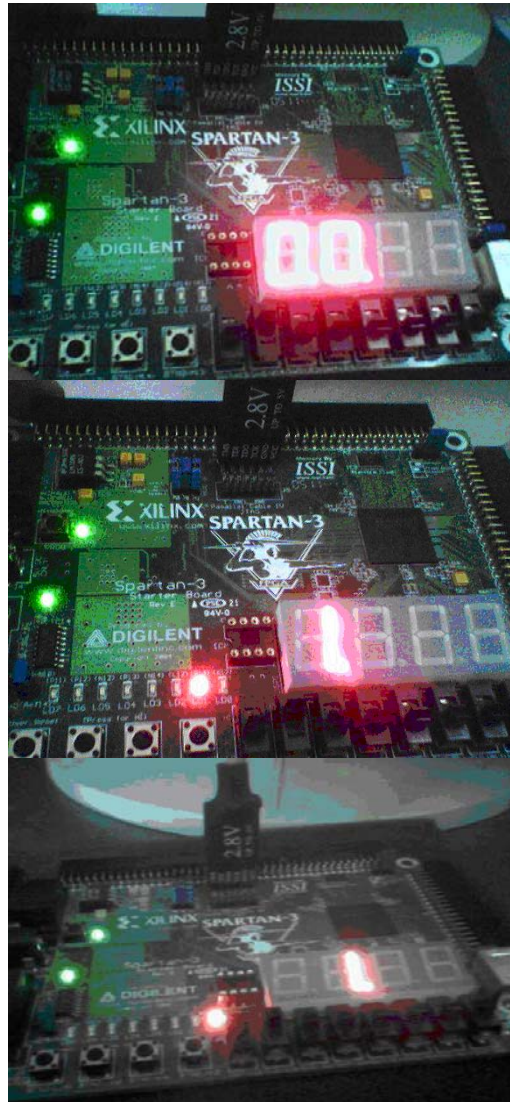


Fig. 4. Testing the design

Obs. For generating the input CK signal, we used the SW7(CK) switch form the developing board. Following this way, the results can be observed much better.

The developing board used contains 8 leds – Led[7:0], 4 digital displays –An[3:0], 8 switches –Sw[7:0]. From all of these, we used:

- 2 leds ( Led(z1) – display the z1 asynchronous digital system output; Led(z0) – display the z0 asynchronous digital system output );
- 2 digital displays ( An1(z1) – display the z1 asynchronous digital system output; An0(z0) – display the z0 asynchronous digital system output );

- 4 switches ( SW7(CK) – CK input values, SW6(Res) – Reset input values, SW5(x1) – x1 input; SW4(x0) – x0 input );

In figure 5- the first image, can be observed that the z1, z0 output signals are 00 which means that An1, An0 presents the 0 values, the Led1, Led0 are off (0 logic- off). The corresponding output values are z1z0=00;

Second image – following the sequence input signals x1, x0 values from the transition table which will trigger the output z1, the output z1=1 means that An1 will display value of 1, An0 will be off. The Led1=on (1 logic- on), Led0=off (0 logic- off). The corresponding output values are z1z0=10;

Third image - following following the sequence input signals x1, x0 values from the transition table which will trigger the output z0, the output z0=1 means that An0 will display value of 1, An1 will be off. The Led1=off (0 logic- off), Led0=on (1 logic- on). The corresponding output values are z1z0=01;

Figure 5 shows the timing diagram signals, read directly from the FPGA chip, using the JTAG protocol.

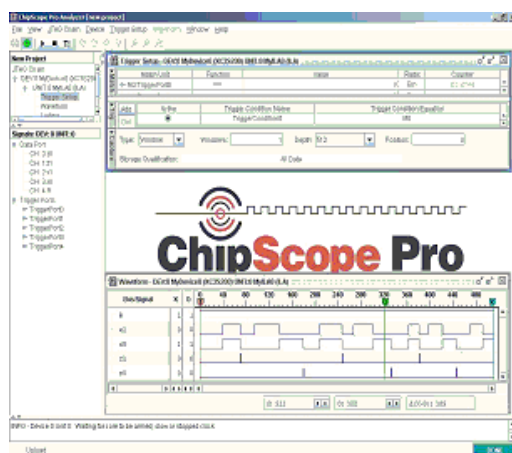


Fig 5. Timing diagrams

### 3. CONCLUSIONS

- The CK signal and the output signals must be free of logic hazard in order to meet the system run concordant with the specifications;
- The minimum propagation delay of CK signal through the combinational system must be greater than the maximum propagation delay for every logic circuit which implements the input/output signals.
- Once the CK signal is triggered it can be reseted without digital hazard.
- Using the improved design described above, the entire asynchronous digital system will work concordant with the specifications.

### 4. REFERENCES

- [1] Steven Mark Nowick . Automatic Synthesis of Burst-Mode Asynchronous Controllers. Technical Report, December 1995.
- [2] C. Roth. Principles of Fundamental Logic Design. New York, 1995.
- [3] Chris J. Myers. Asynchronous Circuit Design. John and Soons, Inc. 1995.
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- [5] Douglas J. Smith. HDL Chip Design. The Doone Publications 2001.
- [6] Verilog HDL Synthesis. A practical Primer. J.Basker, Doone Public.2000.

## ELECTROMAGNETIC SYSTEM WITH TWO ASYNCHRONOUS GENERATORS

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**Abstract:** The paper treats the possibility of fueling the consumers with electric power through two three-phase asynchronous generators. One generator receives mechanical power from the wind turbine, and the second one receives mechanical power from a Diesel engine.

**Keywords:** asynchronous generators, stationary operation, working characteristics.

### 1. INTRODUCTION

The proposed electromagnetic system is made of two groups that produce electrical power (Fig. 1). The first group is made of the wind turbine and asynchronous generator (TV+1GA), and the second group is made of the Diesel engine and asynchronous generator (MD+2GA) [1].

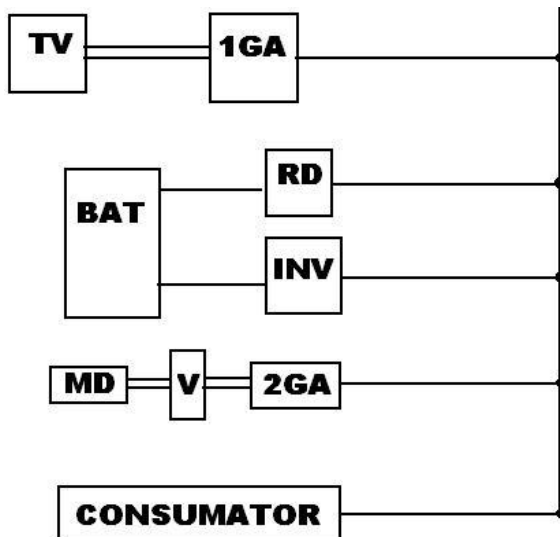


Fig. 1 - The block diagram of the electromagnetic system:

TV - wind turbine; GA - asynchronous generator; BAT - battery; RD - rectifier; INV - inverter; MD - Diesel engine; V - flywheel.

The placement of the big inertia moment flywheel on the generators 2GA axis, offers a better stability of the system frequency to the load shocks.

The electromagnetic system is forecasted with batteries that can absorb the overflow of active power in the system available at a given time, the overflow from a high speed wind or the disconnection of some electric consumers.

It is desirable that the second group provides only the power difference between the needed consumer power and the available power, while the wind turbine gets maximum power.

### 2. THE MATHEMATICAL MODELING OF THE ELECTROMAGNETIC SYSTEM

The working analysis of the proposed electromagnetic system in stationary operation can be achieved with the orthogonal model of the asynchronous machine, where the differentials are cancelled, because all the sizes are time constant.

To receive the maximum available power at a certain wind speed from the wind turbine it has to be  $M_{TV} = M_{TV}^*$  at  $\omega_1$  r.p.m.

The generators 1GA equations are [2]:

$$\left\{ \begin{array}{l} U_d = -R_1 \cdot I_{d_1} + \\ \omega_0 \cdot [L_{1\sigma} \cdot I_{q_1} + L_{1h} \cdot (I_{q_1} + I_{qr_1})] \\ U_q = -R_1 \cdot I_{q_1} - \\ \omega_0 \cdot [L_{1\sigma} \cdot I_{d_1} + L_{1h} \cdot (I_{d_1} + I_{dr_1})] \\ 0 = R_2 \cdot I_{dr_1} - \\ (\omega_0 - \omega_1) \cdot [L_{2\sigma} \cdot I_{qr_1} + L_{1h} \cdot (I_{q_1} + I_{qr_1})] \\ 0 = R_2 \cdot I_{qr_2} + \\ (\omega_0 - \omega_1) \cdot [L_{2\sigma} \cdot I_{dr_1} + L_{1h} \cdot (I_{d_1} + I_{dr_1})] \\ M_{TV}^* = p_1 \cdot L_{1h} \cdot (I_{q_1} \cdot I_{dr_1} - I_{d_1} \cdot I_{qr_1}) \end{array} \right. \quad (1)$$

For the 2GA generator we can consider a generator with the same electrical parameters of 1GA and we have:

$$\left\{ \begin{array}{l} U_d = -R_1 \cdot I_{d_2} + \\ \omega_0 \cdot [L_{1\sigma} \cdot I_{q_2} + L_{1h} \cdot (I_{q_2} + I_{qr_2})] \\ U_q = -R_1 \cdot I_{q_2} - \\ \omega_0 \cdot [L_{1\sigma} \cdot I_{d_2} + L_{1h} \cdot (I_{d_2} + I_{dr_2})] \\ 0 = R_2 \cdot I_{dr_2} - \\ (\omega_0 - \omega_2) \cdot [L_{2\sigma} \cdot I_{qr_2} + L_{1h} \cdot (I_{q_2} + I_{qr_2})] \\ 0 = R_2 \cdot I_{qr_2} + \\ (\omega_0 - \omega_2) \cdot [L_{2\sigma} \cdot I_{dr_2} + L_{1h} \cdot (I_{d_2} + I_{dr_2})] \\ M_{MD} = p_1 \cdot L_{1h} \cdot (I_{q_2} \cdot I_{dr_2} - I_{d_2} \cdot I_{qr_2}) \end{array} \right. \quad (2)$$

The working at  $U = U_N$  and  $f = f_N$  implies:

$$U_N^2 = U_d^2 + U_q^2 \quad (3)$$

$$\omega_0 = 2 \cdot \pi \cdot f_N \quad (4)$$

Considering the load of the following shape:  $\underline{Z} = R + j \cdot X$  it results the tension components  $U_d$  and  $U_q$ :

$$U_d = R \cdot (I_{d_1} + I_{d_2}) - X \cdot (I_{q_1} + I_{q_2}) \quad (5)$$

$$U_q = R \cdot (I_{q_1} + I_{q_2}) + X \cdot (I_{d_1} + I_{d_2}) \quad (6)$$

and for the load equation we can write:

$$U_N^2 = [R \cdot (I_{d_1} + I_{d_2}) - X \cdot (I_{q_1} + I_{q_2})]^2 + [R \cdot (I_{q_1} + I_{q_2}) + X \cdot (I_{d_1} + I_{d_2})]^2 \quad (7)$$

From this mode it results an eleven equation system with 21 unknowns:

$$I_{d_1}, I_{q_1}, I_{dr_1}, I_{qr_1}, I_{d_2}, I_{q_2}, I_{dr_2}, I_{qr_2}, \omega_1, \omega_2, M_{MD}.$$

These unknowns appear based on the consumers load connected at the electromagnetic system terminals.

The current absorbed by the load is determined by the relation:

$$I = I_1 + I_2 \quad (8)$$

where:

$$I_1 = \sqrt{I_{d_1}^2 + I_{q_1}^2} \quad (9)$$

$$I_2 = \sqrt{I_{d_2}^2 + I_{q_2}^2} \quad (10)$$

### 3. CASE STUDY

For the simulation of the electromagnetic system we consider two identical three-phased asynchronous generators with the power  $P_N = 4kW$  at 1500 r.p.m..

The electrical parameters of the generators are:

$$R_1 = 1.694\Omega; R_2 = 1.124\Omega; L_{1h} = 0.189H;$$

$$L_{1\sigma} = 7.394 \cdot 10^{-3}H; L_{2\sigma} = 8.05 \cdot 10^{-3}H$$

The consumer resistance is considered to be variable  $S = 50,60 \dots 1000\Omega$  and reactance  $X=0$ .

The maximum pulling torque of the wind turbine is  $M_{TV} = 26N \cdot m$  at an angular speed of  $\omega_1 = 326rad/s$ .

It is important to analyze the working characteristics of the second group which will provide the power difference that the consumers needs.

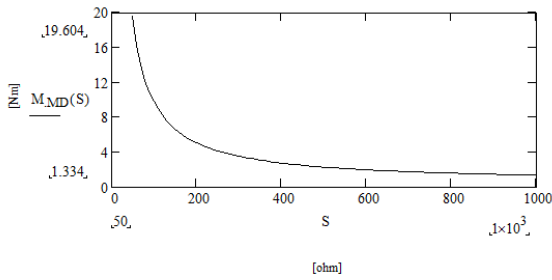


Fig. 2 - The pulling torque needed for 2GA.

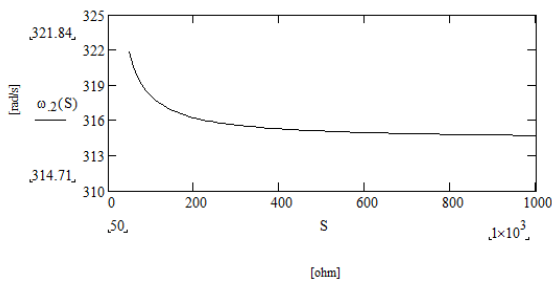


Fig. 3 - The angular speed of  $M_{MD} + 2GA$  group.

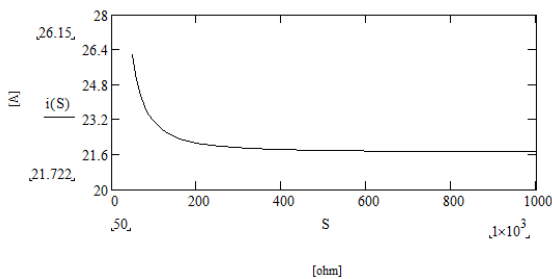


Fig. 4 - The current variation with the load.

#### 4. CONCLUSIONS

The maximum available power of the wind turbine is achieved by adjusting the angle of the blades.

The Diesel engine must provide torque at  $\omega_2$  angular speed determined in figure 3, fact only achievable with a gearbox and fuel adjustment.

For high intensity currents for the voltage and frequency to stay between nominal limits we need the Diesel engines torque to increase quickly.

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## THE MATHEMATICAL MODELING OF THE ELECTROMAGNETIC GROUP - WIND TURBINE AND ASYNCHRONOUS GENERATOR

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**Abstract:** In this paper we present the mathematical model dynamical operating of the electromagnetic group made of wind turbine and asynchronous generator. We determine the mechanical characteristics of the wind turbine which is used in the mathematical model of the asynchronous generator.

**Keywords:** mathematical modeling, wind turbine, asynchronous generator.

### 1. INTRODUCTION

The last generation wind turbines are designed to produce the maximum of electric energy with a relative low investment.

To control the energy production based on wind energy, at desirable parameters, there are used different ways to control the aerodynamic power and turbines rotor angular speed.

It is used the orthogonal model in dynamic operating of the asynchronous generator, where the voltage is expressed due to the connected load at the generator terminals.

The scenario consists in connecting a resistive load at the asynchronous generator terminals, when this one has the following angular speed at shaft:

$$\Omega = \Omega_0(1 + s_N) \quad (1)$$

where  $s_N$  is the nominal slip in generator operating, and  $\Omega_0$  is the angular speed at bare running of the generator.

### 2. THE MATHEMATICAL MODELING OF THE ELECTROMAGNETIC GROUP

The asynchronous generator equations are based on the orthogonal model, where the

stator and rotor windings are placed after “d-q” axis in an electrical enclosure.

Starting from the orthogonal model operating transitory of the asynchronous machine [1], for the operating generator we have:

$$\begin{cases} U_d = -R_1 \cdot I_d - L_{1\sigma} \cdot \frac{dI_d}{dt} - L_{1h} \cdot \left( \frac{dI_d}{dt} + \frac{dI_{dr}}{dt} \right) + \\ \omega_0 \cdot [L_{1\sigma} \cdot I_q + L_{1h} \cdot (I_q + I_{qr})] \\ U_q = -R_1 \cdot I_q - L_{1\sigma} \cdot \frac{dI_q}{dt} - L_{1h} \cdot \left( \frac{dI_q}{dt} + \frac{dI_{qr}}{dt} \right) - \\ \omega_0 \cdot [L_{1\sigma} \cdot I_d + L_{1h} \cdot (I_d + I_{dr})] \\ 0 = R_2 \cdot I_{dr} + L_{2\sigma} \cdot \frac{dI_{dr}}{dt} + L_{1h} \cdot \left( \frac{dI_d}{dt} + \frac{dI_{dr}}{dt} \right) - \\ (\omega_0 - \omega) \cdot [L_{2\sigma} \cdot I_{qr} + L_{1h} \cdot (I_d + I_{dr})] \\ 0 = R_2 \cdot I_{qr} + L_{2\sigma} \cdot \frac{dI_{qr}}{dt} + L_{1h} \cdot \left( \frac{dI_q}{dt} + \frac{dI_{qr}}{dt} \right) + \\ (\omega_0 - \omega) \cdot [L_{2\sigma} \cdot I_{dr} + L_{1h} \cdot (I_d + I_{dr})] \\ p_1 \cdot L_{1h} (I_q \cdot I_{dr} - I_d \cdot I_{qr}) + M_{TV} = \frac{J}{p_1} \cdot d\omega \end{cases} \quad (2)$$

The sizes which intervene in the (2) equation systems are:

$R_1$  - Phase resistance from stator;



$R_2$  - Phase resistance from rotor reported at stator;

$L_{1\sigma}$  - Dispersion inductivity of the stator phase

$L_{2\sigma}$  - Dispersion inductivity of the rotor phase reported at stator;

$L_{1h}$  - Main inductivity;

$p_1$  - Number of pole pairs from stator;

$J$  - Inertia moment;

$M_{TV}$  - Traction torque determined by the wind turbine;

The electrical load connected to the asynchronous generator terminals are like this  $\underline{Z} = R + j \cdot X$ , which results in a voltage drop on load:

$$\underline{U}_1 = \underline{Z} \cdot \underline{I}_1 \quad (3)$$

which disassembled becomes:

$$U_d = R \cdot I_d - X \cdot I_q \quad (4)$$

$$U_q = R \cdot I_q + X \cdot I_d \quad (5)$$

For the determination of the components  $U_d$  and  $U_q$  the load angle can be chosen arbitrary  $U_d = U_1, U_q = 0$  and thus:

$$U_1 = R \cdot I_d - X \cdot I_q \quad (6)$$

The mechanical property of the wind turbine can be considered like this [2]:

$$M_{TV} = A \cdot \Omega + B \quad (7)$$

which can develop the following power:

$$P_{TV} = A \cdot \Omega^2 + B \cdot \Omega \quad (8)$$

Considering the use of the turbine at peak power equal to the nominal power of the asynchronous generator ( $P_{TV} = P_{NGA}$ ) we have:

$$\begin{cases} P_{NGA} = A \cdot \Omega^2 + B \cdot \Omega \\ \Omega = -\frac{B}{2 \cdot A} \end{cases} \quad (9)$$

from where it results the A and B coefficients which determine the mechanical characteristic of the turbine at maximum power.

And so, we achieve a system of four equations where the unknowns are:  $I_d, I_q, I_{dr}, I_{qr}, \omega, U_1$  based on the load connected to the generators terminals.

It's important for solving a first degree system of differential equations, to determine the initial conditions for the unknown values. This can be determined by resolving the following system:

$$\begin{cases} U_1 = -R_1 \cdot I_d + \omega_0 [L_{1\sigma} \cdot I_q + L_{1h} \cdot (I_q + I_{qr})] \\ 0 = -R_1 \cdot I_q - \omega_0 \cdot [L_{1\sigma} \cdot I_d + L_{1h} \cdot (I_d + I_{dr})] \\ 0 = R_2 \cdot I_{dr} - (\omega_0 - \omega) \cdot [L_{2\sigma} \cdot I_{qr} + L_{1h} \cdot (I_q + I_{qr})] \\ 0 = R_2 \cdot I_{qr} + (\omega_0 - \omega) \cdot [L_{2\sigma} \cdot I_{dr} + L_{1h} \cdot (I_d + I_{dr})] \\ 0 = p_1 \cdot L_{1h} \cdot (I_q \cdot I_{dr} - I_d \cdot I_{qr}) + M_{TV} \\ U_1 = R \cdot I_d - I_q \cdot X \end{cases} \quad (10)$$

### 3. CASE STUDY

We consider an asynchronous generator with the power  $P_N = 4kW$  at 1500 r.p.m. driven by a wind turbine which has the following determined torque:  $M_{TV} = -0.149\Omega + 48.970$

The parameters of the asynchronous generator for nominal voltage  $U_1 = 380V$  and the nominal frequency  $f_1 = 50Hz$  are:

$$R_1 = 1.694\Omega; R_2 = 1.124\Omega; L_{1h} = 0.189H;$$

$$L_{1\sigma} = 7.394 \cdot 10^{-3}H; L_{2\sigma} = 8.05 \cdot 10^{-3}H;$$

$$p_1 = 2; J = 0.024kg \cdot m^2$$

The simulation of the mathematical modeling of the considered electromagnetic group is done for a resistive load  $R=100\Omega$ .

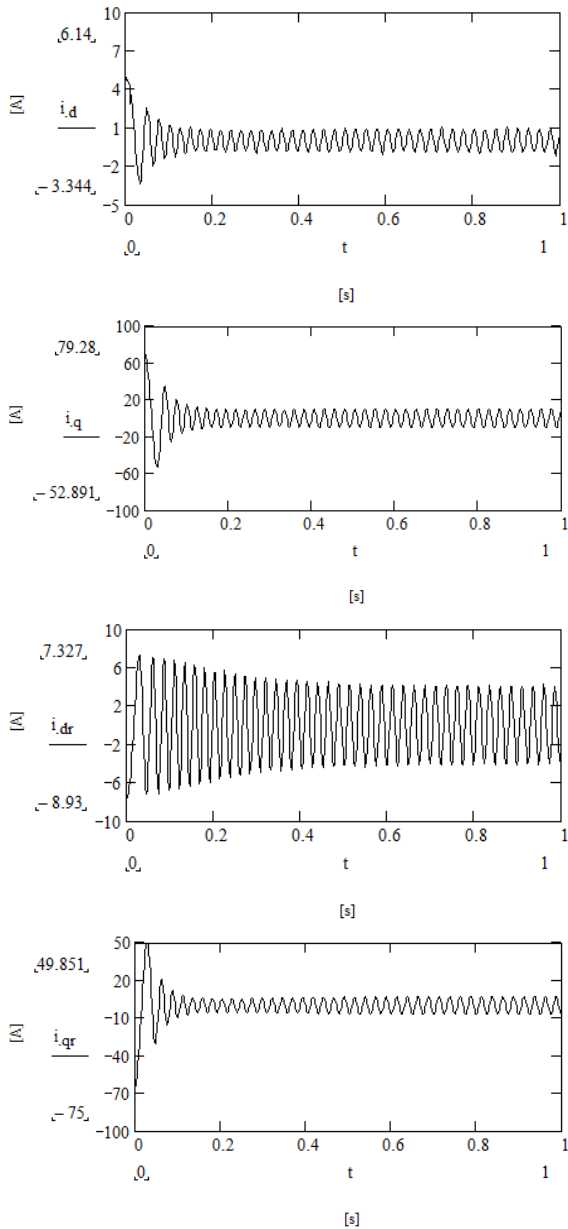


Fig. 1 - The stator and rotor currents for  $R=100\Omega$

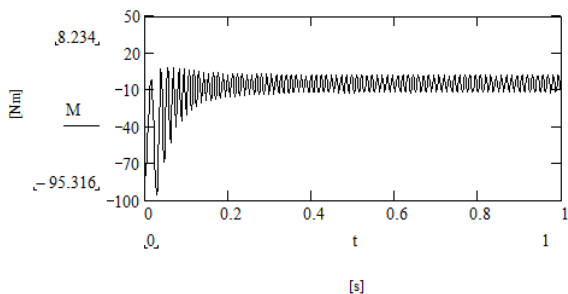


Fig. 2 - The electromagnetic torque for  $R=100\Omega$

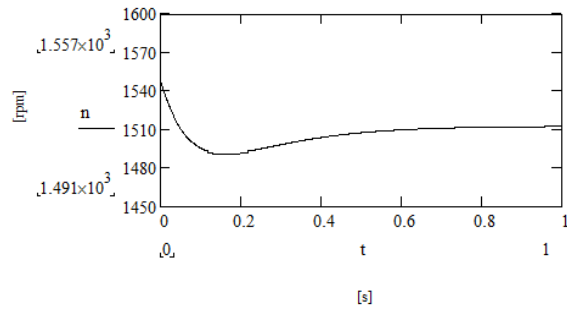


Fig. 3 - The revolution variation in relation with time for  $R=100\Omega$

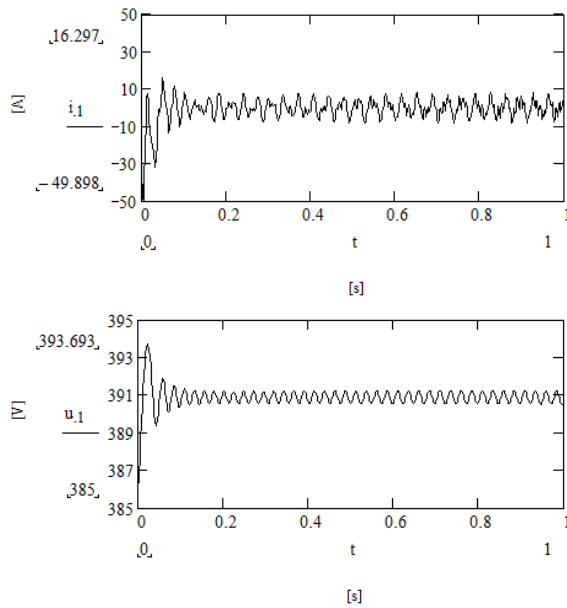


Fig. 4 - The stators current and voltage for the real machine at load  $R=100\Omega$

#### 4. CONCLUSIONS

After the moment of the load connection ( $R=100\Omega$ ), the group r.p.m. reaches a minimum of 1491 r.p.m., after which it settles at 1510 r.p.m. corresponding to the generator operation.

The voltage stays at the nominal value if the maximal value of the driving torque of the turbine is maintained.

The moment the load is connected, the current reaches the peak power of 50A.

The mathematical model enables the working analysis of the electromagnetic group at any value of the connected load at the generators terminals.

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and substituting (6) and (7) into (3) gives the sensitivity as

$$S[N] = \frac{1}{1 + \beta_1 A_1(s)C(s)} \cdot \frac{\beta_1 A_1(s)C(s)}{1 + \beta_1 A_1(s)C(s)} \cdot \frac{1}{1 + N\beta_2 A_2(s)} \frac{N\beta_2 A_2(s)}{1 + N\beta_2 A_2(s)} \gamma \delta \quad (8)$$

where

$$C(s) = \frac{y_2 A_2(s) + y_1 b}{y_2(1 + \beta_2 A_2(s)) + y_1 \beta_1 A_1(s)(1 - b)} \quad (9)$$

Equation (8) is broken into six terms. Again, first and third terms on the right of (8) are the inverse return difference of the feedback loops, the second and fourth are approximately equal to unity and the multiplication of deviations from the correspondent balance conditions takes place. Comparison with the conventional current dumping amplifier with the same system gain makes it clear that a decrease in sensitivity and desensitization in the balance conditions occurs.

Before considering the application to a specific circuit schematic it would be well to put these results to test.

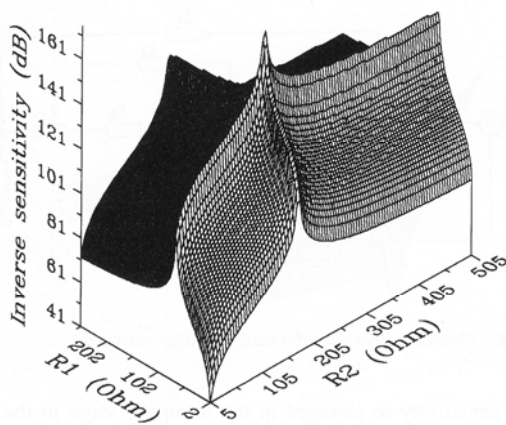


Fig.2 Distortion rejection (inverse sensitivity) of the nested feed-back – feed forward structure

Numerical data was obtained from the fully expanded (3) with the values of elements listed below.

$$z_L = 2 \Omega; \quad z_3 = 5,5 \mu H; \quad z_4 = 5,5 \mu H$$

$$\beta_1 = 0,1; \quad \beta_2 = 1;$$

$$A_1(s) = A_{01} / (1 + s\tau_{11}A_{01})(1 + s\tau_{21}) =$$

$$= A_{01} / (1 + s\tau_{a1}A_{01})(1 + s\tau_{21})$$

$$A_{01} = 3,1 \cdot 10^5 \text{ (110dB);}$$

$$1/2 \pi \tau_{11} = 20\text{MHz (} 1/2 \pi \tau_{a1} = 4,5\text{Hz);}$$

$$1/2 \pi \tau_{21} = 10\text{MHz;}$$

$$A_2(s) = A_{02} / (1 + s\tau_{12}A_{02})(1 + s\tau_{22}) =$$

$$= A_{02} / (1 + s\tau_{a2})(1 + s\tau_{22});$$

$$A_{02} = 3,1 \cdot 10^5 \text{ (110dB);}$$

$$1/2 \pi \tau_{12} = 5\text{MHz (} 1/2 \pi \tau_{a2} = 16,13\text{Hz);}$$

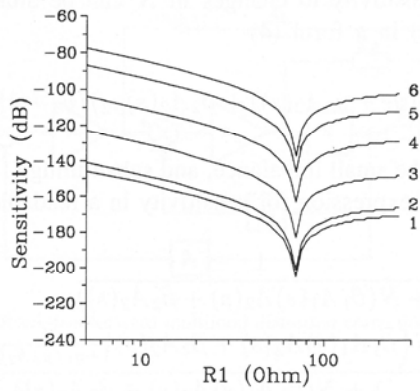
$$1/2 \pi \tau_{22} = 5\text{MHz}$$

Fig. 2 and fig.3 illustrate the effect of variation in  $z_1$  and  $z_2$  at 10kHz. Some observations may be made from the figures.

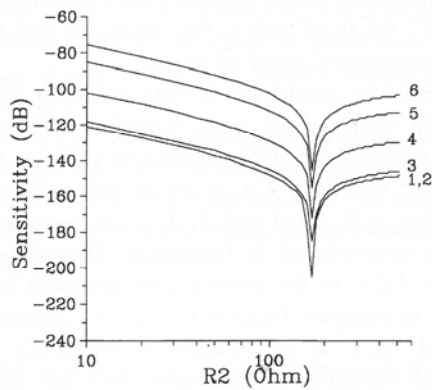
- 1) The extreme positions do not change with the variation of circuit element in another feedback-feed forward loop, thus the loops do not interact with one another.
- 2) A considerable decrease in sensitivity to changes in dumping stage is obtained.

Fig.4 shows the model circuit that was used to verify the basic features of the enhanced current dumping.  $R_1$  and  $R_2$  could be varied to minimize the distortion residual at the load terminals. Fig.5 shows the harmonic analysis and Table 1 gives a 1kHz total harmonic distortion at 0,25W output of the demonstration circuit for various values of circuit components. Signal generator residuals are -110dB for the second and -120dB for the third harmonics. THD was measured with a frequency analyzer with a twin-T input notch filter tuned on fundamental for increasing the equipment dynamic range. The fundamental frequency attenuation is more than 54dB and the second order harmonic attenuation is equal to 4,5dB. Intermodulation distortion (SMPTE and CCIF intermodulation tests) is not detectable with experimental set-up available to the authors.

Special care was taken to improve the power supply rejection of the model circuit. To reduce mutual inductive coupling between power supply rails and output inductors the suggested circuit technique [18] was utilized, the output inductors were wound on toroidal formers made from nonmagnetic material and the critical components were interconnected with a star ground layout.



a)



b)

Fig.3 Plots of the sensitivity to changes in the dumping stage structure as a function of  $z_1$  (a) and  $z_2$  (b), shown for a number: in another 'nest.' Curve (1) - perfect balance; curves (2)-(5) - imbalance values are 0,05; 0,5; 5; 50%, respectively; curve (6) - without another feedback- feed forward loop.

Table 1

$R_1$	$R_2$	THD
$\infty$	$\infty$	-84,8dB (0,0058%)
100% imbalance	$\infty$	-94,0dB (0,002%)
perfect balance	$\infty$	-97,5dB (0,0013%)
$\infty$	100% imbalance	-95,4dB (0,0017%)
$\infty$	perfect balance	-100dB (0,001 %)
100% imbalance	100% imbalance	-101dB (0,0009%)
perfect balance	100% imbalance	-101,5dB (0,0008%)
100% imbalance	perfect balance	-98,5dB (0,0012%)

perfect balance	perfect balance	-105dB (0,00056%)
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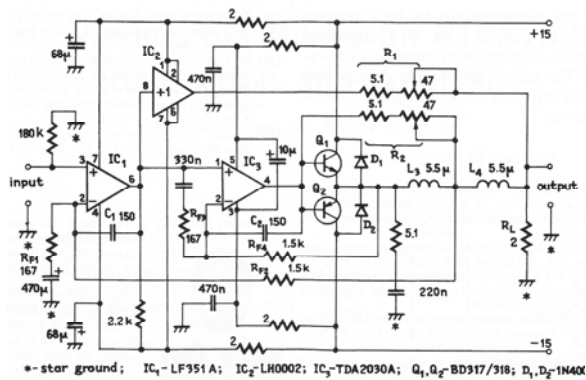
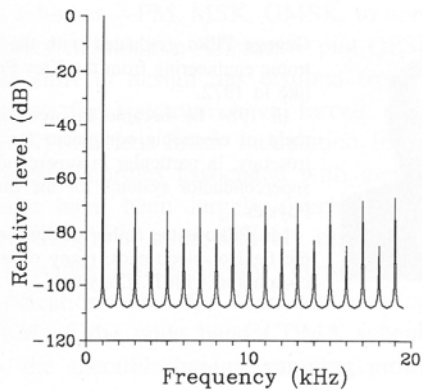


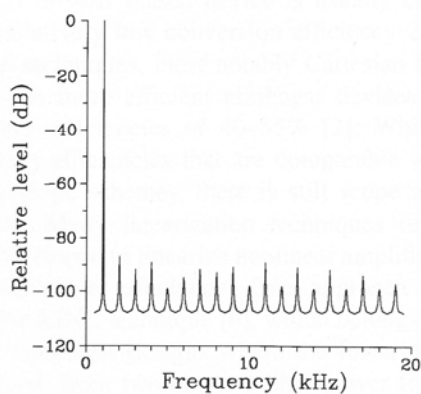
Fig. 4 Full circuit diagram of the model amplifier based on enhanced current dumping. All resistors are in  $\Omega$  and capacitors are in pF unless otherwise the tolerances of the components are  $\pm 10\%$

It should be noted that the circuit realization may be great/ improved if  $IC_3$  were to be compensated for a unity-gain bandwidth of 10MHz. The TDA2030 is compensated for gains 10, and the undesirable network  $R_{F3}$ ,  $R_{F4}$  leads to a low close-loop bandwidth for this stage, based on  $IC_3$ . For this reason the values of  $R_1$  and  $R_2$  that could be get from the circuit of fig.5 do not agree with the values of  $R_1$  and  $R_2$  in fig.3 for minimum distortion corresponding to simulations.

An important point to mention is that the output the network ( $z_2, z_3, z_4$ ) causes high-frequency roll-off. The additional pole associated with this network decreases the loop gain of the feedback loop via block  $\beta_1$  (fig.1 and (8) and (9)). If the low-bandwidth amplifier is employed in  $A_2$ , the lower  $z_2$  should be for obtaining the balance condition so that the loop-gain in the outer feedback loop is decreased. Under such conditions the nested structure is not necessarily more optimal than the one without  $z_2$  (without inner feed forward path). This was confirmed by PSPICE simulations and actual measurements on the model circuit.



a)



b)

Fig.5 Distortion spectrum for the amplifier circuit with enhanced current dumping. The signal fundamental frequency is 1kHz; output level is 2V peak to peak and load is  $2\Omega$ . a)  $R_1$  and  $R_2$  are open circuited, total harmonic distortion is -84,8dB; b)  $R_1$  and  $R_2$  are in optimum balance position, total harmonic distortion is -105dB

The circuit shown in fig.4 cannot be considered as a commercial one. The model circuit was built for checking the nested loop approach and for comparison with the conventional current dumping. The data presented in Table 1 confirmed that the proposed approach really constitutes a worthwhile practical improvement.

## 2. CONCLUSION

The paper has described an approach to a current dumping amplifier design where several feedback-feed forward loops are placed

one within another. The amplifier output is free from the influence of the dumping circuit even using wide tolerance components. This can result in a high degree of linearity even when a class B complementary emitter follower with the two bases joined together is employed. A prototype circuit has been investigated where the technique has proved effective.

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## IMPROVING QUALITY PERFORMANCE OF CURRENTS

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**Abstract:** A method is proposed for improving the performance of current dumping audio amplifiers that allows an increase in the distortion rejection ratio and (or) desensitizes the circuit balance condition. The distortion reduction properties of the existing topologies are reviewed.

**Key words:** current dumping, distortion, feedback loop, feed forward error correction

### 1. INTRODUCTION

There are three main approaches to lowering amplifier distortion. Feedback and feed forward circuits [1] are two such approaches. Another technique widely used, especially in power radio communication amplifiers, is to reduce the distortion caused by the nonlinear behavior of the active devices included in the amplifier; this technique is predistortion. They differ fundamentally in the manner of operation and feed forward is appealing in that in principle it can reduce distortion to zero. The method was employed in two examples of amplifiers [2] in which distortion were reduced by feeding forward an error signal to load terminals. Two problems are inherent in feed forward schemes, namely precise gain matching and creation of antiphase distortion components. The extra complexity and the practical problems of the output summing network make the whole system less than unoptimal. It is possible to apply the feed forward principle to a circuit which initially comprises two identical amplifying paths: bridge [3, 4, 5] and parallel [6] amplifier. This approach is to some extent an economic solution for certain amplifier types due to the absence of a separate error channel. A compromise should be achieved if both principles are applied simultaneously to the single amplifying path [7], [8]. The feed

forward path that extends beyond the feedback loop helps to reduce residual distortion of the overall circuit. Distortion at the output of a dumping stage is inversely proportional to the return difference of the feedback loop, whereas the degree of further feed forward reduction depends on the accuracy of the circuit balancing. In the current dumping amplifier solution [7, 8], the need for a separate error amplifier disappears and the reactive output summing network allows the full output of the dumping stage to be applied to the load at low frequencies. The current dumping amplifier also can be looked at as a negative feedback system in which the overall negative feedback is slightly increased every time the dumping stage transistors come on, to prevent the increase in system gain that would otherwise occur from taking place [9]. The latter explanation provides a simple and convenient physical argument.

One other design example [10] similar to current dumping approach should be mentioned. This employs an error amplifier to sense the difference between the output of the driver amplifiers and that from the output stage. As in the current dumping circuit, the input amplifier provides the drive signal to the load when the power output transistors are not conducting. The practical design [11] achieves the high specifications with the penalty of a circuit of considerable complexity.

A previous report [12] discussed two error correction topologies on the basis of total available gain. To demonstrate error correction, sensitivity analysis was used. It was shown that a decrease in the sensitivity to changes in the main channel is exchanged for a corresponding reduction of gain in the whole system. In a recent paper [13], an attempt to establish a more general feedback - feed forward structure which utilizes multiloop feedback - feed forward paths was made. It was claimed that this structure enables a desensitization of the balance condition.

The present paper extends a multiloop approach to nested topology that can be easily mapped to a practical circuit realization. As an introduction to more general structures, section 2 treats the case of conventional current dumping and includes some consideration of the critical circuit parameters that affect distortion rejection. Section 3 takes up a multiloop approach, determining the sensitivity to changes in a dumping circuit and comparing the balance condition with the one for conventional current dumping.

## 2. CONVENTIONAL CURRENT DUMPING

Fig. 1 is an approximate block diagram of a conventional current dumping amplifier. Here  $A_1(s)$  is the open-loop voltage gain of the error amplifier and  $N$  is the voltage gain of the dumping nonlinear output stage. For a given set of circuit parameters the overall transfer function  $G_1(s)$  can be expressed as

$$G_1(s) = \frac{v_0}{v_i} = \frac{y_1}{y_1 + y_2 + y_L} \frac{A_1(s)}{1 + \beta N A_1(s)} \left( 1 + N \frac{y_2}{y_1} \right) \quad (1)$$

Throughout this paper the concept of admittance ( $y$ ) as the inverse of impedance ( $z$ ) is used to make the equations more readable. Both terms with the same subscripts denote the same circuit element ( $y_1 = 1/z_1$ ). The sensitivity of system gain  $G_1$  to changes in  $N$  variable is

$$S[N] = \frac{1}{1 + \beta N A_1(s)} \frac{1 - y_1 \beta A_1(s) / y_2}{1 + y_1 / N y_2} \quad (2)$$

It immediately follows from (2) that when the balance condition

$$y_1 \beta A_1(s) / y_2 = 1 \quad (3)$$

is satisfied then  $S[N]$  is equal to zero and the output stage gain  $N$  does not appear in (1). Let us rewrite the balance condition (3) in a form

$$\|y_1 \beta A_1(s) / y_2 - 1\| = \gamma \quad (4)$$

where  $\gamma$  is a relatively small deviation ( $\gamma \approx 0$ ) from the perfect balance condition (3). Substituting (4) into (2) gives the sensitivity to changes in  $N$  in the vicinity of the balance point as

$$S[N] = \frac{1}{1 + \beta N A_1(s)} \frac{\beta N A_1(s)}{1 + \beta N A_1(s)} \gamma \quad (5)$$

It is interesting to note that the first term on the right here is the inverse return difference of the feedback loop - the motivation to maintain as large a loop gain as possible. The third term is the deviation from the perfect feed forward balance condition; second term is approximately equal to unity except at high frequencies. To meet a natural frequency roll-off in  $A_1(s)$  let  $z_1$  be a resistor and  $z_2$  be an inductor [8] (another possible set for  $z_1$  and  $z_2$  are a capacitor and a resistor, respectively). Now the balance condition (3) can be replaced as

$$A_1(s) = R_1 / s \beta L_2 \quad (6)$$

This sets a lower limit on the gain bandwidth product  $1/\tau_1$  of the error amplifier, which must be higher or at least equal to  $R_1/\beta L_2$ . If  $1/\tau_1$  is higher than  $R_1/\beta L_2$ , any suitable frequency compensation method can be applied to obtain the desired frequency response (6) of the error amplifier. In the canonic form [8] the error amplifier is an ideal integrator and any deviation in  $A_1(s)$  will be reflected on the balance condition (3).

It was shown by a judicious combination of analysis and measurements [1, 14, 15] that the precise balance condition operate over a

narrow frequency range if it operates at all. Aspects of particular concern are:

1) a finite value of the open-loop gain of the error amplifier, which places a limit over a wide frequency range [14]. Let  $A_I(s)$  be expressed as

$$A_I(s) = A_0 / (1 + s\tau_1 A_0) = A_0 / (1 + s\tau_a) \quad (7)$$

where  $A_0$  is the direct current gain of the error amplifier,  $1/\tau_1$  is the gain bandwidth product and  $1/\tau_a$  is the open-loop bandwidth of the error amplifier. Substituting (7) into (4), (5) can be obtained

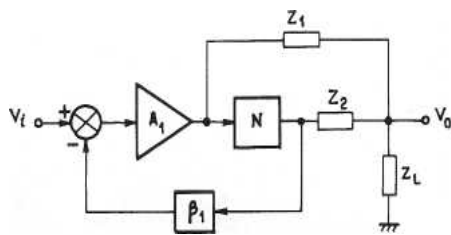


Fig. 1 Current dumping principle, with error amplifier and parallel output summing network

$$S[N] = \frac{1}{1 + \beta N A_0} \frac{s\tau_1 / \beta}{1 + s\tau_1 / \beta} \approx \frac{1}{1 + \beta N A_0} \quad (8)$$

2) far-out singularities (no dominant poles) in the error amplifier frequency response produces a phase lag at higher frequencies and strongly affects sensitivity to changes in the dumping stage. Let us investigate the influence of a second pole numerically, as opposed to doing a general analytic analysis. The  $A_I(s)$  in this case is described by

$$A_I(s) = A_0 / (1 + s\tau_1 A_0) = A_0 / (1 + s\tau_2) = A_0 / (1 + s\tau_a)(1 + s\tau_2) \quad (9)$$

here  $1/\tau_2$  is the frequency of the second pole and  $1/\tau_1$  is the frequency at which the forward path gain would have fallen to unity if there had been one pole only. Fig. 2 shows three-dimensional plots of sensitivity to variations in the dumping output stage. The position of the second pole  $\beta A_0 \tau_2 / \tau_a$  is normalized to the closed-loop cut-off frequency  $\beta A_0 / \tau_a$ . For the case considered the circuit parameters are the following:

$$R_I = 69,118 \Omega; \quad L_2 = 5,5 \mu H;$$

$$A_0 = 3,1 \cdot 10^5 \text{ (110dB)}; \quad \beta = 0,1;$$

$$1/2 \pi \tau_1 = 20 \text{MHz} \quad (1/2 \pi \tau_a = 64,5 \text{Hz})$$

It should be noted that the sensitivity is increased with a 12dB/oct slope at high frequencies when the second pole is taken into consideration. The first pole in the frequency response of the error amplifier gives a phase lead relatively to the phase response of an ideal integrator and the second pole produces a phase lag. Consequently, in the middle of the frequency band restricted by the first and second pole frequencies the point where the phase shift is exactly equal to  $-\pi/2$  is located. If the balance condition (6) is satisfied a deep notch (down to zero) appears at this frequency.

The distortion performance in the case of a two-pole compensated amplifier can be improved with a more complex output summing network [15].

3) Another aspect of imbalance is a frequency dependence of inductance and the real part of the inductor impedance (resistance). The frequency dependent losses (resistance) in the inductor are due to the skin effect. Magnetic field produced by high-frequency currents in the wire pushes the current from the center of the wire to the wire surface. This reduces the effective cross sectional area of the wire, changes the geometry of lines of current thus increases the inductor resistance and inductance with increasing frequency. Insulated the inductor from parallel strands of fine wires on large former increases the cross sectional area available for current flow at high frequencies, thereby reducing the internal resistance [1].

Many features tend to influence the balance condition and without cumbersome optimization and adjustment of the circuit elements the residual distortion of a conventional current dumping amplifier is hardly likely to be lowered below -80dB(0,01%) [1, 8, 14].

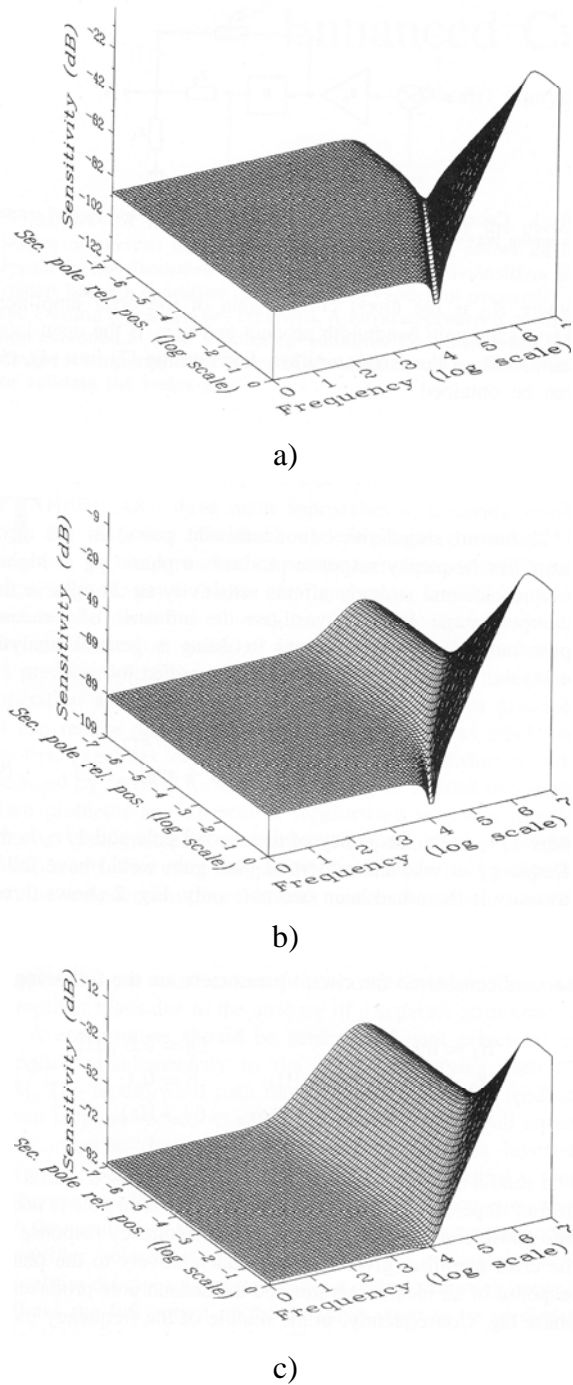


Fig.2 Effect on sensitivity to changes in the output stage of a conventional current dumping amplifier of the frequency and position of the second pole.

- (a) Perfect balance; (b) 0,05% imbalance in  $R_1$ ;
- (c) 0,5% imbalance in  $R_1$ .

### 3. MULTILoop FEEDBACK-FEEDFORWARD STRUCTURE

A multiloop method [13] was devised for improving the distortion performance of a feedback-feed forward error correction

structure [16]. As the current dumping amplifier belongs to that class of active networks [13, 14], it is interesting to estimate the effect of a multiloop rearrangement of a conventional current dumping. The discussion is restricted to the case of a topology such as Fig.3 with two amplifying blocks.

The overall transfer function  $G_2(s)$  for the two-stage structure of Fig.3 is given by

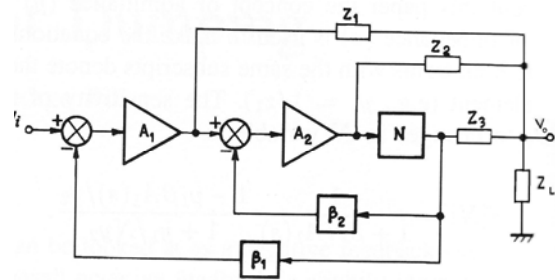


Fig.3 Feedback – feed forward multiloop distortion correction

$$G_2 = \frac{v_0}{v_i} = \frac{1}{y_1 + y_2 + y_3 + y_L} \frac{y_1 A_1(s) + y_2 A_2(s) A_1(s)}{1 + N(\beta_1 A_1(s) A_2(s) + \beta_2 A_2(s))} \left( 1 + N \frac{A_2(s)(y_1 \beta_2 + y_3)}{y_1 + y_2 A_2(s)} \right) \quad (10)$$

The sensitivity of system gain  $G_2$  to changes in  $N$  variable is given by the relation

$$S[N] = \frac{1}{1 + N(\beta_1 A_1(s) A_2(s) + \beta_2 A_2(s))} \frac{1 - (\beta_1 \beta_2 A_1(s)(y_1 + y_2 A_2(s)) + y_2 \beta_2 A_2(s)) / y_3}{1 + y_2 \beta_2 / y_3 + (y_1 + y_2 A_2(s)) / N A_2(s) y_3} \quad (11)$$

Observation of (11) reveals that providing

$$(\beta_1 A_1(s))(y_1 + y_2 A_2(s)) + \beta_2 A_2(s) y_2 / y_3 = 1 \quad (12)$$

and zero sensitivity to changes in  $N$  can be attained.

Rearranging (12) in a form (4)

$$\|(\beta_1 A_1(s))(y_1 + y_2 A_2(s)) + \beta_2 A_2(s) y_2 / y_3 - 1\| = \gamma \quad (13)$$

where  $\gamma$  is the small imbalance, and substituting (13) into (11) one can get expression for sensitivity in a readable form

$$S[N]=\frac{1}{1+N(\beta_1 A_1(s)A_2(s)+\beta_2 A_2(s))} \cdot \frac{N(\beta_1 A_1(s)A_2(s)+\beta_2 A_2(s))(1/(1+y_1/y_2 A_2(s)))}{1+N(\beta_1 A_1(s)A_2(s)+\beta_2 A_2(s))} \quad (14)$$

Again the sensitivity is a product of three terms, where the first is a return difference of the correspondent multiloop feedback structure [17], the third term is the imbalance and the second term is approximately equal to unity.

The decrease in sensitivity is obtained only by using an extra gain in the forward path, whereas it is much more difficult to satisfy the balance condition (12), as it depends now upon five variables. Let  $z_3$  be an inductor ( $z_3=sL_3$ ), for this choice  $y_2 \beta_2 A_2(s)$  and  $\beta_1 A_1(s)(y_1 + y_2 A_2(s))$  must be inversely proportional to frequency. Thus the open-loop voltage gain  $A_2(s)$  of the second error amplifier is inversely proportional to complex frequency  $s$ ;  $y_2$  is a resistor;  $y_1$  is an inductor and  $A_1(s)$  is independent of frequency. With any other sets of elements the structure does not possess low output impedance. It is evident that the result is completely impractical as both amplifier blocks are loaded one on the other at the low frequencies through the inductors  $z_1$  and  $z_3$ . The multipath structure thus needs a serious revision to match the requirements that can be placed upon the basic topology for error correction schemes.

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## 5. MECHANICAL ENGINEERING

„ANALYZE OF WELDING PROCESS ON THE HIGH ELASTICITY STEEL PLATES”, <b>Remus BOBOESCU, Valentin GLOD</b>	809
„CONSIDERATIONS REGARDING MATHEMATICAL MODELING OF THE CEREAL DRYING PROCESS”, <b>Laurențiu CĂLIN, Ioana IONEL, Mihai JĂDĂNEANȚ, Nicolae BRIA</b>	815
„OPTIMISATION OF THE DRYING TECHNOLOGICAL SYSTEMS AND THE ADHERENCE TO THE EUROPEAN REGULATIONS REGARDING POLLUTANT EMISSIONS”, <b>Laurențiu CĂLIN, Francisc POPESCU, Adrian CIOABLA, Nicolae BRIA</b>	819
„STUDIES REGARDING THE CAUSES OF AVERAGES PRODUCED AT COMPONENT PARTS OF ROLLING MATERIALS”, <b>Mihaita CAZACU, Emil ZAMFIR, Adriana ZARA</b>	823
„VALUE ANALYSIS AND REDESIGN OF EQUIPMENTS” Parth I, <b>Florin CHICHERNEA, Alexandru CHICHERNEA</b>	829
„VALUE ANALYSIS AND REDESIGN OF EQUIPMENTS” Parth II, <b>Florin CHICHERNEA, Alexandru CHICHERNEA</b>	835
„DATA BASES DEDICATED TO COMPUTERIZATION OF FOUNDRIES ACTIVITIES”, <b>Ion CHIRA, Ruxandra IONICĂ, Ruxandra BECA (NEMEȘ), Bogdan Constantin TEODORESCU,</b>	841
“PRELIMINARIES CONCERNING OMPUTERIZATION OF STOCKS MANAGEMENT IN FUNDRIES”, <b>Ion CHIRA, Ruxandra BECA (NEMEȘ), Ruxandra IONICĂ, Bogdan Constantin TEODORESCU</b>	847
“SOLVING THE FUNDAMENTAL PROBLEM OF THE INTERIOR BALLISTICS USING THE REAL BURNING LAW OF THE PROPELLANT”, <b>Lucian CIOBANU, Florin SUCIU, Titică VASILE</b>	853
“ADVANCED COMPOSITE MATERIALS FOR NOTAR HELICOPTER FUSELAGE”, <b>Ionică CÎRCIU</b>	857
„ON THE LIFETIME OF RAILWAY VEHICLE SUBSYSTEMS THAT HAVE A BEARING CAPACITY QUALITY”, <b>Ion COPACI, Bogdan TĂNĂSOIU</b>	861
„POWDER PROPERTIES RESULTED FROM THE BEARINGS PROCESSING”, <b>Ion DINESCU</b>	865
„A FEW CONSIDERATIONS REGARDING THE GEOTHERMAL HEAT PUMPS”, <b>Alexandru DRAGALINA, Traian FLOREA, Anastase PRUIU, Adrian POPA, Marian RISTEA, Traian-Vasile FLOREA</b>	869
„SOME ASPECTS REGARDING THE WATER BASED TECHNOLOGIES USED ON DIESEL ENGINES FOR THE REDUCTION OF NO <sub>x</sub> EMISSIONS”, <b>Alexandru DRAGALINA, Anastase PRUIU, Traian FLOREA, Adrian POPA, Marian RISTEA, Traian-Vasile FLOREA</b>	877
„STATE OF THE PRESENT RESEARCH OF THE METALLIC GLASSES AND THEIR PROPRETIES”, <b>Emilian ENE, Adriana ZARA, Bogdan NOVAC, Ioan GIACOMELLI</b>	883
„MATHEMATICAL MODEL OF A HYDRAULIC MODEL “WITH APPLICATIONS IN THE VIBRATIONS OF THE MECHANICAL MACHINES”, <b>Olivia FLOREA</b>	887
„APPLICATION OF COMPLEMENTARY ENERGY METHOD TO DEFLECTION PROBLEMS”, <b>Lavinia GAVRILĂ</b>	893
„ALUMINUM POWDERS USED IN AUTOMOTIVE APPLICATIONS FOR OBTAINING PARTS WITH HIGH TECHNOLOGICAL PERFORMANCES”, <b>Horia Ovidiu GEAMĂN, Virgil GEAMĂN, Maria STOICĂNESCU</b>	898
„HOT ISOSTATIC PROCESSING APPLIED TO CEMENTED CARBIDES AND CERAMICS”, <b>Virgil GEAMĂN, Gheorghe BEJINARU-MIHOC, Horia Ovidiu GEAMĂN</b>	903

„THE INFLUENCE OF CHEMICAL COMPONENTS AND THERMIC TREATMENT ON ALUMINIUM ALLOYS CASTED IN PISTONS FOR THERMIC ENGINES”, <b>Richard HERMAN, Ioan SPOREA, Mihaiela HERMAN</b>	<b>907</b>
„OPTIMIZED THE GRASPING MECHANISM, SPECIFICALLY TO THE INSPECTION ROBOTS IN HAZARDOUS ENVIROMENTS”, <b>Catalin Eugen IONESCU</b>	<b>911</b>
„PIERCING INCENDIARY BULLETS’ IMPACT PHENOMENON. EXPERIMENTAL RESULTS AND NUMERICAL DATES”, <b>Catalin Eugen IONESCU</b>	<b>914</b>
“THE METALS DEFORMING THROUGH THE PLASTICITY CRITERIA”, <b>Gabriela IVAN</b>	<b>918</b>
“THE TRACTOR’S CAB STRUCTURE, BEHAVIOR IN ELASTICO- PLASTIC FIELD”, <b>Gabriela IVAN</b>	<b>922</b>
“ESTABLISHING RELIABILITY OF ANGULAR COUPLINGS USED TO ENABLE TRANSMISSION TO THE ANTITORQUE ROTOR FOR IAR 316B HELICOPTERS”, <b>Doru LUCULESCU, Bogdan Gheorghe MUNTEANU</b>	<b>925</b>
“OPTIMIZATION OF SOME HYDRO-AERODYNAMIC PROFILES FOR OBTAINING LIFT OR MAXIMAL PROPULSION”, <b>Mircea LUPU, Ernest SHEIBER, Stefan NEDELICU</b>	
„APPLICATIONS OF SHAPE MEMORY MATERIALS”, <b>Dan MÂNDRU, Ion LUNGU, Simona NOVEANU, Olimpiu TĂTAR</b>	<b>929</b>
“MULTILAYERED STRUCTURES ZIRCONIA BASE IN AEROSPATIAL FIELD”, <b>V. MANOLIU, N. MARIN, A. STEFAN, Gh. IONESCU, S. GAMAN</b>	<b>935</b>
„SOME ASPECTS REGARDING THE SELF GENERATED TORQUE WITHIN THE 4WD DRIVETRAIN”, <b>Marin MARINESCU, Florin OLOERIU, Marian TRUȚĂ</b>	<b>939</b>
„SIMPLIFIED MECHANISM FOR NO <sub>x</sub> FORMATION” <b>Daniela-Elena MITU, Liviu STAN, Nicolae BUZBUCHI</b>	<b>943</b>
“RELIABILITY OF TECHNICAL SYSTEMS-CONCEPT, CLASSIFICATION AND QUANTIFICATION”, <b>Nicolae MORO</b>	<b>948</b>
„THE QUALITY CHARACTERISTICS AND QUALITY OF PRODUCTS INTENDED FOR MILITARY”, <b>Nicolae MORO</b>	<b>952</b>
“THE MECHANISM OF MODIFYING CAST IRON BY MIXING LIQUID STATE OF TWO CAST IRON TO A DIFFERENT DEGREE OF SATURATION IN CARBON”, <b>Bogdan NOVAC, Adriana ZARA, Emilian ENE, Gheorghe NOVAC</b>	<b>956</b>
“DEVELOPMENT OF MINIATURIZED SYSTEMS BASED ON COMPLIANT MECHANISMS”, <b>Simona NOVEANU, Dan MÂNDRU, Ion LUNGU, Olimpiu TĂTAR</b>	<b>962</b>
„MODERN INSTRUMENTS FOR MEASURING AND ERIFICATION OF SURFACES MADE BY MECHANIC PROCESS”, <b>Rita Vasilica OPRISAN (STOICA</b>	<b>968</b>
“SOLUTIONS OF INCREASING THE PRODUCTIVITY IN ODULAR FIXTURE DESIGN USING AUTODESK INVENTOR”, <b>Rodica PĂUNESCU</b>	<b>973</b>
„THE INFLUENCE OF CHEMICAL COMPOSITION, STRUCTURE AND THERMAL TREATMENT ON THE CASTING REFRACTORY ALUMINUM ALLOYS”, <b>Ion SPOREA, Remus BOBOESCU, Alin Vasile BĂEȚAN, Mircea OLARIU, Ion CÂRPEAN</b>	<b>977</b>
“ANTHROPOMORPHIC GRIPPERS FOR ROBOTS - CURRENT STAGE AND PERSPECTIVES”, <b>Ionel STARETU</b>	<b>983</b>
„THE INFLUENCE OF CONDITIONS OF THE HEAT TREATMENT OF ALUMINUM ALLOYS”, <b>Maria STOICANESCU, Mihaela SMEADA, Ioan GIACOMELLI</b>	<b>989</b>
„A NEW MATHEMATICAL MODEL OF BALLISTIC CYCLE FOR ARTILLERY SYSTEM”, <b>Florin SUCIU, Lucian CIOBANU, Titică VASILE</b>	<b>993</b>
„ON THE TRAVEL SAFETY OF RAILWAY VEHICLES USED FOR FREIGHT TRANSPORT”, <b>Aurelia TĂNĂSOIU, Bogdan TĂNĂSOIU</b>	<b>1001</b>
„STUDY ON THE ENERGETIC CHARACTERISTICS OF THE SHOCK INSULATORS OF RAILWAY VEHICLES”, <b>Aurelia TĂNĂSOIU, Ion COPACI</b>	<b>1006</b>
“BLAST WAVE SCALING LAWS (Hopkinson-Cranz Scaling Method)”, <b>Cristian ULEANU, Costin ZAGONEANU, Octavian ORBAN</b>	<b>1011</b>

„SIMPLIFIED CALCULATION METHOD FOR EXPLOSIVE SAFETY QUANTITY DISTANCE (QD)”, <b>Cristian ULEANU, Costin ZAGONEANU, Octavian ORBAN</b>	<b>1015</b>
„EXPERIMENTAL PROGRAMMING IN MATERIALS SCIENCE”, <b>Petrica VIZUREANU</b>	<b>1020</b>
„STUDIES REGARDING OF SUPERFICIAL HEAT TREATMENTS EFFECTUATED WITH MODERN TECHNOLOGIES”, <b>Adriana ZARA, Emilian ENE, Bogdan NOVAC, Ioan GIACOMELLI</b>	<b>1023</b>



## ANALYZE OF WELDING PROCESS ON THE HIGH ELASTICITY STEEL PLATES

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**Abstract:** *The steel plates with fine grain and high elastic limit have been done lines of fusion (welding). The welds obtained are described with identification welding regime conduction or keyhole , from section in weld shape. The weld surface details like solid waves, weld lifting, humpings , crater at end of welding process are analyzed. There is a primary investigation of experimental welding process with the aim to select the results.*

**Key words:** *laser welding, steel, keyhole welding, heat affected zone*

### 1. INTRODUCTION

Laser welding is one of the most widespread processes in material processing. Specific for process is using radiation at heat flux density of over  $10^5$  W/cm<sup>2</sup>. A large number of applications relates to welding of metals, especially of steels of different thicknesses.

The process shows two major categories of influence factors: the influence of factors related to radiation and the influence of factors related to material and the process design. In the field of laser welding an important issue is to identify welding regime (welding in the conduction regime or in the keyhole regime).In paper [1] are presented the differences between the two welding regimes. On the welds surface appears solid waves, produced by solidification in movement of melted metal. They are at equal distances, and show a paten reproduction. This is associate with the weld lifting These provide information about phenomena occurring during the welding process [2].

To have a clear the irradiation effect is necessary to have a welding process conditions

which minimize factors that can induce instability in the process.

For this purpose has been achieved the fusion lines on the steel plates also named welding belts.They provide information about the ability of laser to melt the material.

In the present paper an primary analysis is made on the experimental results aiming to record the diferences between the welds on the visual observations.This type of analysis is performed before moving to the actual measurements about weld parameter (width and depth).We identified on each weld and the weld characteristics and the features of weld surface.

### 2. EXPERIMENTAL PROCEDURE

The experiment consisted of fusion lines (welds) with the line length of 110mm on steel Dillimax500 plates with thickness 10 mm.An industrial laser machine Nd: YAG Triumph Haas 3006D was used. It emits radiation with wavelength  $\lambda = 1.06$   $\mu$ m and have a maximum power of 3kW. Irradiation was performed in continuous regime. Laser

beam was transmitted through a fiber with 0.6 mm diameter. The focusing system assures the spot in focal point with 0.6 mm diameter.

The focal distance of lens was 200 mm. As protective gas was argon with a flow rate of 20 l / min. On the 6 sheets of material with 100×130×10 mm dimensions was made between 5 and 8 welds on each plate, total 37 welds.

The material used was steel Dillimax500 EN 10137. This is a fine grain steel with high elasticity limit elasticity. Chemical composition in percent is presented in Table 1:

Tabel 1 Chemical composition of steel

C	Si	Mn	P	S	Cr	Ni	Mo	V+Nb
≤0.16	≤0.50	≤1.60	≤0.02	≤0.01	≤0.7	≤1.00	≤0.60	≤0.08

Steel was made by tempering in water and return .Dillimax500 has a low carbon content and relatively low carbon equivalent index.

Also it shows a low hardness in heat affected zone and therefore a low risk fracture at cold because inclusion of hydrogen and good tenacity. Experience shows that good characteristics are obtained in welded area if the parameters are chosen so that cooling times  $t_{8/5}$  have value between 10 to 30 seconds. In welding process the elasticity limit usually decreases. As a material structure steel Dillimax 500 is relatively homogeneous. Also presents good anticorrosive properties.

The radiation was controlled by variation of three parameters: laser power, welding speed and defocusing distance (position between the focal point and the piece surface).

By variation of these parameters was made the control of two parameters: the laser beam intensity and time interaction time. Both parameters were calculated in relation to the size of 0.6 mm focal spots. To achieve a complete characterization of experimental conditions were presented in term of calculated parameters interaction relative to the size of focal spots and the laser beam intensity.

Data characterizing each experimental test are presented in Table 2. Cutting of plates was

performed at 20 mm before the end of the process. The area was considered the most stable in the process.

Tabel 2 Experimental parameter of welds

weld	Interaction times $t_i$ [ms]	intensity I [W/cm <sup>2</sup> ] ×10 <sup>5</sup>	weld	Interaction times $t_i$ [ms]	intensity I [W/cm <sup>2</sup> ] ×10 <sup>5</sup>
1	60	1.76	20	24	3.59
2	60	3.52	21	60	0.54
3	60	5.29	22	60	1.09
4	60	8.81	23	60	1.63
5	60	10.58	24	60	2.72
6	240	7.05	25	60	3.27
7	120	7.05	26	240	2.18
8	60	7.05	27	120	2.18
9	40	7.05	28	60	2.18
10	24	7.05	29	40	2.18
11	60	0.89	30	24	2.18
12	60	1.79	31	24	3.53
13	60	2.69	32	24	10.61
14	60	4.49	33	24	1.8
15	60	5.39	34	24	5.41
16	240	3.59	35	36	4.91
17	120	3.59	36	36	4.91
18	60	3.59	37	36	2.45
19	40	3.59			

### 3 EXPERIMENTAL RESULTS

Experimental results are presented in the form of images welds, top view and section. They were seen as aimed at rapid identification of weld characteristics preceding analysis based on measurement and conclusion based thereon. In this analysis the welding regimes were identified by shape of weld in section on the imagines shape type 1 shows the conduction, shape the type 2 shows an intermediate regime between the conduction and keyhole, a shape of type 3 shows the keyhole, figure1).

Heat affected zone was observed in both cases surface and on section. The two observations are correlated .Thus , the presence of a heat affected zone on the surface was confirmed by the presence of the section. On the weld surface appear solid waves due to solidification process of molten metal waves. There are two aspects of this process namely general lifting of weld cord and solid waves that appear on the weld surface. Usually these waves are uniform as the height and frequency, which is designated in term “uniform or homogeneous solid waves”. Also there is situation in which there are two or more types of regularly waves, which is

designated in term of “multiple solid waves”. An extreme form of multiple solid waves affect the weld lifting, it produces regularly or less regularly lift on the weld surface, phenomenon called „humping”; This is an undesirable phenomenon because it hurts the appearance and quality of the weld.

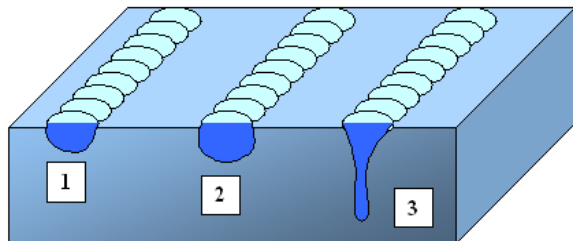


Figure 1 The three types of weld shapes 1. conduction regime 2. intermediary regime between conduction and keyhole 3. keyhole regime.

There was also the study about the crater that appears at the end of the welding process. The surface has a shape ovoid. This is the remains from welding bath after solidification. Study of solid waves and crater issues are on the one hand a role phenomenological role related to the welding regime and on the other hand, are useful to study the surface quality weld.

Weld 1 (figure 2) shows smooth surface without lifting, elevation on start process and crater at end process reduced. There is conduction regime type 1 shape only the surface is melted not a distinguished section, there is not a melt in depth. Weld 2 (figure 2) shows smooth surface, solid waves almost homogeneous, smooth edges of weld, circular crater at end of process and low heat affected zone. The section shape is type 2, this mean conduction regime, low heat affected zone. Weld 3 (figure 2) shows lifting almost homogeneous solid waves smooth edges, final circular crater at end of process extended heat affected zone. The section shape is type 2, and shows a keyhole regime. Weld 4 (figure 2) shows heat affected zone in surface and section, multiple solid waves, straight edges, elongate crater at end of process, strong weld lifting. There is a keyhole regime and shape of section is type 3.

Weld 5 (figure 2) shows extended heat affected zone in surface and section, visible on the back side of piece. It shows very elongate crater at end of process, straight edges, with multiple solid wave great lifting with formation the “humps”. There was observed small drop of molten material scattered near the weld. The welding regime is keyhole, with type 3 shape of section.

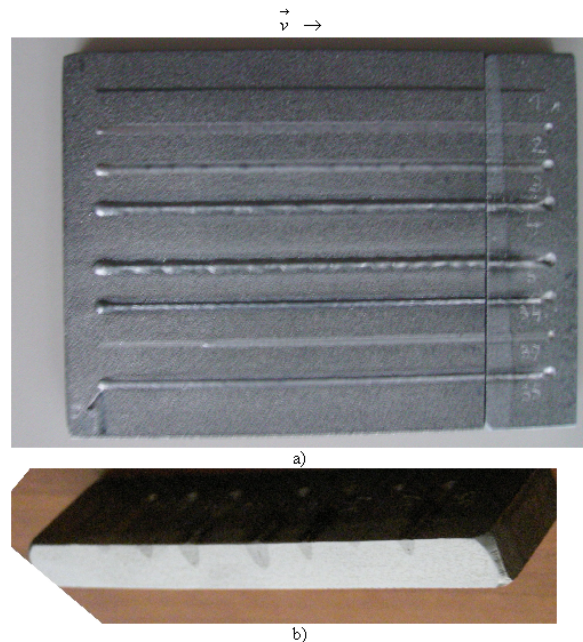


Figure 2 Photograph of the plate 1) Top view b) view section view, from left to right the welds: 1,2,3,4,5, 34,37,35

Weld 34 (figure 2) shows straight edges, multiple solid waves with a relative homogeneity, heat affected zone on surface, but reduced in the depth, elongate ovoid crater at end of process, significant lifting, besprinkle scattered near the weld. The weld is in the keyhole regime and section has type 3. Weld 37 (figure 2) is less penetrated, indicates a conduction regime, with section shape type 1. There is not melting in depth and heat affected zone is reduced. Weld 35 (figure 2) Cord shows heat affected zone in surface, solid wave nearly homogeneous finally, crater ovoid, straight edges, low tendency to produce besprinkle. The section is type 3, keyhole

regime with reduces heat affected zone in section.



Figure 3 Photograph of the plate 2) Top view b) view section view, from left to right the welds: 6,7,8,9,10

Weld 6 (figure 3) shows considerable width multiple solid waves extended heat affected zone, in surface and section visible on the back side of piece, the weld edges variables due lateral melt flow ,the crater at end process final circular crater, the weld don't have lifting Section shape is type 3 and show a keyhole welding regime. Weld 7 (figure 3) shows multiple solid waves with tendency to homogenization, reduced lifting, extended heat affected zone visible on surface section and on the back side of piece .The crater is almost circular .Section shape is type 3 and shows a keyhole regime. Weld 8(figure3) shows great lifting, multiple solid waves, ovoid crater at end of process, straight edges, and heat affected zone. The welding regime is keyhole and the shape of section is type 3.Weld 9(figure3) shows lifting, strongly elongate ovoid crater at end of process, heat affected zone, solid waves multiple .There is a keyhole regime and section shape is type 3.Weld 10 (figure3) shows lifting , strong flow of melt flow with tendency to form

besprinkle, multiple solid waves, crater at end of process ovoid and heat affected zone reduced. The shape of section is type 3 and the there is a keyhole regime.



Figure 4 Photograph of the plate 3) Top view b) view section view, from left to right the welds: 11,12,13,14,15,36

Weld 11 (figure 4) shows smooth surface, not lifting, all surface details are reduced. There is only a thin melt layer on surface. The welding regime is conduction and shape of section is type 1. The melt in section is difficult to be distinguishing. Weld 12 (figure 4) shows smooth surface without lifting, crater circular at end the process. The section is type 1, and welding regime is keyhole. Weld 13(figure 4) shows small lifting, circular crater at end of process, multiple solid waves. The section has type 2 shape and welding regime is keyhole. Weld 14 (figure 4) shows lifting, crater at end of process is ovoid, heat affected zone , multiple solid waves. The section has type 3, keyhole regime and shows extended heat affected zone. Weld 15 (figure 4) shows great lifting , great heat affected zone on surface, section and visible on the back side of piece. The shape of section is type 3 which show a clear keyhole regime.

Weld 36 (figure 4) presents lifting almost regular solid waves, ovoid crater at end of process. Section shows heat affected zone, type3 shape and keyhole regime.

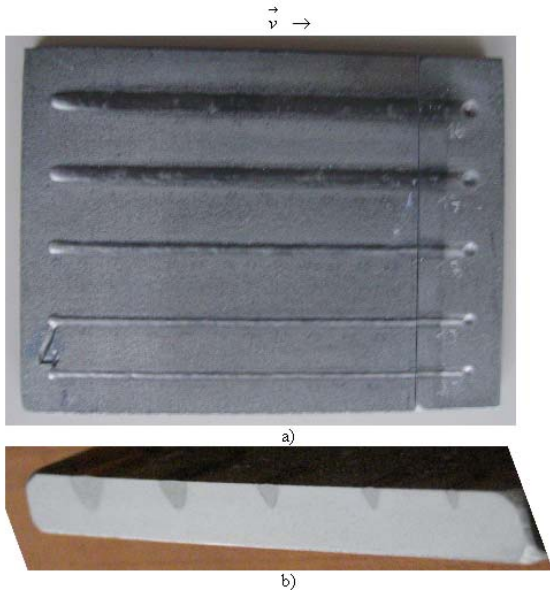


Figure 5 Photograph of the plate 4) Top view b) view section view, from left to right the welds: 16, 17,18,19,20

Weld 16 ( figure 5) shows great extended heat affected zone in surface, section and visible on the back side of the plate, small lifting circular crater at end of process , homogeneous solid waves. The weld was in keyhole regime and section shape is type 3. Weld 17( figure 5) shows great visible heat affected zone in surface section and on the back side of piece, small lifting , almost circular crater at end of process homogeneous solid waves The weld is in the keyhole regime and shape of section is type 3. Weld 18 (figure 5) shows heat affected zone in surface and section, lifting, solid waves multiple ,ovoid crater at end of process. The welding regime is keyhole, and section shape is type 3. Weld 19 (figure 5) shows, lifting homogeneous waves, heat affected zone in surface and section, ovoid crater at end of process. The welding regime is keyhole and the section shape is type 3. Weld 20 (figure 5) shows the heat affected zone in surface and section, lifting, elongate ovoid crater at end of process,

almost homogeneous solid waves. There is a keyhole regime and the section shape is type 3. Weld 22 (figure 6) shows smooth surface without lifting, straight edges, all details of surface are reduced. The section shape is type 1 and there is a conduction welding regime.

Weld 21 figure 6) is thin melt layer on the surface of piece. The surface details are reduced. The welding regime is keyhole, the section has type 1 shape, but is very weak penetration. Weld 23 (figure 6) shows relative straight margins, without lifting, circular crater at end of process, homogeneous solid waves. There is a conduction welding regime and section shape is type 2. .

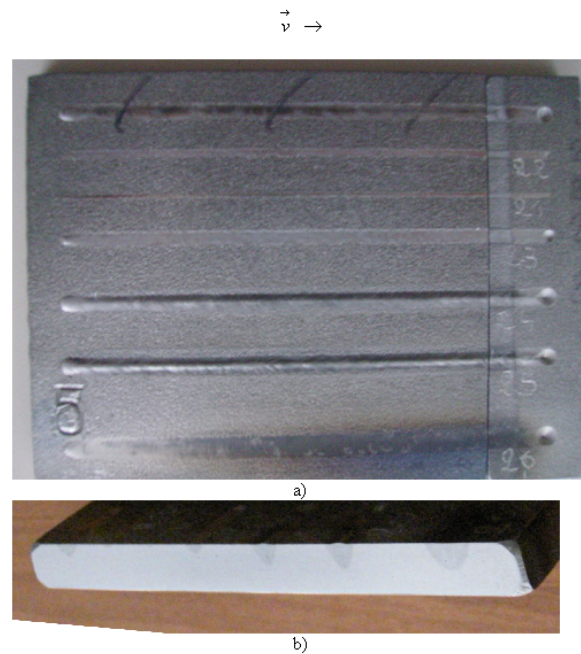


Figure 6 Photograph of the plate 5) Top view b) view section view, from left to right the welds: 22,21,23,24,25,26

Weld 24 (figure 6) shows relatively homogeneous solid waves, moderate lifting, straight edges, circular to ovoid crater at end of process, heat affected zone at surface and in section. The section has type 3 and shows a keyhole regime. Weld 25(figure 6) shows lifting, multiple solid waves due strong melt flow, elongated ovoid the crater at end of process, great affected zone in section and

surface. The welding regime is keyhole and the section shape is type 3. Weld 26 (figure 6) shows heat affected zone at surface in section and visible on the back side of piece, no lifting, homogeneous solid waves circular crater at end of process, heat damage is visible to end of weld. Heat affected zone is much expanded much. The section shape is type 3 and show a keyhole regime. Weld 27 (figure 7) shows low lifting, homogeneous solid waves, circular crater at end of process, extended heat affected zone, small asymmetry of the melt. The section shape type 3 and the welding regime is keyhole.

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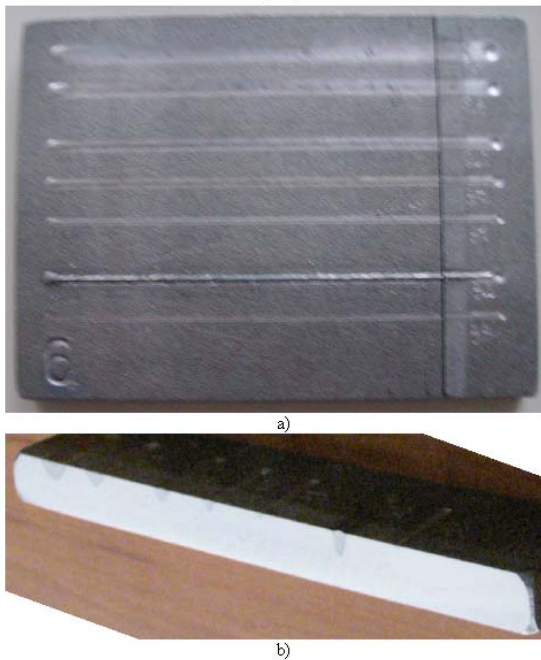


Figure 7 Photograph of the plate 6) Top view a) view section view, from left to right the welds: 27, 28, 29, 30, 31, 32, 33

Weld 28 (figure 7) shows reduced lifting, homogeneous solid waves, round to ovoid crater at end of process, extended heat affected zone. The welding regime is keyhole section has type 3. Weld 29 (figure 7) shows reduced lifting crater 1 round to ovoid crater at end of process, almost nearly homogeneous solid waves, heat affected zone. The section shape is type 3 and show a keyhole regime. Weld 30 (figure 7) shows reduced lifting, almost homogeneous

solid waves, the circular crater at end of process, reduced heat affected zone. The shape of section is type 3 and show keyhole regime. Weld 31 (figure 7) shows a conduction regime, with type 1 section, without lifting circular crater at end of process, low heat affected zone. Weld 32 (figure 7) shows great lifting, strong melt flow with besprinkle spread near the weld, heat affected zone relative small, multiple solid waves elongate crater at end of process. This is very clear keyhole regime, section shape is type 3. Weld 33 (figure 7) shows smooth surface, circular crater, at end of process, multiple solid waves and low heat affected zone. There is conduction regime, the section shape is type 1

#### 4 CONCLUSIONS

In the case of use of high laser intensity is achieved strong penetrate welds in the keyhole welding regime. At increase the intensity the section shape goes gradually to type 3 shapes. Increasing intensity leads to increased penetration but not necessarily and welds width. Intensities higher than  $5 \times 10^5 \text{ W/cm}^2$  make lifting, multiple solid waves and elongated crater at end of process. At intensities above  $10^6 \text{ W/cm}^2$  were produced melt drops and their expulsion near the weld. Also there is undesired phenomena like humps and melt flows.

Increasing interaction time leads to increased weld width. For times of interaction great than 100ms from heat affected zones are extended. Also in this case there is the risk of burning the weld.

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## CONSIDERATIONS REGARDING MATHEMATICAL MODELING OF THE CEREAL DRYING PROCESS

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**Abstract:** This paperwork shows some observations and conclusions regarding the necessity of technical methods utilization for preservation of cereal products by cooling systems, in the meaning of efficient storage activities and preservation of cereals, of keeping the standards for quality and nutritional safety in the present context of integration in the great European family.

**Keywords:** cereals humidity, storage temperature, temperature of the drying agent

### 1. INTRODUCTION

Cereals represent the most important basic food for human kind. According to data from FAO [4], annually there are losses of 20% from the harvested crops in the world. The larger part is due to insect activity and development of fungus and mold.

Each year approximately 60 millions tons of cereals are lost through the process of molding, due to poorly storage [5, 6, 9].

Detailed analysis of existing dryers in exploitation shows that their cycle of functioning can be improved through implementing command and monitoring systems conducted by computer, on the basis of calculation programs for the value of one or more parameters, as a function of the input data.

The designs for an automatic adjusting system for temperature in a drying installation impose knowing a complex of parameters, and their interdependence is expressed through criterion equations of different forms.

### 2. NEW ASPECTS REGARDING CEREAL CONSERVATION

Usually, the experimental data consist in data pairs  $(U_i, \tau_i)$ , for dependencies of one variable, or sets of data  $(U_i, \tau_i, t_i \dots)$ , for dependencies of more variables [1,7,8].

Here,

$U$  is the humidity content, [%],

$\tau$  - drying time [minutes],

$t$  - temperature [ $^{\circ}$ C],

$i = 1, 2, 3, n - 1,$

$n$  - measuring number .

The problem is in approximating the discrete dependencies  $U_i(\tau_i)$  or  $U_i(\tau_i, t_i)$  with continuous dependencies,  $U(\tau)$  or  $U(\tau, t)$ . There are three types of approximations:

- data interpolation and extrapolation,
- data regression,
- data filtration.

The method consists in determining the class coefficients for the chosen function, so, for the process modeling it will be chosen the polynomial:

$$U(\tau) = a_0 + a_1\tau + a_2\tau^2 + \dots + a_{N-1}\tau^{N-1} \quad (1)$$

Filtering techniques are applied to the sum analysis for excluding of the noise effects, meaning for functions intensively oscillating, and so, for this type of application is preferably the regression of the experimental data.

The regression consists in determining a function  $U(\tau)$  that in a certain sense minimizes the digressions  $|U_i(\tau_i) - U(\tau_i)|$ .

The success of this kind of application depends in a large measure of the correct choice





$$T_3(\tau_3, U_3) = a_U \cdot U_3^2 + b_U \cdot U_3 + c_U + a_\tau \tau_3^2$$

$$T_4(\tau_4, U_4) = a_U \cdot U_4^2 + b_U \cdot U_4 + c_U + a_\tau \tau_4^2$$

In figures 1, 3 are presented the diagrams for the equations of the drying agent temperature for grain seeds, destined for consumption, and

in figures 2, 4, for seed, and the graphical evolution of those functions. Also, in figures 2, 4, 6, 8, there are presented the maximum temperatures of the drying agent for grain and corn seeds as a function of the product humidity and drying period.

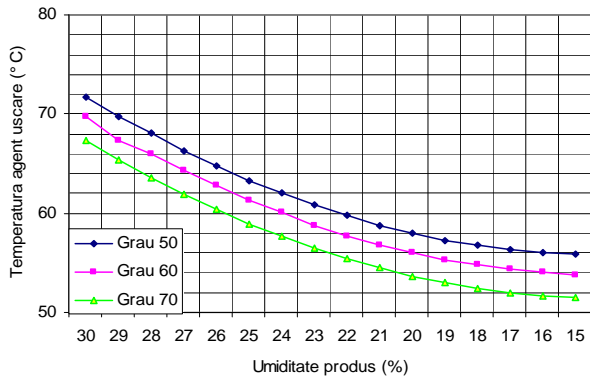


Fig. 1 Maximum temperature of the drying agent for consumption grain

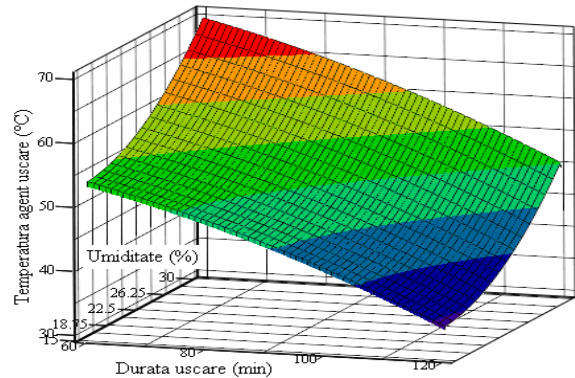


Fig. 2 Maximum temperature of the drying agent for consumption grain

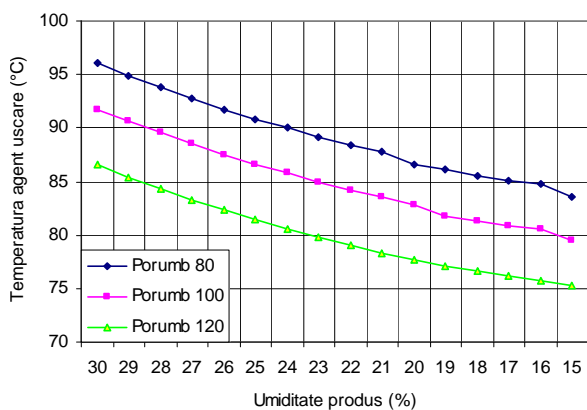


Fig. 3 Maximum temperature of the drying agent for consumption corn

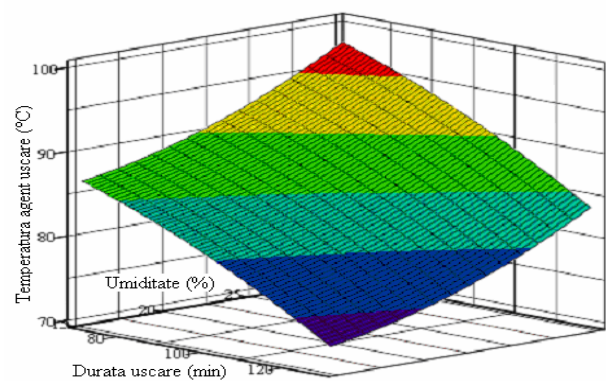


Fig. 4 Maximum temperature of the drying agent for consumption corn

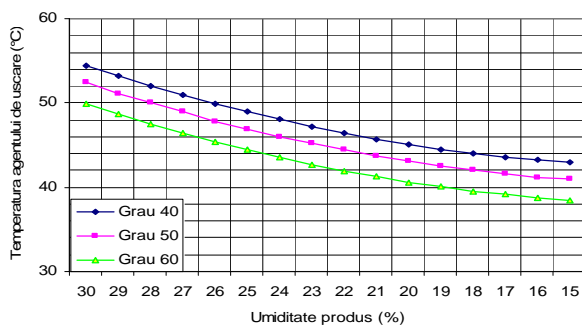


Fig. 5 Maximum temperature of the drying agent for grain seeds

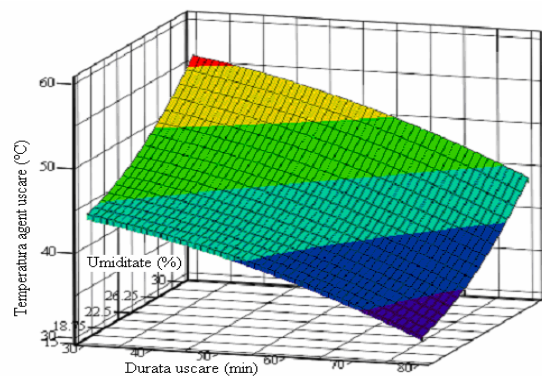


Fig. 6 Maximum temperature of the drying agent for grain seeds

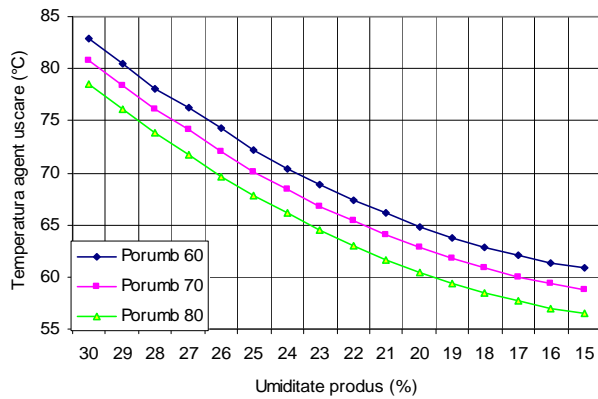


Fig. 7. Maximum temperature of the drying agent for corn seeds

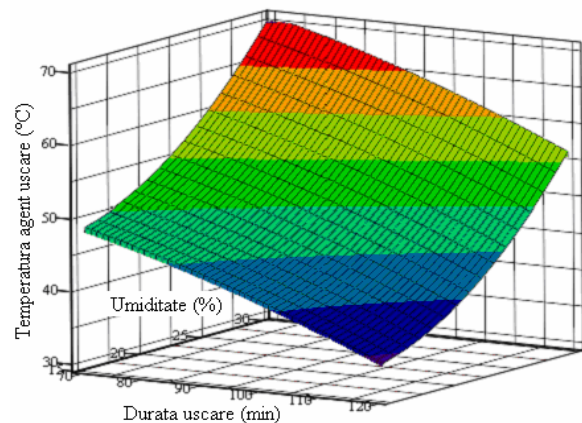


Fig. 8. Maximum temperature of the drying agent for corn seeds

#### 4. CONCLUSIONS

Following the analysis of the experimental data it will be observed that for conserving in good conditions the germinative quality of the grain seeds at a constant thermal regime, in the conditions of average energetic consumption it is recommended a temperature of 80°C for the drying agent and a period of 55 – 65 minutes, followed by a cooling of minimum 10 minutes. Also, for seeds destined for consumption it is recommended a constant thermal regime, but an increase of 10 - 15% for the temperature value of the drying agent. The temperature value for the drying agent depends of the species and their destination.

Applying of an aggressive regime (high values for the drying agent temperature, longer period of maintenance, etc), can lead to the depreciation of the products (frying, burning, etc), implying modifications of the organoleptic characteristics of the cereal.

For this, the applying of the drying and storage technologies in a complete volume with good quality, in the case of the analyzed cereals can concur to the reduction of the unwanted effects with great psychological impact over the population.

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## OPTIMISATION OF THE DRYING TECHNOLOGICAL SYSTEMS AND THE ADHERENCE TO THE EUROPEAN REGULATIONS REGARDING POLLUTANT EMISSIONS

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**Abstract.** *The present paper shoes a few observations regarding the drying process through convection of the grains, using the actual storage technology, keeping the standards for quality and nutritional safety in the present context of integration in the European Union. Drying seed grain for the purpose of storage for long periods, it's a method used in food industry on a large scale, but should take into account the parameters of drying, and the process, and the process takes place without the depreciation of the quality of grain..*

**Keywords:** *regression coefficients, drying process, final humidity, final temperature, technological process, mathematical modeling.*

### 1. DESIGNING THE NON-LINEAR EXPERIMENTS RDS( = RESPONSE SURFACE DESIGN) TYPE

This set of experiments named factorial superior order experiments are used for the purpose :

- setting the factors for obtaining the best response,
- setting the factors that are satisfying the technical imposed conditions,
- identification of new operating conditions that are leading to improving the quality of the technological process,
- establishing the quantitative interdependencies model between factors and response.

For the experiment at which we need to find the answer – corn drying, are established the control factors and their variation [1].

The realization of 14 tests, planned according to the previous information obtained in the drying process that identified the optimum domain [2, 4, 5].

The chosen statistical programs package allowed mathematical modeling for the drying process, resulting the regression coefficients from tables 1.

Table 1 Regression coefficients for corn drying

Termen	Coef	SE Coef	T	P
Constant	10.6230	0.862564	12.316	0.000
Block	-0.0772	0.029491	-2.618	0.034
Temperature	0.1133	0.016743	6.769	0.000
Time	0.0653	0.021076	3.097	0.017
Temp*Temp	-0.0006	0.000103	-6.278	0.000
Time*Time	0.0001	0.000183	0.532	0.611
Temp*Time	-0.0012	0.000184	-6.797	0.000

It is observed an important influence that temperature has over humidity \* time and temperature\* temperature (interaction of 2nd order).

The mathematical model is very good, it approaches the experimental data, 98% of it can be found in it [3, 6, 7].

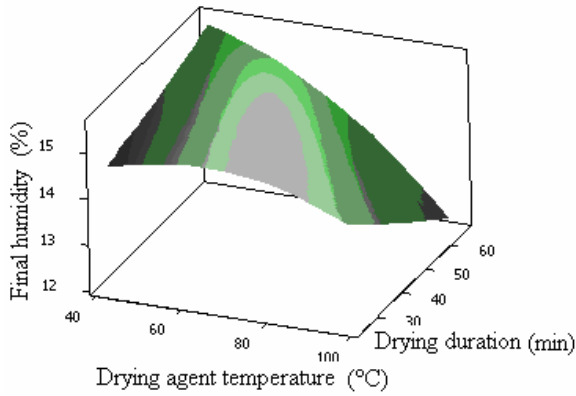


Fig.1 Final humidity variation for cereal as a function of the drying agent temperature and the process duration.

The mathematical model allows tracking the influence of each control factor over the drying process. Such resulting the final humidity variation diagrams as a function of the drying agent's temperature and the duration of the process [4, 5, 7].

The dependencies drying duration as a function of the drying agent's temperature (figure 1) and the level curves indicate the presence of a local optimum for this dependence.

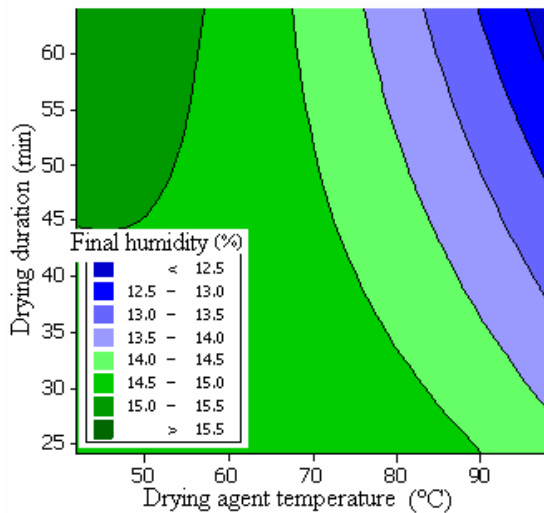


Fig. 2. The final humidity surface outline as a function of drying temperature and process duration.

Using the same reasoning, after running the statistical control program there were obtained the next regression coefficients estimated for the final humidity and the final temperature dependences of the corn as a function of the

drying agent temperature (figure 3), and the level curves that at their turn indicate the presence of a local optimum for this dependence.

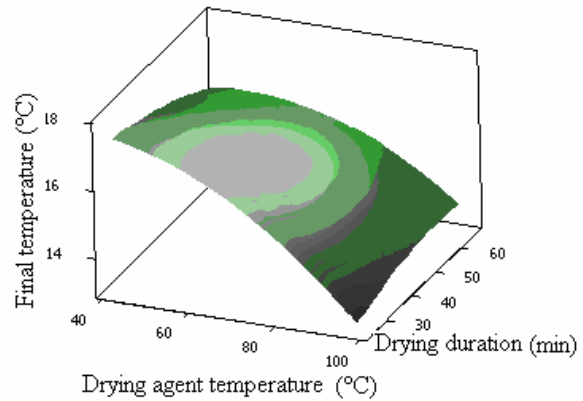


Fig.3. Final temperature surface of cereal as a function of the drying agent's temperature and the process duration.

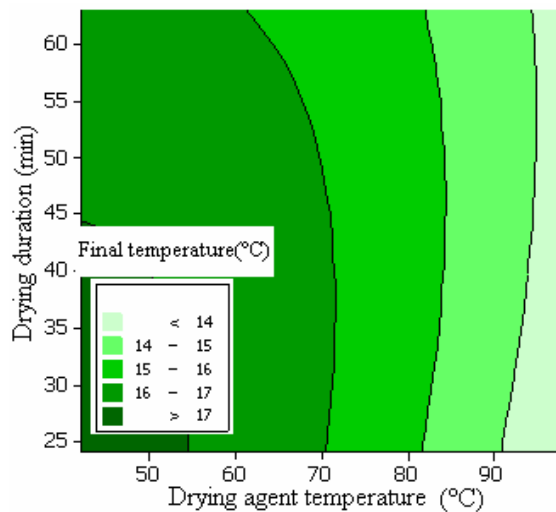


Fig.4. The final temperature outline for cereal as a function of the drying agent's temperature and the process duration.

## 2. IMPROVING THE CEREAL DRYING PROCESS.

So, for the chosen solution of the drying parameters, and also for the chosen mathematical model, the results are very good, following the identification for the optimum value chosen for the corn drying process.

Through superposition of the level curves for the humidity and temperature outlines of the drying agent it was possible to select the

optimum domain of setting the factors for improving the drying process (figure 5).

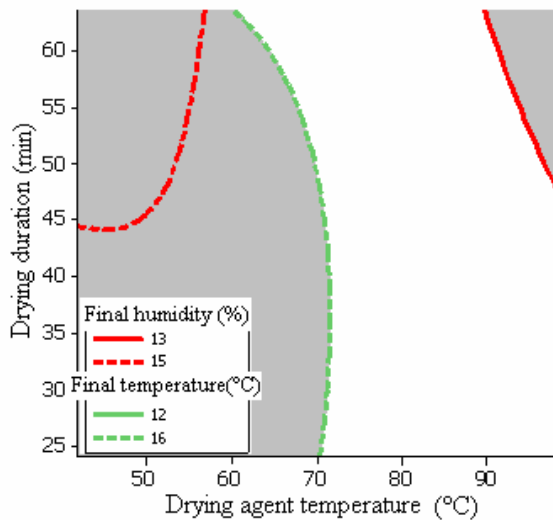


Fig.5 Outline for the humidity surface in case of cereal, their temperature as a function of the drying agent's temperature and the process duration.

The obtained values after running the MINITAB program allowed obtaining the next graphical representation for the improvement of the corn drying process

The obtained results confirm the truth of the presented technical solution in the realised research and also the fact that the technological process is found in statistic control. The controlling factors that are assuring this quality are, the drying agent's temperature = 98°C and the duration of the drying process = 66 minutes.

### 3. THE MEASUREMENT OF THE POLLUTANT EMISSIONS FROM THE FLUE GAS OF THE DRYING AGENT

For the control of the pollutant emissions from the flue gas of the drying agent for the model GSI 1126, it was used the analyzer TESTO 350 M/XL, a preferment device for the determination of the emissions in the flue gas [2, 8].

The purpose for the pollutant measurements of the emissions resulting from the burning process of the propane in order to obtain the flue gas necessary for the fresh air mix used for drying the grain, was to show that the allotment of the burning compounds in the

moisture extraction process from the grain using this type of dryer, through convection, does not affect from the point of view of the food safety.

Also, through harvesting a sufficient number of samples, there were made laboratory analysis from a certified organism for the determination of the contaminants (heavy metals – Pb, Cd) that can be found after grain drying.

The analyzed gases are SO<sub>2</sub>, CO, C<sub>m</sub>H<sub>n</sub>, O<sub>2</sub>, NO and NO<sub>2</sub>. Also it is detected the coefficient of air excess and it's determined through a computational operation the concentration of CO<sub>2</sub>, flow speed of the gas and the mass flow for all the analyzed gas species.

The device is formed from three main parts : analysis unit, control unit and the probe for gas sampling. Optional, there can be attached different sensors for temperature and a Pitot / Prandl probe.

The TESTO equipment was connected to a laptop and to a data acquisition system set to a time of 10 seconds, and was used for data acquisition through corn drying process showed in figure 6.



Fig 6 Pollutant emission acquisition form the flue gas during corn drying process

After the measurements, the determined values under the form of volumetric concentration (ppm) were transformed in (mg / m<sup>3</sup>), mass concentration and they were compared with a reference value for the oxygen, O<sub>2</sub> % = 19 %, resulting the variation laws for CO, NO, H<sub>2</sub>S, NO<sub>x</sub>, H<sub>2</sub> and O<sub>2</sub>, (figures 7,8, 9).

The average value measured of approximate 400 – 450 mg/m<sup>3</sup> for CO, indicates a normal functioning for the burner, those values being realized for the beginning part of the drying process, followed by an increasing part of approximate 10 – 15% in the end of the drying process.

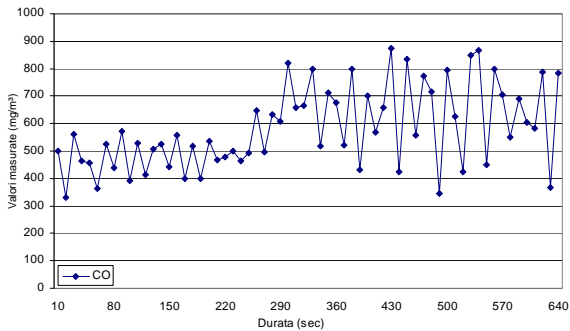


Fig.7. Diagram with the CO concentration variation for GSI 1226

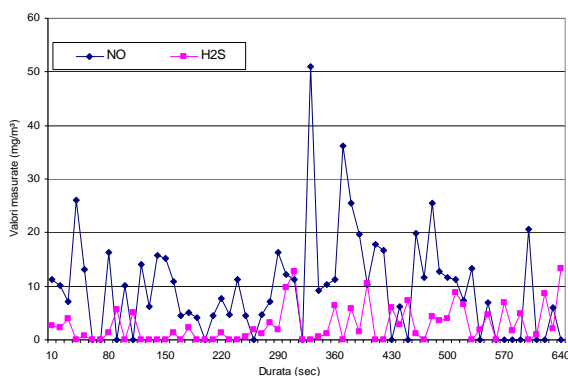


Fig.8. Diagram with the NO and H<sub>2</sub>S concentration variation for GSI 1226

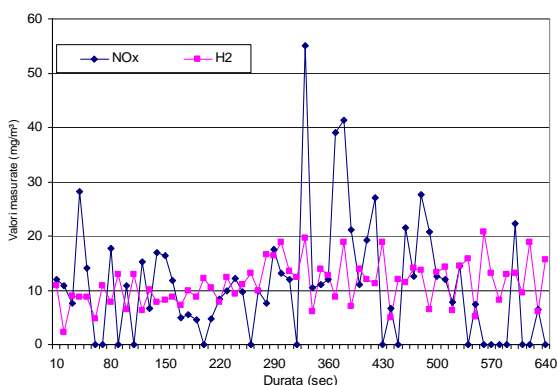


Fig. 9. Diagram with the NO<sub>x</sub> and H<sub>2</sub> concentration variation for GSI 1226

The values for NO, H<sub>2</sub>S, NO<sub>x</sub>, H<sub>2</sub> are in the range of normal values. NO and NO<sub>x</sub> have two peak values that are in normal range of the accepted limits. The other values, H<sub>2</sub> and H<sub>2</sub>S are favorable and in concordance with the legislation.

#### 4. CONCLUSIONS

1. Making the statistical control using the MIBITAB program showed that the mathematical model is well determined if the installation is working properly, in the accepted limitations, the measurements are realized in a correct manner and the results for the drying process are the desired ones.
2. Making measurements in real time over the dried material, it was determined the values for the main parameters : drying agent temperature, final humidity for the product, final temperature for the product, using the statistic analysis, fact which allowed the determination of the optimum value for the drying process.
3. The determination of the values for the pollutant emissions from the flue gas allows the use for consuming of the dried grain through convection in the GSI 1226 dryer.

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## STUDIES REGARDING THE CAUSES OF AVERAGES PRODUCED AT COMPONENT PARTS OF ROLLING MATERIALS

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**Abstract** .The paper refers to railway rolling stock parts stress behavior. It describes the causes and the types of damage during operation.The conclusions emphasize possibilities for increasing reliability.

**Keywords** : wear adhesion, rolling stock, corrosion wear, abrasive wear.

### INTRODUCTION

The railway transports development occurs as a consequence and as a necessity of general development of economy. At the same time with the increasing tonnages towed and increasing the speed it is necessary to improve traffic safety measures.

An important factor of train traffic insurance is the elimination of derailments and the causes that produce them. The big weight that the waggon have, the multiple handling waggons, determined the majority number of the derailments produced at this waggons. From the research of evidence register of accidents and events of the railway , it was possible to determine the most common causes that lead to derailment of railway vehicles, namely :

- widening of the gauge under load due to inadequate railway sleeper ;
- uneven settlement of the load inside the waggons, without respecting the instructional precautions ;

- handling the railway switchgear under the train ;
- breaking the axle neck , due to the destruction of the rings from the bearings of the axle box;
- breaking the iron rail under the weight;
- the railway engine personnel and the railway train personnel ,did not respect the instructional indications ;
- technical defects of rolling materials were not tracked down in time.

The most common cases of derailments are due to wearing parts of rolling materials. Because the majority of these wears can not be detected when performing technical reviews at trains, or brake tests at trains , they are considered to be the most dangerous for traffic safety trains.

The main components of rolling materials, which are subject to wear and that can endanger traffic safety are :

monoblock wheel or the wheel clamping tyre ( fig. 1 – 6 ) ;



Fig. 1



Fig. 2



Fig.3



Fig. 4



Fig. 5



Fig. 6

foot step bearing ( fig. 7- 8 ) ;



Fig. 7



Fig. 8

head step bearing ( fig. 9-11 ) ;

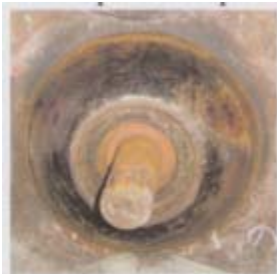


Fig. 9



Fig. 10



Fig. 11

boards of wear between chassis and bogie ( fig. 12-13 ) ;



Fig. 12



Fig. 13

the brake hangers ( fig.14 – 15 ) ;



Fig. 14



Fig. 15

Through the process of wear it is understood any loss of material from the solid surfaces in friction, having as a result the

modification of dimensions, geometric form and bearing clearance. This process appears as a complex phenomenon, due to various



causes and determined by a large number of factors and conditions ( mechanical properties, micro and macro geometrical surfaces particularities, operating parameters, quality lubrication, the axle lubricant used) . The physical wear, it is a progressive process, complex, destructive, by physical chemical nature, which has as a main effect the produce of wear. In relation to processes that developed during friction surfaces in contact, with the forms of surface interactions, the phenomena and the laws that governing the wear process ,which appears both at wear drying and in the presence of the lubricant, the wear can be: adhesive wear, abrasive wear, surface fatigue, and corrosive wear. In practice, at the operationing of the waggon coupler friction appear combinations of these types of wears and separate only in special cases.

**The adhesive wear** ( wear contact ) appears in all forms of friction when the joint surfaces are no longer completely separated by lubricant, that is in the moment when the lubricating is intrerrupted as a result of defects at the lubricating instalation, use of a lubricant inadequately in relation to the clearance, speed and load of coupler ,or an insufficient amount of lubricant between the contact surfaces. The adhesion wear is produced by welding and breaking of welding bridges between micro areas of contact, being characterized by a high coefficient of friction and a high intensity of wear as in figure 16.

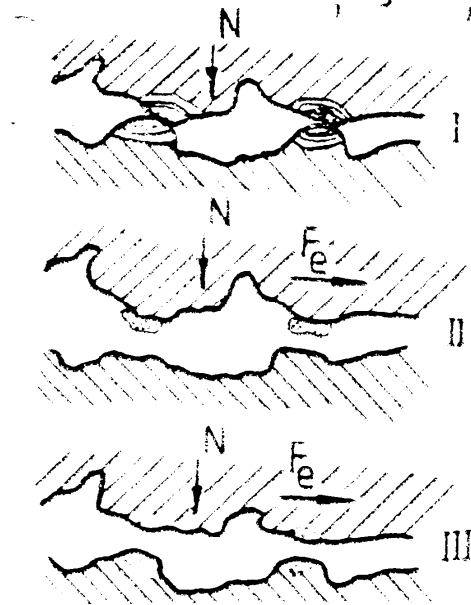


Figure 16. formation of junction and their shearing.

A consequence of wear adhesion is seizing, which appears at large weight, when the lubricant is missing or the piercing the film after a local high heating until the temperature of melting material.

Under the action of load , the surfaces are approaching at a distance of atomic interaction. The adhesion or the strong micro contracts that were wearing can not be slate and the relative movement between the surfaces stop, the friction couple being stucked.

**The abrasive wear** is provoked by the presence of hard particles by one of contact material parts. This wear is of mechanical nature and it is easy of recognizing, by tracks leaved by micro cutting from pins parts of hard particles or asperity on direction of move, or by plastic deformation, if the asperity are rounded and the weight is large. Abrasive wear accelerates the corrosion wear. The hard particles can be proceed from previous shearing of some contacts ( adhesion of wear ),by detachment of portions from the harder layer of the surface ,by detachment and disposal of pinched material etc. , as well as by metal products, from other wear.

The furrow is a form of severe abrasion, with wide and deep scratches, which may be directly produced by counter part at gearing, by big particles, hard, interpose (in brake disc case), by metallic parts and other hard materials. Example: there are cases in exploitation, when during the friction, the wheel wear is bigger than the wear chock, detaching almost exclusively wheel material which then deposit stratified and uneven on brake shoe. These deposits produce during the previous friction an ondulatory wear of rolling surface, characterized by circular scratches. These wears are produced in special when are used blocks from composite material or agglomeration material. The scratch represents the easiest form of abrasion and it manifests by linear, parallel, isolated scratches, etc.; it may appear on different parts (bearing boxes, sheathing) being produced also by interdeposit of some hard particles, by action of rugosity etc.

The surface fatigue is the result of a cyclical sollicitation of the contact surfaces, followed by plastical deformations in atomic

lattice of superficial layer, by cracks, pinches, exfoliations.

The factors that influence this type of wear are: the material structure of friction parts; temperature; the type of sollicitation; concentration of efforts; variable frequency sollicitation; parts dimensions, etc. Generally, these wears appear as detachments of material particles, leaving characteristic traces of each type of wear. The fatigue of wear are: the pitting, exfoliation wear, cavity wear and impact wear. Pitting is a form of surface fatigue, of surfaces with punctiform and linear contacts, which is recognized by characteristic forms of caves and pinch (different from those of adhesive wear provoked by pulling out).

The layer fatigue is being exteriorized through very fine cracks in weak places between the crystals, namely: at the surface, in the concentration points of stress, or at a certain depth, in close proximity at the surface, in the place where there is maximum unit effort at shearing

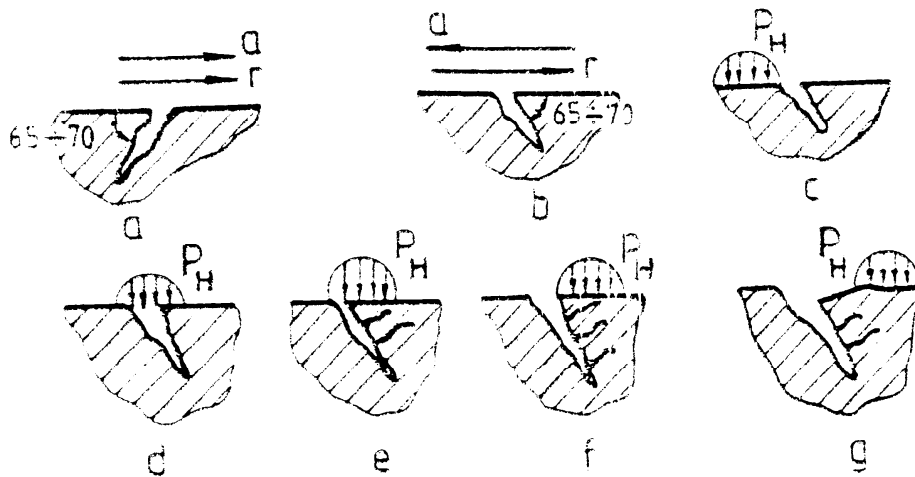


Figure 17 formation of cracks in pitting's case.

The wear by exfoliation (barking) is characterized by detachment of small metal particles of the order of 1 mm, or oxides of the order of 0,01 mm, occurring at metallic

plastic material, it is overtaken the resistance to shearing, in the areas of contact with friction concentrated. Example: spatter are loadings material in the form of blades which

are the material from rail or from the brake hangers, which are well welded on rolling area of the wheel and which are smooth laminated rolled wheel. Spatter are formed after a braking prolonged, which leads to the impossibility of eliminating heat resulted from the wheel-rail contact or chock-wheel.

*The cavitation wear* is defined as a process of destroying on the surface (and the movement of material in the form of small particles), produced by liquid or gaseous medium in contact with metal, without the presence of the second friction surfaces, as in other forms of wear. It also called for cavitation erosion and cavitation corrosion, and is produced usually on the surfaces palettes, rotors of the pump, diesel engine cylinders etc., which are in contact with fluids at high speeds.

*The impact wear* is due to local repeated strikes and appears when the slip or the rolling is an composed impact (normal and tangential components). The impact wear can be classified in two categories : the percussion wear and the erosion wear. Generally, the wear impact contains basic mechanisms of wear : adhesion, abrasion, surface fatigue, chemical and thermal wear.

**The corrosion wear** constitutes the damage to the surface friction and therefore loss of material, weight, due to the action of simultaneous and successive chemical factors in the aggressive chemical environment and mechanical solicitations. The wear mechanism involves correlating corrosion effects : chemical, electrochemical and mechano-chemical . The chemical corrosion is a continues chemical action on the environmental on surfaces of the component determinate fund. The chemical corrosion may evolve differently, depending on the parameters physico-chemical of respectively material. During the rest act this corrosion acting as a pure chemically process only on open surfaces, that do not pass through the contact. The electrochemical corrosion

involves, besides chemical reactions and a transfer of electric charge on the surface of separation between the metal and corrosive environment.

The mechano-chemical corrosion (tribochemical) refers to modifications suffered by surface friction during the operation time.

**CONCLUSIONS** Conclusions regarding the possibilities of increasing the fiability of parts by material rolling componency. Parts of the rolling stock which are subject to wear during operation time , may be improved increasing the operation if it consideres the following :

- the correct choosing of materials for the parts that come in contact;
  - applying of adequate heat treatment ;
  - the quality of the surface subject to wear to correspond ;
  - to prevent the apparition of suplimentary solicitations at biger clearance between the waggon coupler, shocks, the access of strange particles,etc.
- Also for increasing the fiability of some products, there have been considered the following :
- the study of solicitation and their size for bench mark at which appers wear and defects ;
  - preventing the events through periodic control of the subassemblies;
  - operative replacement of parts subject to moderate wear ;
  - parts with moderate wear to be reconditioned to be used again if needed.

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## VALUE ANALYSIS AND REDESIGN OF EQUIPMENTS

### Parth I

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**Abstract:** Value Analysis (VA) is a method that provides an operating technique using a creative and organized approach. It is managed by a group, each of them selected by their expertise in specific subjects and coordinated by a Value Analysis expert.

The paper presents a complete study of VALUE ANALYSIS applied concretely to a selected piece of equipment. The phases and ITERATIVE operation of the Value Analysis method are presented.

Value Analysis combines both ENGINEERING and ECONOMICS without, however, placing neither ENGINEERING or ECONOMICS first. They both are similarly important, as can be concluded by the end of this paper.

**Key words:** value analysis, value, optimum variant

### VALUE ANALYSIS APPLIED TO THE DESIGN OF A JAW CRUSHER

Further on an example of Value Analysis is presented, applied to the redesign of a jaw crusher used for primary crushing of a wide variety of materials in the mining, iron and steel and pit and quarry industries.

Next the establishing mode of the optimum constructive solution is presented from the technical and economic viewpoint for a part participating in a function of over-dimensioned cost.

**Value Analysis (VA)** is a method that provides an operating technique utilizing a creative and organized approach.

It is managed by a group, each of them selected by their expertise in specific subjects and coordinated by a Value Analysis expert.

The VA group activity is managed in seven stages:

- formation and functional analysis,
- creativeness,
- evaluation and selection of the proposals,
- the creative phase,
- development of the selected proposals,

- presentation of the selected proposals, set in order by priority,
- implementation phase.

### ESTABLISHING THE LIST OF FUNCTIONS AND DIMENSIONS

“When functions have been identified, clarified, understood and specified, the greatest help would come from the answer to the questions:

- How much, under our conditions of quantities, manufacture, etc. is the lowest cost that would provide that function ?
- What approach and method would secure it for that cost ?
- The great danger comes in the form of a proper and practical – sounding question:
- How have we accomplished it in the past and what did that cost ?”

The three questions are at the beginning at the Thirdly Chapter “Evaluate the Function” of the “Techniques of Value Analysis and engineering” by Lawrence D. Miles.

The process of evaluating functions typically is as follows:

- Individualize separate functions,
- Understand them completely.

Table 1 presents the list of functions of the jaw crusher.

Table 1 List of functions

	Function	Type of function
$F_1$	Ensure milling	FS
$F_2$	Ensure protection of machinery	FC
$F_3$	Ensures adjustment	FC
$F_4$	Supports the assembly	FS
$F_5$	Aesthetics	FE
$F_6$	Supplies working energy	FS
$F_7$	Ensure uniformity of the movement	FS
$F_8$	Capability of work	FC
$F_9$	Wear resistance	FC
$F_{10}$	Part evacuation	FS

\*FS – Service function; FC – Constraint function; FE – Estimation function

Table 1 List of functions

Technical dimension of function			
	Name	UM	Value
$F_1$	blast degree	-	3 - 12
$F_2$	moment, force	daN*m daN	200 100
$F_3$	length	mm	10 - 25
$F_4$	weight	daN	20000
$F_5$	colour, form,	-	7
$F_6$	moment	daN*m	100
$F_7$	revolution pulsation	rot/min rad/sec	
$F_8$	volume	m <sup>3</sup>	2
$F_9$	eroded material	g/an	
$F_{10}$	Debit	m <sup>3</sup> /h	1 - 2

### ESTABLISHING THE LEVELS OF IMPORTANCE OF THE FUNCTIONS

Table 2 presents the value weighting of the functions.

The following percentage values of the functions value weighting result:

$X_{F1} = 33,3 \%$ ,  $X_{F2} = 26,7,7 \%$ ,  $X_{F3} = 20,0 \%$ ,  $X_{F5} = 6,67 \%$ ,  $X_{F7} = 13,3 \%$ .

The product value is equal to the sum of the functions levels and is equal to 15.

Foto 1 and figure 1 shows the studied jaw crusher.

Table 2 Value weighting of the functions

Functions	$F_1$	.	$F_7$	Total
Number of points	5	...	2	<b>15</b>
Ratio	0,333	...	0,133	<i>1</i>
*Percentage %	<b>33,3</b>	...	<b>13,3</b>	<b>100</b>

(\* - X coordinate)



Foto 1 Jaw crusher

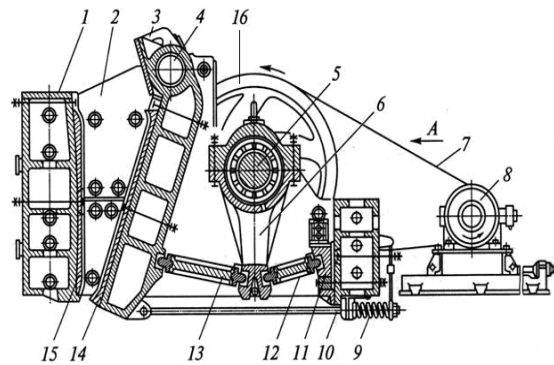


Fig. 1 – Jaw crusher:

1 – fixed crushing jaw; 2 – walls of the crushing zone are made of replaceable wearing sheets; 3 – moveable crushing jaw; 4 – axle; 5 – eccentric shaft; 6 – pitman, 7 – belting; 8 – electric motor; 9 – cylindrical spring; 10 – the bar; 11 – the adjustable wedge system makes infinite adjustments of the crusher setting possible; 12, 13 – toggle; 14, 15 – wearing parts; 16 – flywheel.

### ECONOMIC DIMENSIONING OF THE FUNCTIONS

Costs were assigned to the various functions by means of the functions-costs matrix shown in table 3.

The percentage values of the functions participation in the total cost are:

$$Y_{F1} = 22,0 \%, Y_{F2} = 28,4 \%, Y_{F3} = 21,7 \%, Y_{F5} = 9,63 \%, Y_{F7} = 18,3\%.$$

Table 3 Distribution of costs on functions (\*Y coordinate, \*\* monetary units)

	Parts	**Cost/ part	F u n c t i o n	
			F <sub>1</sub>	F <sub>7</sub>
1	Fixed crushing jaw	90		
2	Walls	200		90
3	Axle	25	10	
4	Eccentric shaft	15		
5	Flywheel	395	280	100
.	...			
n	...			
Total cost		2678	590	490
Ratio		1	0,22	0,183
*Cost of functions %		100	22,0	18,3

**COMPARISON OF THE FUNCTIONS VALUE AND COST WEIGHTINGS**

The value – costs relationship needs to identify:

- The functions that are very expensive in relation to the others,
- The functions that are too expensive in relation to their contribution to the value of the product,
- The functions that are too expensive in relation to the existing technical possibilities of achievement.

**DIAGRAMS**

Further on the construction of the diagrams is presented.

Based on the values for coordinates  $x_i$  and  $y_i$  presented in table 4 the diagrams of figures 2, 3, 4 and 5 are plotted.

Table 4 provides the necessary values for constructing the following types of diagrams:

- 1) In figure 2 the diagram of the functions value weighting,
- 2) In figure 3 the diagram of the functions cost weighting,
- 3) In the figure 4 the diagram of the functions value and cost weighting,
- 4) In figure 5 the diagram of the comparing the functional values and costs weighting.

Figure 2 shows the ranking of the functions by their value.

Figure 3 shows the ranking of the functions by their functional cost.

Table 4 Computational elements for plotting the diagrams

Calculus elements	F u n c t i o n s			Total value
	F <sub>1</sub>	.	F <sub>7</sub>	
$X_i$	33,3		13,3	100
$Y_i$	22,0		18,3	100
$(X_i)^2$	1111		177,8	2444
$X_i * Y_i$	734,4		244	2233
$(Y_i - a * X_i)^2$	70,76		37,45	148
$S' *$	560,8		-163,2	-0

$$*S' = 2 * a * (X_i)^2 - 2 * X_i * Y_i$$

The parameters have the following computed values:

$$a = 0,91, \alpha = 42,4^\circ, S = 195, S' = 0.$$

The diagram allows significant comparisons of the functions total costs, and, within the total costs, of the work and material costs, highlighting:

- The very expensive functions with the highest weighting in the total cost of the product,
- The secondary functions that are very expensive in relation to the objective functions, or even more expensive than these,
- The functions the achievement of which requires disproportionate material or work costs.

The diagram reveals a Pareto type distribution, meaning that 20 - 30% of the total number of functions include 70 - 80% of the total costs of the functions.

These functions are  $F_1, F_2, F_3 \dots F_7$ .

In the case of such a distribution, the first functions in the order of costs, representing 20 - 30% of the total number of

functions are considered to be very expensive functions.

The real situation is represented by the shape of the straight line in figure 4, plotted by means of the smallest squares method, and showing disproportions in the distribution of costs and in the contribution of the various functions to the value of the product.

An analysis of the diagram of figure 4 shows that functions F<sub>7</sub>, F<sub>4</sub> and F<sub>1</sub> are located above the regression line, indicating high costs, not justifiable in relation to the value.

The disproportions are highlighted also in the diagram of figure 5, where it can be noticed that functions F<sub>5</sub>, F<sub>7</sub>, F<sub>3</sub> and F<sub>2</sub> have disproportionate costs (9,56%, 18,9 %, 21,5%, 28,2%) in relation to their respective contributions to value (6,67%, 13,3%, 20%, 26,7 %).

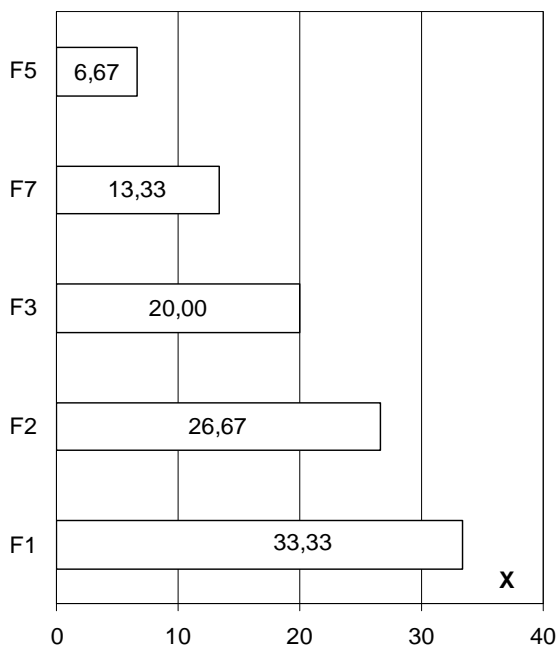


Fig.2 Diagram of the functions value weighting

These aspects allow the assumption that these functions are deficient, hence the solutions to be identified are to focus on those assemblies, parts, materials and technological operations that contribute, within the general structure of the product, to the achievement of these functions.

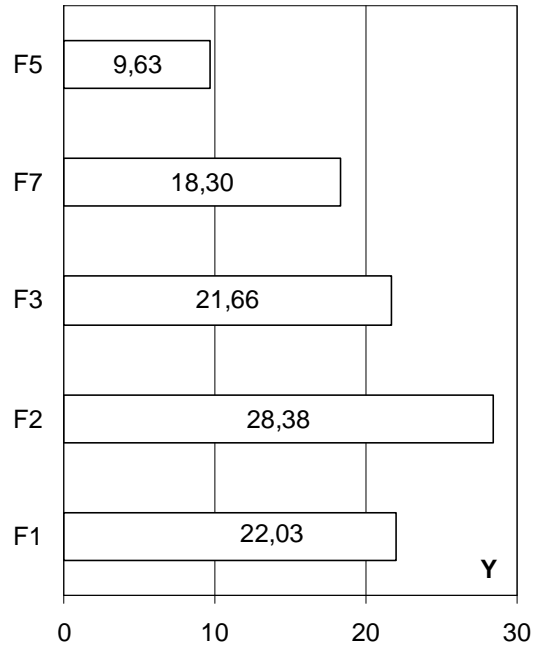


Fig.3 Diagram of the functions cost weighting

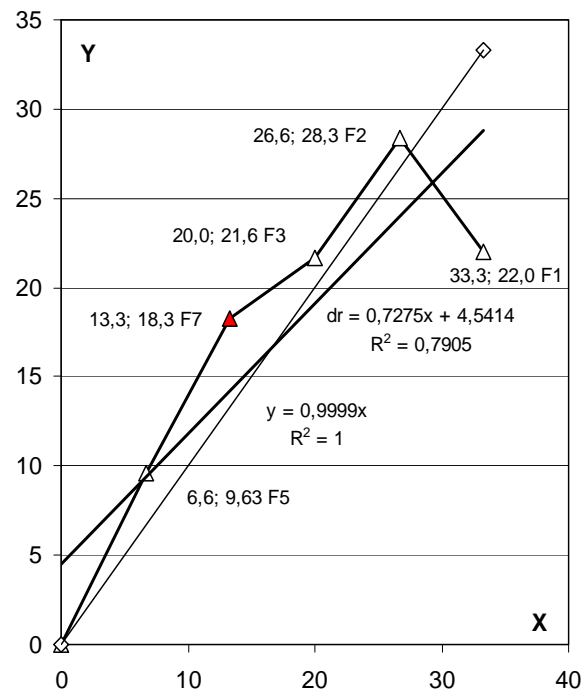


Fig. 4 Value and cost weightings of the functions

In figure 4 shows the regression line (01), for (x, y) points and R<sup>2</sup> – (R squared value on chart) and the ligne y = a \* x (02) first bisector and R<sup>2</sup> – (R squared value on chart).

$$y = 0,9999 * x, \quad R^2 = 1 \quad (01)$$

$$dr = 0,727 * x + 4,54, \quad R^2 = 0,7905 \quad (02)$$



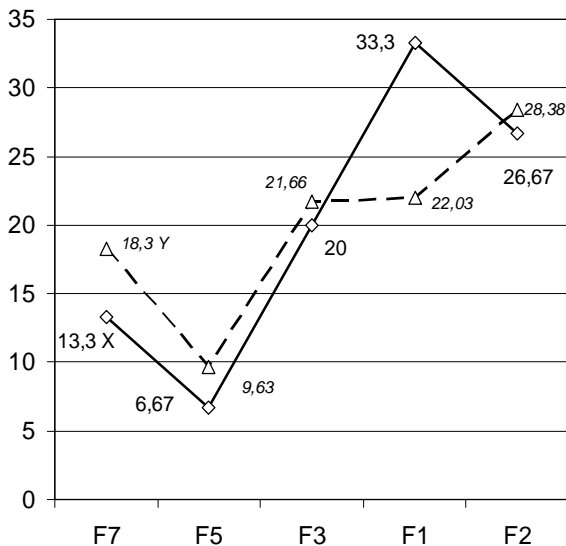


Fig.5 Comparison of values weighting (x---) and functional costs (y-- --)

A basic criterion of Value Analysis is obtaining a minimum value for  $S'$ .

**In order to diminish estimator  $S'$  the points need to be aligned as perfectly as possible along the straight line  $y = a * x$ , with a tilt of  $45^\circ$ .**

**Firstly, in order to diminish costs those functions will be redesigned that are located above the straight line.**

For the points below the line the problems is more complicated.

By diminishing the cost of the functions above the straight line, it may change its tilt and the points initially located below the line may appear above it.

It is also evident, that by diminishing the cost of certain functions the total costs of the product decreases, the weighting of the functions that were not modified increasing implicitly. This is another cause for some points relocating from below the straight line to above it, without, however, any modification occurring in the absolute value of the costs of these functions.

**Secondly, the minimization of  $S'$  needs to be understood in the sense of growth the value/cost ratio as much as possible, and not in the sense of imposing  $S' = 0$ .**

**Thirdly, Value Analysis also admits the increase of the costs of some functions, provided their value increases at a faster rate than the costs.**

**Practically, the criterion of minimization of  $S'$  leads most often to cascading Value analysis studies, the optimisation of the constructive solution being thus an iterative process.**

At first the functions above the regression straight line are analyzed and their costs reduced, then the regression line is re-plotted and the functions relocated above it are noted; these functions too are analyzed in view of reducing their costs, followed by the re-plotting of the regression line, etc. etc.

**Hence the constructive solution is improved from one iteration to the other.**

### CONCLUSION CONCERNING THE EXISTING SOLUTION

One of the causes of the disproportions is the distribution of costs on functions for that no certain values are available in all cases, they being the result of approximate averages.

Other causes may appear from answers to the following question:

➤ Which are the most conclusive criteria and means of critical evaluation for identifying the deficient functions ?

**The main criterion is the economic one.**

This comparison typically yields the conclusion that some functions cost too much in relation to their contribution to the product value and are overdimensioned from the economic viewpoint, the study of solutions having to focus on reducing the achievement costs of these functions.

Although interesting and revealing, this modality of critical evaluation entails however the disadvantage of using a scores system for establishing the levels of contribution of the functions to the product value, which is, **in essence a subjective operation**, that cannot prevent certain assessment errors.

In literature also other modalities for the critical evaluation of functions from the economic dimensions viewpoint are recommended, with more or less limited applicability.

Of these the following should be mentioned:

- Comparison of the achievement costs of the product functions to the same functions of similar products,
- Theoretical computation based evaluation of the costs of a function.

### CRITICAL EVALUATION OF THE FUNCTIONS

The critical evaluation of the functions aims at identifying the deficient functions, which by their contribution the product functionality and by their constructive and technological achievement have a negative influence on the value/cost ratio.

By identifying the deficient functions the directions of re-conception of the existing product are determined, with a focus on solutions for the constructive and technological achievement of these functions.

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## VALUE ANALYSIS AND REDESIGN OF EQUIPMENTS

### Parth II

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**Abstract:** Value Analysis (VA) is a method that provides an operating technique using a creative and organized approach. It is managed by a group, each of them selected by their expertise in specific subjects and coordinated by a Value Analysis expert. The paper presents a complete study of VALUE ANALYSIS applied concretely to a selected piece of equipment. The phases and ITERATIVE operation of the Value Analysis method are presented. Value Analysis combines both ENGINEERING and ECONOMICS without, however, placing neither ENGINEERING or ECONOMICS first. They both are similarly important, as can be concluded by the end of this paper..

**Key words:** value analysis, value, optimum variant

### ESTABLISHING THE FUNCTIONAL-TECHNOLOGICAL FORM OF THE PARTS IN VIEW OF COST REDUCTION

Further on an analysis from the technical and economic viewpoint will be carried out in order to select a technically optimum variant for one of the parts: the flywheel.

Four constructive variants of flywheel will be studied and eventually the most cost effective and the most competitive one from the technical and economic viewpoint will be selected.

Prior to the actual study a number of basic ideas of creative engineering will be presented in short.

Figures 6 and 7 presents a flywheel made from the welded semi-products.

The functional characteristics for this type of part, are the following:

- maximum diameter,
- diameter of egagement,
- geometrical elements of connecting gear,

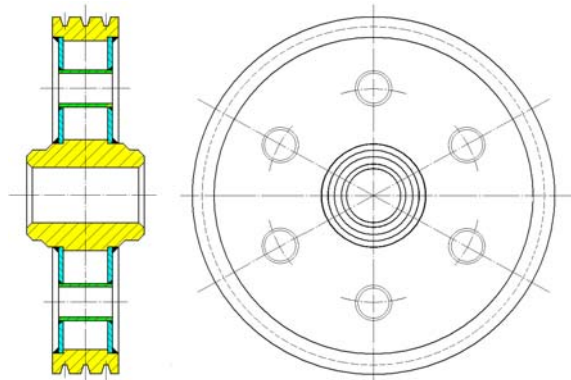


Fig. 6 Flywheel made from the welded semi-products

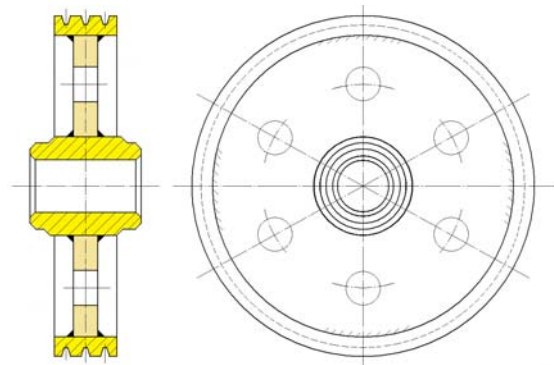


Fig. 7 Flywheel made from the welded semi-products

- internal diameter of wheel hub,
- concentricity between flywheel axis and diameter of egagement,

- wearing resistance,
- reconditioning method.

Figure 8 presents a flywheel screw assembled and figure 9 presents a flywheel made from a cast semi-product.

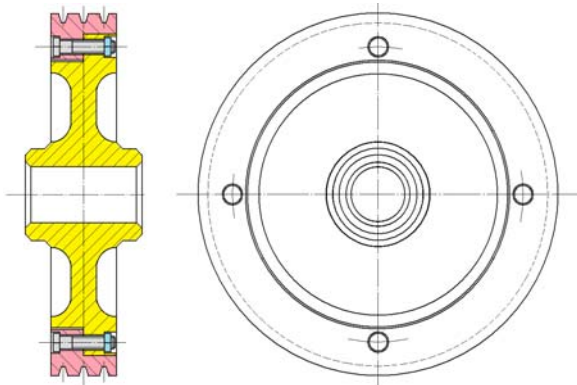


Fig. 8 Flywheel screw assembled

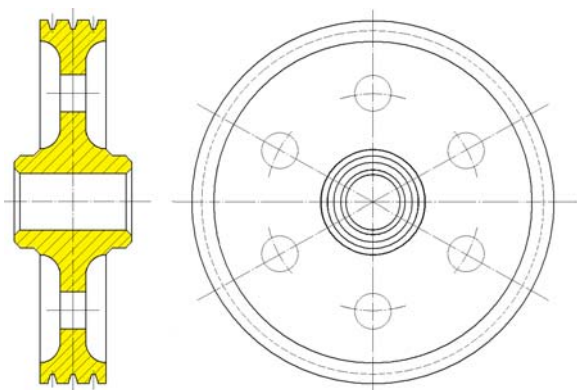


Fig. 9 Flywheel made from a cast semi-product

All variants are technological and the selection of one of them depends on the level of endowment of the company.

Thus the variants presents the aspects enumerated below.

The analysis of the constructive variants for the flywheel of figures 6, 7, 8 and 9 is presented further on.

The example above represents an analysis on the influence of the semi-product on the constructive form and functional characteristics of part.

By analyzing the welded variants by the criterion:

UNDER WHAT CONDITIONS IS IT ACHIEVED ?

valid conclusions follow also for other parts made from such semi-products.

The welded semi-products are usually obtained by welding simple parts made from rolled semi-products.

In order to ensure a good weldability steels with reduced contents of carbon are used for welded constructions, like OL 37 ( $C = 0,15 - 0,22\%$ ); even if the additive material has an identical composition to that of the base material, these semi-products cannot be hardened or hardened-annealed in order to achieve the imposed wear resistance, only subsequent to cementing the surfaces that require a higher hardness.

The welding seams need to be protected during cementing in order to avoid the occurrence of cracks during and after heat treatment.

The solution of heat treating constructions welded from low carbon steels is not applicable due to the required large number of technological conditions.

On the other hand, any welded construction is subjected to a relaxation heat treatment in order to eliminate the welding stress and ensure stability of form.

Using for the simple welded parts rolled semi-products of hardening-annealing high carbon steels like OLC 45, 25MoC11 does not ensure a good weldability. These steels allow superficial hardening-annealing or hardening by high frequency currents or oxy-acetylene flame.

This is not a correct solution as the mechanical strength of the part is not ensured by classical welding procedures.

Using a rolled semi-product of OLC 45 for disks and of OL 37 for the ribs does not ensure a strong joining as the steels have different carbon contents (OLC 45 has 0,45% and OL 37 has 0,15-0,22% C).

Such solutions need to be completely avoided as cracks occur in the welding seam due to welding stress.

The imposed characteristics are not ensured for the studied part.

In order to avoid obtaining a fragile welding seam by rapid cooling particularly

when rolled semi-products with large differences of cross-sections and different carbon contents are used, a pre-heating of the part to 200 - 300°C is required, while the cooling needs to take place slowly, in the furnace or by wrapping the part in asbestos.

The pre-heating is successfully applied in all described cases.

Finally it can be argued that the „welded construction” variant is not one to ensure all imposed characteristics.

Dimensional precision is obtained in any welded construction by machining of the functional surfaces, of the central bore and of the mounting surface of the sole only after welding and relaxation and never prior to welding, as at times is wrongly done.

Prior to welding only the contour of the simple parts is machined if these have been cut with oxy-acetylene flame, as well as their joining surfaces. A series of mechanical machining operations is eliminated by mechanical cutting.

From the viewpoint of achieving the assembly of the flywheel the welded variant is technological, as the welding ribs are not positioned with a hidden welding.

Further analyzing the variants by the FROM WHAT IS THE PART MADE ? criterion the following can be established.

Flywheel can be achieved only from a semi-product cast of OT 45 or OT 55.

The constructive variant of figure 9 obtained from a cast semi-product ensures the best functional characteristics, if the technical conditions for heat treatment are provided.

It has, however, the disadvantage that it allows only one solution for reconditioning: build-up welding.

**COMPARISON OF THE VARIANTS**

Table 5 presents the denoting by 9 assessment criteria of the analyzed constructive variants of a flywheel.

The cost variant of figure 9 has obtained the highest score, and will thus be selected as the constructive solution within the assembly of the jaw crusher.

The cost of the final variant of figure 9 presented in table 6 (step 2 of the Value

Analysis – VA – study) is of 295 monetary units and has a weighting of 17,1% of the final cost as compared to the initial situation of 395 monetary units with a weighting of 18,3%, for function F<sub>7</sub> presented in table 3 (step 1 of the Value Analysis – VA – study).

Table 5 Synthetic table with the analyzed constructive variants

Analysis criteria	Fig. 6	Fig. 8	Fig. 9
	welded	screw	cast
variant	initial		final
Functional characteristics	4	4	4
Semi-product	1	3	4
Mechanical machining	1	3	1
Mounting	4	4	4
Repair	4	4	4
Rigidity	3	2	4
Ergonomics	2	2	4
Aesthetics	3	3	4
Cost	1	3	4
<b>TOTAL</b>	<b>23</b>	<b>28</b>	<b>33</b>

Table 6 (partial) Cost distribution on functions, \* Y coordinate, \*\* monetary units)

	Parts	Cost/ part**	F u n c t i o n s		
			F <sub>1</sub>	..	F <sub>7</sub>
	...				
5	flywheel	295	230		50
	...				
Total cost		2578	540		440
Ratio		1	0,209		0,171
*Cost of functions %		100	<b>20,9</b>		<b>17,1</b>

The final situation – step 2 of the VA study

Table 3 (partial) Cost distribution on functions, \* Y coordinate, \*\* monetary units

	Parts	Cost/ part**	F u n c t i o n s		
			F <sub>1</sub>	..	F <sub>7</sub>
5	flywheel	395	280		100
	...				
Total cost		2678	590		490

Ratio	1	0,21		0,183
*Cost of functions %	100	22,0		18,3

Initial situation – step 1 of the VA study

By introducing the new data into table 7 the four diagrams of figures 10, 11, 12 and 13 are plotted.

These diagrams will be compared to those of figures 2, 3, 4 and 5.

Table 7 Computational elements for plotting the diagrams

Calculus elements	Functions			Total value
	F <sub>1</sub>	...	F <sub>7</sub>	
X <sub>i</sub>	33,3		13,3	100
Y <sub>i</sub>	20,9		17,1	100
(X <sub>i</sub> ) <sup>2</sup>	1111		177,8	2444
X <sub>i</sub> * Y <sub>i</sub>	698,2		227,6	2229
(Y <sub>i</sub> - a * X <sub>i</sub> ) <sup>2</sup>	89,18		24,12	174
S' *	629,6		-131	-0

$$* S' = 2 * a * (X_i)^2 - 2 * X_i * Y_i$$

The parameters have the following computed values:

$$a = 0,91, \alpha = 42,4^\circ, S = 149, S' = 0.$$

It can be noticed that S and S' have smaller values than in the initial variant.

Table 7 provides the necessary values for the plotting of the following types of diagrams:

- 1) The diagram of the value weighting of the functions (figure 10). This diagram has not changes, as the value of the system and of the functions has remained the same.
- 2) The Diagram of the functions cost weighting (figure 11). The diagram of figure 11 presents the functional costs of the new variant, step 2 of VA study.
- 3) The diagram of the cost weightings of the functions, step 1 and step 2 (figure 12). Figure 12 presents comparatively the old variant, step 1 and the new one, step 2 af VA study.
- 4) The diagram of the comparison of values weighting (x-----) and functional costs (y-- --) (figure 13).

Only the costs are represented in order to not overload the diagram and to observe the decrease of the value of cost of function F<sub>7</sub>, from 18,3 %, in the first step of VA study to 17,1 % in the second step of VA study.

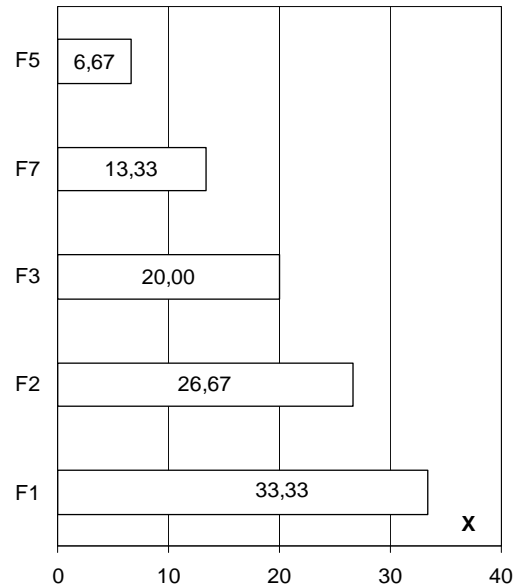


Fig. 10 Diagram of the value weighting of the functions

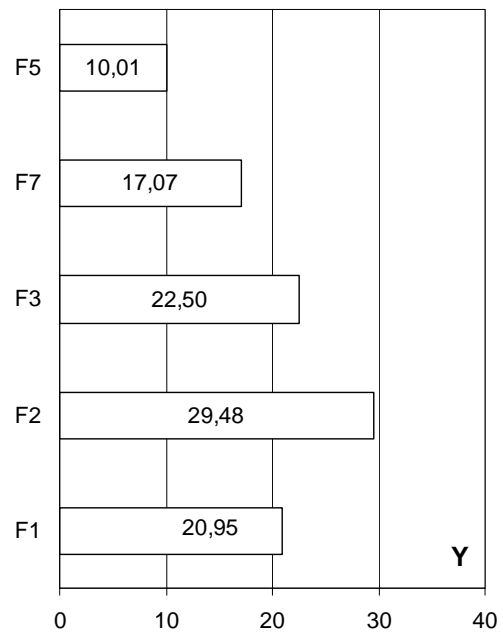


Fig. 11 Diagram of the functions cost weighting

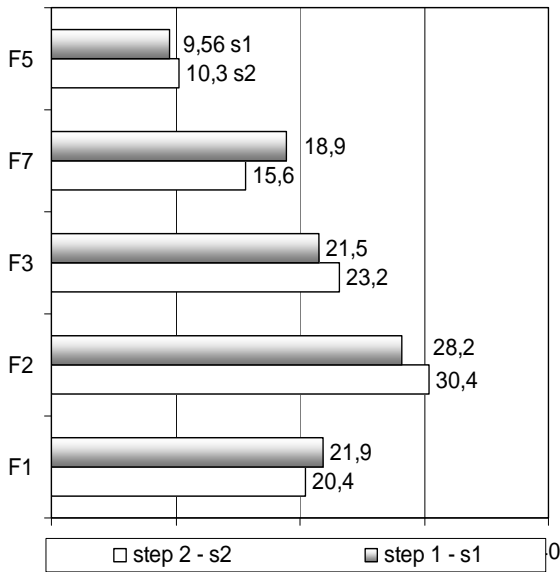


Fig. 12 The diagram of the cost weightings of the functions, step 1 and step 2

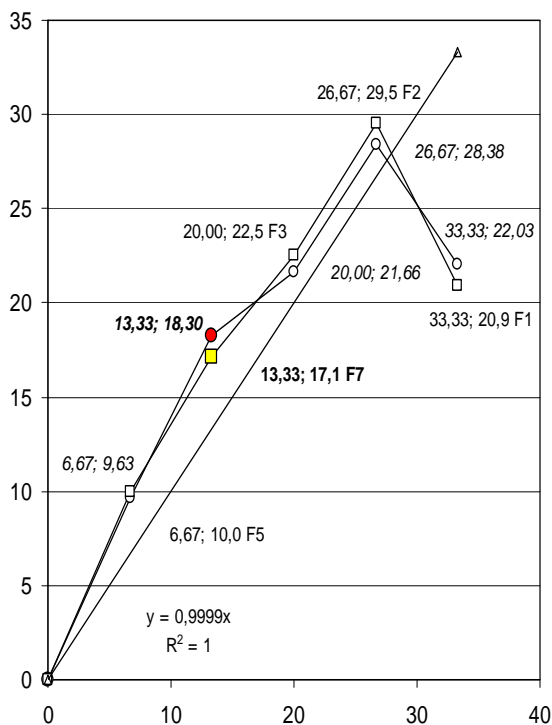


Fig. 13 Comparison of values weighting (x---) and functional costs (y-- --)

### CRITICAL EVALUATION OF THE FUNCTIONS

The critical evaluation of the functions aims at identifying the deficient functions, which, by their contribution the product functionality and by their constructive and

technological achievement have a negative influence on the value/cost ratio.

By identifying the deficient functions the directions of re-conception of the existing product are determined, with a focus on solutions for the constructive and technological achievement of these functions.

The critical evaluation of the functions is carried out by the following methods:

- the utility criterion,
- the technical dimension criterion,
- the economic dimension criterion.

### EVALUATION BY THE ECONOMIC DIMENSION CRITERION

**The economic dimension or the cost of the function represents the main criterion for the critical evaluation of functions.**

These evaluations aim at identifying those functions, the too costly technical solutions of achievement of which affect the total manufacturing cost of the analyzed product.

A correctly completed critical evaluation will directly lead to the identification of what can be called the deficient functions of the analyzed product, that is of those functions that include useless costs.

The deficient functions from the economic viewpoint appear as:

- very expensive functions in relation to the others,
- too expensive functions in relation to the existing technical possibilities of achievement.

Evaluation by the criterion of economic dimension can be achieved in several ways, presented below:

- 1) comparison of costs per function, by means of the diagram presented in figure 13,

This diagram allows comparisons of:

- the costs of the functions and comparisons of the total cost and the cost of each function,
- work and material costs, highlighting the very expensive costs, with the highest weighting in the total cost of the product,
- functions the achievement of which requires disproportionate costs, of either work or material,

- 2) comparison to the functions of other products,  
Other products refer to:
- products of the same typodimensional range or family, manufactured by that company,
  - products similar to the analyzed one, manufactured by other companies,
  - products with other destinations, but having some functions similar to those of the analyzed product.
- 3) Theoretical evaluation of the costs of the function. Such an evaluation is possible when a function is determined by a single part or by a small number of parts. Evaluation is carried out in relation to material consumption.

### STUDY OF THE SOLUTIONS

Based on the conclusions resulting from the critical evaluation of the functions, the study of the solutions will focus on identifying re-conception solutions of the product, in view of reducing its costs and improving its value.

This is possible by constructive and technological modifications of the parts, sub-assemblies and assemblies, according to the identified deficient functions.

### EVALUATION BY THE UTILITY CRITERION

The starting point in relation to this criterion is the close examination of the list of functions, in order to identify potentially useless or partially useless functions.

Useless service functions can be identified by relating to user requirements, while useless technical functions result from relating to functionality requirements.

A service function is useless if it is not required by any of the product users (if it does not satisfy any real necessity), and is partially useless if it is required only by a small part of the users.

A technical function is useless if it can be established that it does not condition any service function, and hence does not contribute, from the technical viewpoint, to the

product functionality, in its studied constructive concept.

If existing and identified, from the utility aspect deficient functions entail useless achievement costs, which can be eliminated by product re-conception.

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## DATA BASES DEDICATED TO COMPUTERIZATION OF FOUNDRIES ACTIVITIES

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### **Abstract**

*Industry software applications have an interdisciplinary character, which involves partnership and collaboration between theoretical and application science experts, IT designers and different industries technologists.*

*In many cases, there are differences in the mentioned sectors development that occur; in this case, though the essential issue of data base management systems (DBMS) is relatively solved (Microsoft Access systems, Microsoft Query, Personal Oracle, with Visual Basic, Visual C++, Fox Pro, Visual Fox, Billand Delphi, Power Builder language libraries), there occur some difficulties within different activities computerizing implementation.*

*The present work intends to advance a series of propositions concerning the complex process of the foundries activities computerization.*

**Key words:** *information system, foundries activity computerization, data bases, management programmes.*

### **1. COMPUTERIZATION OF FOUNDRIES ACTIVITIES**

The passing from the mechanistic era of the whole economic-productive activity towards the computerised industrial society has been possible thanks to the explosive development of the IT field (*Information Technology – IT*).

*The information system* stands for the set of elements involved in the collection, processing and electronic transmission of data between different component parts and compartments of an economic unit. Within an information system, one can find: carried off information, information carrying documents, staff, communication means, information processing systems etc.

The set of elements involved in all this processing and electronic transmission of data action (computers, data transmission systems, other hardware and software component parts, processed data, staff that exploits the calculation technique and theories that lie at the basis of the processing algorithms) forms an *information system*, that obviously includes the respective information system, too.

The information is critically analysed, assessed, structured and organized, and it turns into data that form a decision making support.

For a productive industrial economic agent, such as a foundry, data management must assure an integral approach, starting from which specialists should be able to identify and solve the specific issues of the respective field.

In figure 1, we schematically introduce the information systems of mix integrated foundry on the basis of which its information system can be achieved.

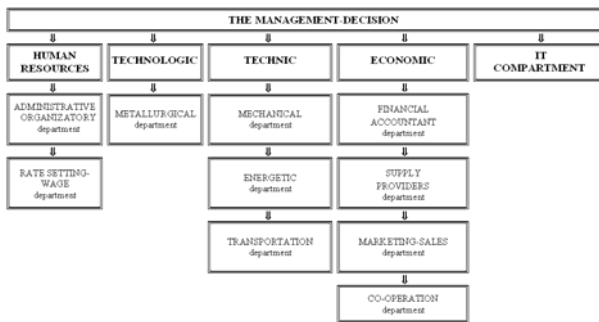


Fig. 1 A foundry's main information highways from the metallurgical field – engines building

The achievement of an efficient information system involves the respect of the following structural and morphological principles specific to the IT field:

1. *The modular overall approach*; when designing the system, one must take into consideration its connection to the exterior world, the communication means with other similar systems, its compatibility to other types of systems, the possibility of including the system into a more complex one or into other systems;

2. *The economic efficiency criterion*; the main criteria to achieve a system is the economic one. In other words, when designing a system, one must take into account the fact that the balance between the direct or indirect result or results achieved by the implementation and usage of the economic system and the achievement costs sum should be as great as possible, in order to be profitable;

3. *Orientation towards users*; when achieving a system, one must take into account the users' demands and preferences. To achieve that, one must have a previous conversation with the users and begin the said design starting from their suggestions and preferences;

4. *Assurance of data implementation oneness*; in most of the cases, a series of data must be used in several places within the information system. When projecting the

system, data must be introduced once, and the system must automatically dispatch data to the other places where it is needed;

5. *Involving the beneficiary in the system's achievement*; this principle also comes from the orientation towards the user. One must talk to the user before designing, in order to avoid from the very beginning a series of difficulties. One must talk about the means of introducing data and adapting the application to the user's needs, data calculation manner and processing;

6. *A general solution, independent of the actual configuration of the information system (possibly partially achieved, in advance)*; the designed system must not, as much as possible, depend on the beneficiary's current technical endowment, but one must take into account possible new calculation techniques acquisitions and even a possible change within the information system;

7. *The subsequent development possibility*; one must take into account the possibility that the system should be able to achieve improvement according to the future demands of the beneficiary firm.

The leading and decision making management in a foundry sectors and workrooms are performed on the basis of a decision making support system – DSS (see Figure. 2).

## 2. DATA BASES

A *data base*, sometimes named „*data bank*”, stands for a means of stocking information and data on an external support (a stocking device), being able to quickly refind them, and it is made up of 3 elements:

- compilation of interdependent data;
- description of data and connections between them;
- a programming system that assures the data base exploitation (updating, interrogation).

In figure 3, we present the principle diagram of a data base, made up of the following component parts:

1. • *data base/bases* – stands for the data type component of the system (the so called data collections, indexes); a data base is usually memorised in one or more files;

2. • data base/bases management system – the set of programmes by which we can assure data management and complex processing and which stands for the software component part of the data base system (DATA BASES MANAGEMENT SYSTEM – DBMS);

3. • other component parts – hand or automatic procedures, including administrative regulations, dedicated to the system’s good working, a data base dictionary (data metabase) that contains information about data, their structure, semantics description elements, statistics, documentations, the hardware means used, staff involved in the process.

pattern, as well as the security and integrity assurance pattern;

5. System development by settlement of the details associated to the data stipulated to be taken into account, the connections between them and their physical representation;

6. System implementation by programme designing, writing and testing, users involvement, documentation organization, files creation and loading;

7. Revision and maintenance through working tests of the new system, performance of some possible changes, addition of new component parts and pursuit of data processing course.

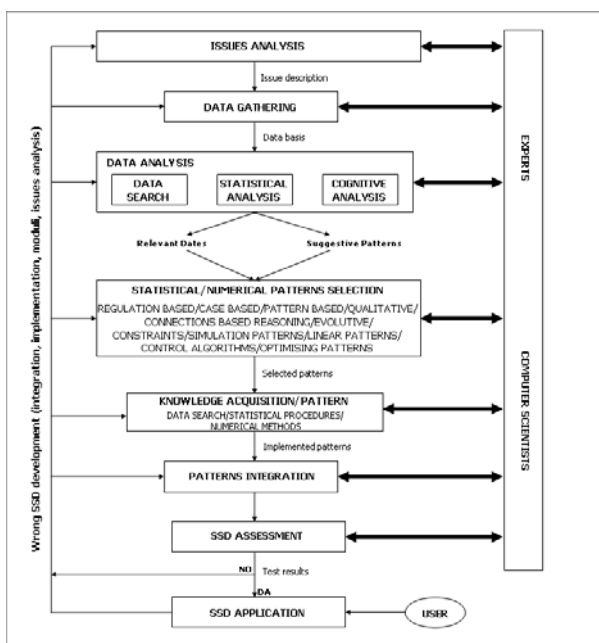


Fig. 2 Principle architecture and stages of achieving a decision making support system – DSS.

The stages of achieving a data base are the following:

1. Feasibility study, which consists of existent systems research, costs estimation on different alternatives;
2. Research of the existent system (data types, sizes etc.);
3. System analysis by determination of different events’ causes and adoption of possible methods and alternatives;
4. System designing by determining the best representation and processing data

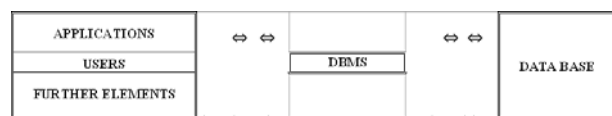


Fig. 3 Principle component parts of a data base

The designing pursuits the achievement of data bases that have the following features: correctness, consistency, distribution, flexibility.

The classification criteria to determine the data optimal logical pattern adequate to a data base are the following:

- *Structural validation* – the consistent reflection of the way in which information is used in the real world;
- *Simplicity* – easiness in understanding structures even by users with no special training;
- *Non redundant* - elimination, as much as possible, of a several times representation of the same information or of the information that can be logically deduced from another one;
- *Distribution* – a pattern generally applicable to several fields, with no features specific to applications or private technologies;
- *Extensibility* – the possibility to develop new component parts with minimum effects upon the existent data base;
- *Integrity* – consistency in the usage and maintenance of the information values.

The raw data stand for, in their widest signification, numbers, letters, images and other data forms produced by devices that convert physic sizes into symbols.

Data from a data base can be structured on 3 levels, according to the involved staff category:

- *the conceptual level (overall)* – expresses the data base manager’s vision upon data. This level communicates to the conceptual structure (diagram) of the data base, by which a description of all data is achieved, in such a manner that does not depend on applications, which makes data management possible;

- *the logical level* – expresses the application programmer’s vision upon data. At this level, it is being achieved a description of data adequate to a certain application programme;

- *the physical level* – that expresses the system engineer’s vision upon data. It corresponds to the internal diagram of the data base through which a data description on physical support and memory is achieved.

The data pattern stands for the set of concepts and instruments necessary to build a diagram of the data base. Data shaping can aim at the sum of data from a data base (data diagram/architecture) or a part of it (data base sub diagrams). The data base diagram and sub diagram are the logical patterns of a data base, that associate to general principles for data management/definition (structure), data integrity manipulation and assurance, without reflecting this data representation and stocking manner on the memory device (which stand for the physical pattern attributes).

In Table 1, the main criteria of data classification are presented.

Table 1 Data classification

CLASSIFICATION CRITERION	
DATA TYPE	DEFINITION
<i>POSITION DURING PROCESSING</i>	
Entrance data	Data that an exterior algorithm must receive
Manoeuvre data	Temporary data that the algorithm uses to get exit data on the basis of the entrance data
Exit data	Data the algorithm must deliver to the exterior
<i>POSSIBILITY TO CHANGE VALUE</i>	
Constant data (constant)	Data that do not modify their value
Variable data (variable)	Data that receive different values during the processing actions
<i>THEIR VALUE</i>	
Number data	Data whose values are numbers (natural, complete or real)
Alphabetical data	Data whose values are characters or character rows
Logical data	Data whose values are truth and false, being true or false

Several data bases types are known according to the organization type, data and their component elements manner of disposing on magnetic support (see table 2).

Table 2 Data Base Types

DATA BASE TYPES	ARCHITECTURAL CHARACTERISTICS
Primitive models	Data are organized at the logical level in files. The basic structure is recording, several recordings being grouped in file like structures.
Hierarchical data bases	The connections between data are one raw ranged, access being done by the hierarchy top only, a subordinate can only have one direct superior and one can be reached on one way only.
Network data bases	Data are represented as in a set of hierarchies, where one of its members can have as many superiors as it likes, and one can reach a subordinate in several ways
Connecting data bases	The data basic structure is that of relation – table. The Structured Query Language - SQL is specialized in manipulation instructions at the table level. The relational data base stands for a data structured mass, accessible through computer, which can satisfy several users within a minimum period of time and in a selective manner. This data mass shapes a system or a process of the real world and stands for an information application support.
Distributed data bases	They are the result of the data bases technology integration into that of the computers networks. They stand for logically integrated data bases, but which are physically distributed on several calculation systems.
Semantic models – object oriented	These modules are oriented towards data meaning representation. The basic structure used for data representation is that of objects class defined by the abstractization of the physical entity that can be found in the real world. Here, there are simple and classes of entities that are represented by simple objects or object classes, ranged in classes and subclasses hierarchies. This type of data base came out of the necessity to manage complex objects: texts, graphics, maps, images, sounds (multimedia applications) and dynamic objects: programmes, simulations, shapings.

DATA BASE MANAGEMENT SYSTEMS (DBMS) stand for the sum of the programmes used to create, interrogate and maintain a data base; they include two categories of modules:

1. modules that are common to those of the computer operating systems;
2. modules with functions specific to data base.

The history of DBMS has three generations:

- **HIERARCHIC MODELS AND NETWORK.** For the hierarchic models and network, data are represented at the article level through hierarchical (tree) or graph connections. The data weak physical independence complicates their administration and management. The data manipulation language requires the programmer to specify the access ways to data. The network model is powerful, but complicated. A network like data base stands for a collection of junctions and connections that allows the achievement of the following types of structures: linear; hierarchic; network;

- **RELATIONAL MODELS.** The relational model treats entities as connections. The present data base market is massively covered with relational systems. These ones, as well as the first generation models, have been conceived for classical applications: accountancy, stocks management etc.;

- **ADVANCED SYSTEMS:** object oriented DBMS, deductive DBMS, distributed DBMS.

An *operating system* stands for a soft product that is a component part of a computational system that deals with a computer activities management and coordination. The operating system plays the part of a hostess for the applications that roll on a working station (see fig. 4).

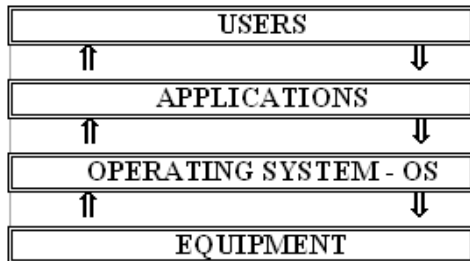


Fig. 4 Relating an operation system’s (OS) position within a computational system

In table 3, we represented the most known and frequently used operating systems.

Table 3 Wide Applicability Operating Systems

OPERATING SYSTEM	FEATURES
DOS = Disk Operating System, PC-DOS, MS-DOS	It's a <b>single-tasking</b> operating system (one simultaneously rolled application), <b>single-user</b> (on possible user) based on the control line, created in 1981 by Microsoft for IBM (IBM = <b>International Business Machines</b> ); up to Windows 95, it was the most popular operating system on the x86 architecture.
Linux, AIX, HP-UX	It's one of the best known examples of <b>free software</b> and <b>Open Source</b> software development. The term <b>Linux</b> refers to the Linux nucleus, but it is currently used to describe the whole operating system, which contains this nucleus, software libraries and different tools.
Mac OS (Mac / Macintosh Operating System)	It's an OS produced by Apple Inc. in 1984 for its Macintosh 128 K computers, having a commercial success and being based on a <b>graphic user face (GUI)</b> .
UNIX	It's a portable and modular OS; the UNIX name does not stand that much for one operating system only, but rather for the name of a compatible operating systems class, although they do not share a common source code.
Microsoft Windows	It's an OS family created by <b>Microsoft</b> in 1985 as a supplement to MS-DOS. The monitor subsystems contain the <b>peripheral control programmes</b> and the file management system. The external subsystems are made up of the definition processor and the administration programme. Alongside, there are data base description programmes and processing requirements. Between user and system, there are two faces: definition and usage of the data base. The data base definition is executed under the <b>definition processor control - DP</b> , capable of processing description programmes, formulated using specialized languages known as <b>data definition languages - LDD</b> .

A significant distributed data bases type is the relational one, leaded by a *Relational Data Base Management System - RDBMS*. Within these data bases, there are:

1. Horizontal fragments – subsets of tuples (rows) from a connection (table);
2. Vertical fragments – subsets of attributes (columns) from a connection (table);
3. Mix fragments – a fragment divided both horizontally and vertically;

4. Equally distributed data base – it uses a DBMS (for example: Oracle);

5. Heterogeneously distributed data base – it uses several DBMS (e.g.: Oracle; MySQL; PostgreSQL).

The relational algebra is complete under the mathematical construction balance; with its operators, we can interrogate, update and maintain a relational data base. To apply it, we need a real method of practice, a structured query language (*SQL*) which represents a data definition and manipulation language.

The SQL language, developed by D. D. Chamberlin in the IBM laboratories after the '70, includes both *commands to define the data (CDD)*, such as *create table, grant and revoke*, and *commands handling data (CHD)*, such as *select, insert, delete and update*.

Since different data can be grouped according to obvious relations, *the relational data bases model - RDBM* offers the designer a great degree of flexibility when describing the relations between these data. By the mathematical concepts of *join and union*, the relational data bases can return the user o combined data collection (information).

The SQL language (*structured query language – SQL*, therefore  $SQL \approx structured, interrogation, language$ ) interrogates the data base, creates tables, adds, deletes and combines data, opens actions according to the modifications made to the data base, records interrogations in the programme.

As a conclusion, SQL stands for a structured language for adding, modification, delete, junction, recording, launching and interrogation.

With SQL, a data base programmer or administrator can perform the following operations:

- modifies a data base structure;
- changes the configuration values for the system security;
- adds rights of the users on the data base;
- interrogates a data base;
- updates a data base content.

Out of the DBMSs that use the SQL language, the following are representative:

1. *Microsoft Access* is a DBMS designed for small computers such as PC;

2. *Microsoft Query* is a powerful interrogation tool, that uses the *ODBC* standard (*ODBC = Open Database Connectivity*, Microsoft strategic application for interfaces) to access data in an information system, which gives independence to the data base programme project;

3. *Personal Oracle*, alongside with a set of developing instruments that includes a *C++* and *Visual Basic* language library.

4. *ODBC* is a *library of functions designed (LFD)* to supply an *interface application programming (IAP)*, that should assure the data bases support.

*ODBC* developed within a standard adopted by several products: *Visual Basic; Visual C++; Fox Pro; Visual Fox; Billand Delphi; Power Builder*.

Alongside with the development of a relational data base model, two new technologies led to a quick development of what we call today a CLIENT-SERVER data base system.

The first significant technology was the personal computer – „*personal computers - PC*”, term introduced in 1980 by *Portia Issacson* to point out its usage by one person only, compared to the big computers (main frames) that we take as a transition stage towards the achievement of the *distributed computing* concept.

The second significant technology was the development of the local computer networks (LAN) and their integration. Macintosh introduced the Apple Macintosh computer with a friendly interface, which was taken and improved by Microsoft through the WINDOWS application.

This new type of application, called *Client/Server*, since the processing is separate between the client computers and a data base server, has the following advantages:

- it reduces maintenance costs;
- it reduces network overloading;
- operating systems inter-efficiency, by using a common *network protocol*;
- raises data integrity due to their centralized placing.

*Bernard H. Boac* defines the *client/server technology* as it follows: „The client/server technology is the processing model where one

single application is commonly used by several processors, which cooperate to finish processing as a one unified task. A client/server product combines the processors to ensure one single image of the system. The dividable resources are placed to the clients who demand to access authorised services. This technology is entirely recursive; servers can successively become clients and require services from other servers of the network.”

Using SQL and a connection to the network, the application can achieve the interface to a data base existent on a server placed at distance, since the SQL is a language for combined platforms.

When it comes to distributive data bases, users approach the system by:

- Local applications (applications which do not need data from other sites);
- Overall applications (applications which need data from other sites).

The most popular data base type is the relational one, where data are memorised in tables. Besides the tables, a relational data base can also contain: indexes, stored procedures, users and users groups, data types, security and transactions management mechanisms etc.

Some other types of data bases are the hierarchic model, the object oriented model and, lately, the *eXtensible Markup Language – XML* model. The XML language is nowadays a model how to stock unstructured and semi-structured data within the native data bases.

Similarly, another marking language is the *HTML - HyperText Markup Language*, used to create web pages that can be posted on a browser (or navigator). The HTML’s purpose is rather to introduce information – paragraphs, fonts, tables etc. – than describe the semantics of the document.

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## PRELIMINARIES CONCERNING COMPUTERIZATION OF STOCKS MANAGEMENT IN FUNDRIES

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**Abstract:** The activity of an economic agent, such as a foundry, implies technical-technological, economic-financial and structural-organizing aspects.

The supply accounts (raw and other materials, technological consumable articles, SDVs, intermediary and final goods) and, especially, their right size making stand for a common topic to the previously mentioned aspects, that, under the market economy conditions, is able to lead either to a high degree of efficiency and profit making, or to syncope, production trouble and even bankruptcy.

The present work designs a computerizing methodology of supplies accounts within an enterprise such as a foundry, therefore an economic agent with metallurgic profile or car building technology.

**Key words:** stocks, stocks management and standardization, stocking operations computerization.

### 1. STOCK MANAGEMENT TASKS

The materials stocks appear, in time, as a difference between the suppliers' entrances in the system, exits to achieve the respective unit production and revaluation of the finite products. Both materials entrances and exits are registered, managed, entered in the accounts according to some specific documents.

The stock management tasks result from the double character of the stocking process which stands for an economic process with an essential role in the traffic mechanism, on the one hand, and for a material and money funds immobilisation, on the other hand. As a consequence, the stock management must be conceived in such a way that it should simultaneously assure the solving of the next tasks:

a. *The production continue provisioning* stands for the essential task of the raw material stocks, materials and merchandise to different economic agents. To solve this task means to study the future evolution of the enterprise's needs and close with the suppliers some delivery contracts for the products, in accordance with the needs (from a quantitative, structural and repartition in time perspective), stated in such a way that they should assure the existence of the required products in stock, when and as many as necessary – a safe way to achieve the enterprise's goals;

b. *The stock situation* stands for the most complex task of stock management. One can explain the complexity degree as well as the difficulty to solve this task by the fact that it means the creation and exploitation of an adequate information system, adapted to the stocks management requirements. The situation

issue must be reconsidered since the actual information system only partially satisfies the stock management specific requirements. In this field, the main issue focuses on each manager's obligation to permanently hold stocks and their structure's situation, take operative measures to rationally manage the stocks according to the changes that can occur, introduce an operative system of stocks surveillance, that should allow right decision making all over the year, taking into account the concrete stock situation of each enterprise;

c. *Accelerating the rotation speed* of the circulating means represents another stock management task. By assuring the stocks sizes and structure, according to the real needs of goods and/or services production process and, of clients, the management contributes to time reduction as long as the products are stopped (as stocks in the distribution channels), thus determining the shortening of the "supply-making-sales" cycle. Generalizing the interest concerning stocks management, one can get, assuming the funds rotation speed acceleration, significant funds economies at the whole country scale;

d. *The growth of the whole activity economic efficiency* must finally stand for the synthetic goal of stock management. It can be essentially touched by reducing expenses (interests and bank commission, perishable staff etc.) – a natural resultant of the rotation speed acceleration of circulator means – and by shortening the period in which raw materials, materials and goods remain in the enterprise as stocks.

These stock management tasks put some „pressures" for a certain stock size, as it follows:

- „Pressures" for *small stocks*: stocking costs; stocking rooms; the risk of goods degradation during the stocking period; some goods seasonal variation; money funds immobilization.

- „Pressures" for *big stocks*: assuring continuous clients serving; elimination of stock breakage; supply, transport, reception costs; possible reduction from supplier, when contracting big amounts of goods.

## 2. STOCK MANAGEMENT SYSTEM RESTRICTIONS

Stock management stands for a complex action system whose final goal is the material assurance that the activity takes place in maximum economic efficiency conditions. The system functioning, the degree in which it touches its goals depend on the system restrictions.

According to their nature and secret character, they will affect differently the stock management results. If by stock management we tend to maintain the smallest stock that should assure the enterprise needs accomplishment (raw materials, materials and goods) indifferently of their evolution, it is also true that the stock quantitative and qualitative sizes will be conditioned by a series of restrictions that outline the frame to which the stock management submits and to those connected to electronic computers – in front of which, the enterprise management, in general, and stock management, in particular, is unconceivable.

## 3. SERVICE LEVEL

The contracts with suppliers are concluded according to the previsions that, in the last analysis, are average values, indifferently of the calculation method that is being used. Under these circumstances, it is expected that the effective needs of the enterprise should exceed, in half of the situations, the expected average values. Every time such an eventuality takes place, a stock breakage occurs, with known outcome.

Under these circumstances, if the enterprises elaborate their provisioning project on the basis of previsions only, without taking any further protection measure, in many cases, the stock will be consumed before its reprovisioning.

In order to prevent these "unpredictable" situations, enterprises are forced to make up a supplementary stock, which the bigger it gets; the more it reduces the risk of stock breakage (figure1).



But one cannot accumulate a safety stock whose sizes should be able to completely eliminate the risk of breakage, because of the stocking expenses that are prohibitive, so that, the leading staff practically decides the maximum allowed limits of the stock breakage; for example, if they decide to limit the stock breakage up to a maximum of 2 % of the received orders, this decision stands for a 98% enterprise service level. Therefore, the safety stock size depends on the service level one (always in terms of percentage), which can be expressed by the stock breakage frequency (not taking into account the importance of the orders that have not been respected – method scarcely used) or by the proportion of the respected orders (according to quantity, value or the total order number).

The decision concerning the service level size is always difficult, since it is influenced by various factors, such as: product unitary value (immobilized financial funds depend on it), product „profitableness” – that affect a stock breakage cost etc. After the enterprise determines the service level, it is necessary to determine the safety/supplementary stock sizes, which depends not only on the service level size, but also, on prevision errors that occurred in the past (see figure.1).

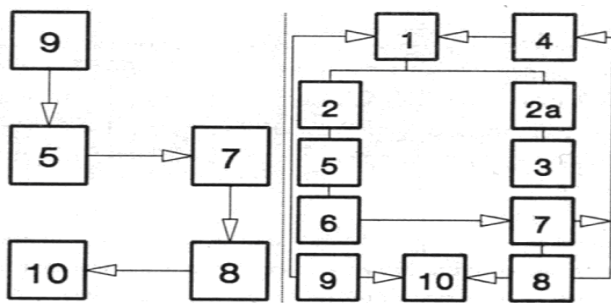


Fig. 1 Stock supply: a – stock supply according to consumption standards; b stock supply according to previsions (1 – history; 2. requirement prevision; 2a. requirement aleatory deviation prevision; 3 – safety stock calculation; 4 – stock and coming orders situation; 5 – outfit calculation; 6 – provisioning plan; 7 – orders for suppliers; 8 – stock provisioning; 9 – orders from beneficiaries; 10 – needs satisfaction).

#### 4. STOCK COST

The achievement of industrial enterprises' economic goals requires a technical-material basis, adapted to the respective economic agent's profile, qualified staff and, obviously, circulatory funds. From an economic perspective, these premises communicate to costs of certain structure and size, determined, among other things, by the stocking process, management politics adopted by the enterprise's leading staff.

As a consequence, the decisions that will aim at the stock management politics will take into account their influence upon costs sizes and structure that they bring about. If costs influence cannot be explicitly taken into account (for example, due to the quantification difficulties), they are still measured, being estimated that coherent management politics will automatically lead to stock expenses reduction.

The optimization of stock sizes depends on determining a strategy according to which, the stocking process expenses should be minimum; to touch the this goal, one should „find” the answers to the following two questions, to which we can attach antagonistic costs (see fig. 2):

- what is the provisioning/order frequency, meaning WHEN TO DO IT? The greater the provisioning (order) frequency is, the greater this operation costs are (provisioning or order launching cost);
- how many products do use for provisioning, every time we do it, meaning, HOW MUCH ? The greater an order provisioning is, the grater the stocking products costs are (stocking costs) and the other way around.

The overall cost analysis from figure 2 leads to two significant (because of their consequences) findings:

- a. First of all, after a spectacular collapse of the overall cost, parallel to the annual provisioning number increase, we can note that, within the A-B part limits, the deviations of the provisioning number from the optimal size (20, in the example from figure 2) do not determine

sensitive modifications of the overall cost. Corroborating this finding to the practical activity in which the stocks optimization cannot always stand for the real purpose of their management, due to the issue's special complexity, we can reach the conclusion that, without reaching the optimal situation, we can still better the stock situation by introducing some rationalizing rules of the provisioning politics;

b. Second of all, it is interesting to analyse the hatched zone in figure 2. Although the increase of the provisioning number leads to stock decreases and, therefore, to circulation speed acceleration, (counted according to the rotation number), the overall cost increases alongside with the annual provisioning number and stock rotation speed acceleration. This finding is particularly special since it leads us to the conclusion that the "great rotation speed=efficient activity" principle is true up to a point only (position B, in fig. 2), after which, due to costs increase, its observance becomes inefficient and even harmful.

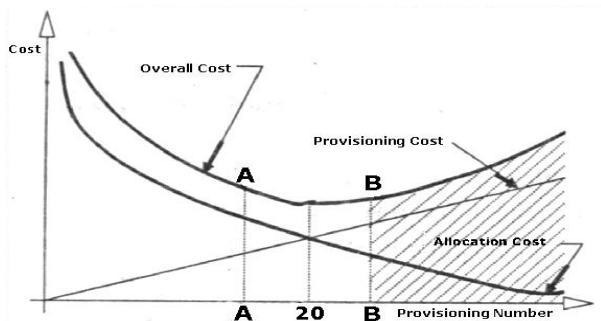


Fig. 2 Costs evolution according to annual provisioning number

## 5. INFORMATION SYSTEM

The information system is very significant for stock management. To permanently and systematically know the stocks evolution, as well as all the economical processes that are directly or indirectly connected to their level, is one of the fundamental premises of their scientific management.

The economical activities that influence the stock level – such as: determination of the ordered outfit (contracted), closing deals with suppliers, warehouse and operative units provisioning, pursuit of contract execution, products getting out of stocks, stocks physical and/or statistic inventory, expense accounts caused by the stocking activity etc. – generate information that, not only that they cannot miss, but must also reach the leading staff with maximum promptness, taking into account that it's the only way to prevent deviations (from normal), on the one hand, and size right after they occurred in order to reduce stock within the standardized limits (normalized), on the other hand.

Generally speaking, in order to answer all the tasks imposed by stock management, the information system must have the following general features:

- it must be easy to install and have an economical configuration;
- it must be able to be installed in logical successive stages, that should ease the evolution towards a more refined management, alongside with the enterprise's development and the system users experience;
- it must deliver the necessary data and make anticipations;
- it must allow control and „alarm” in due time the notorious deviations and goals rectifications;
- it must rapidly take into account the changes caused by unexpected events that affect the settled decision making rules;
- it must issue a general provisioning plan, starting from the sales provisioning.

## 6. STOCKS STANDARDIZATION

The stock management includes all the activities that revolve round the stock issue, starting with the contract making, contract achievement pursuit up to the enterprise stock pursuit.

To rationalize (or optimize) this activity, one must determine measurement units for some

objectives or standards, that should help both to orient the enterprise's products provisioning and assess the difference created between the stocks real evolution and the settled object. Therefore, the rules must assure a stock that warrants the satisfaction of all the needs expressed in the different compartments of the respective commercial enterprise, with a known probability (the proposed service level).

Fixing the stock standardized level stands for the starting point of the whole stock management system organization, all the enterprises activities being further coordinated (oriented) according to the settled stock norms. Elaboration of stock norms is one of the most important and complex commercial management activities. It implies a specialized well trained staff, an informatics system able to deliver all the necessary data, strong knowledge of all the specific factors that influence the stock management, such as: demand evolution, predictable changes in clients' needs, predictable marketing actions of competition that can change market trends etc.

The stock norms expression takes different shapes; thus, they can be materialized in monthly average stocks, sales day stocks (covered days, namely the balance between the value stock within a given period of time and daily average sales), traffic speed.

The stocks management system configuration stands for the set of data gathering, processing and transmission means within a specific information system. The stock standardization operation represents the setting of a stock rational, optimal level, expressed by the stock norm; to determine it, there occurred and have been used numerous statistic-mathematical models.

*The basic parameters of stocks standardization.* The standardization goal is to settle the stocks rational, optimal level. No matter what aspect of the stock is being standardized, one must set the standardization basic parameters, that are nothing else than the characteristic sizes according to which we search an answer to the two questions that the

stock management involves, namely when and how much to order.

The quantity that the provisioning  $q$  will need and the provisioning number  $n$  (namely, the provisioning intervals) are the two basic parameters between which there are causal relations, that have been first emphasized with the „Wilson” model, according to which, when the two costs are equal, we get the optimal size, as far as the correct standardization and stock sizes optimizing are concerned.

In figure 3, we represent the total cost function evolution [ $C=f(q)$ ] for different values of  $q$  variable.

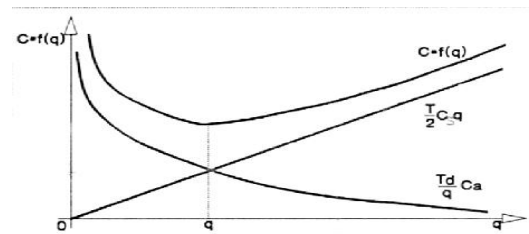


Fig. 3 Total cost evolution for different values of the  $q$  variable

## 7. SPECIFIC INFORMATION APPLICATIONS

The software industry has achieved numerous applications dedicated to stock standardization; many of them are built on the fundamental principles of mentioned „Wilson” model.

For example, the *Romfast Applications – RoA* programme is an *Enterprise Resource Planning - E.R.P.* system, which includes specific applications such as:

- Customer Relationship Management - C.R.M.;
- Supply Chain Management - S.C.M.;
- Human Resources - H.R.;
- Business Intelligence - B.I.

The Enterprise Resource Planning - E.R.P. system is the software tool that facilitates the integration of all the information from an organization into a unique platform, thus assuring data transparency within a company and access to any kind of information that is

useful within the respective enterprise activity development. Many business men called the ERP as „the way to range information within a company”.

The Customer Relationship Management - C.R.M. application is a powerful reporting and analysis tool that leads to a better understanding of clients' needs and behaviour. A C.R.M. efficient system allows opportunities identification in the shortest time possible, trends identification and settlement of relations between the most profitable clients and the products they used, measurement of the new products and services effectiveness.

The Supply Chain Management - S.C.M. application is a combination of procedures and programmes that aim to better the way in which a company finds the components it needs to keep on offering a product or service to its clients. The S.C.M. (The Provisioning Chain Management - PCM) programme has 5 main components:

1. *The Plan* - a strategy to manage all the necessary resources for a company's products or services;

2. *The Source* – the suppliers that provide the products and services that are necessary to create the company's products;

3. *The Product* – planning the activities necessary for production, testing, packing and preparation for delivery;

4. *Delivery or logistics* – receiving the delivery orders from clients, development of a warehouse network, choosing the couriers to transport the products and the payment reception system;

5. *Return* – creation of a network to receive defective or excess products and the support for the clients that encounter problems with the purchased products.

Human Resources – H.R. is a management application for the human resources of a company. The information about the staff is personal, professional and financial. Starting from this information, we can generate a series of reports that can be viewed and/or ranged in a

list, create pay lists that can be interactively modified by the user, calculates the wages rights concerning holidays, benefits and penalizations.

The B.I. Business Intelligence - B.I. application allows the companies to manage their great data bases number and offer the employees, the management team and their partners a perspective easy to understand view. This application is used to find new opportunities to increase the organization's income, to reduce costs, reassign resources and better the operational efficiency.

In conclusion, Romfast Applications – RoA represents the solution that centralizes all this information, and the C.R.M., S.C.M. and H.R. takes advantage on benefits by the existence of one and only up to date information source.

The RoA applications use the Oracle technology; Oracle is one of the world software industry leaders and one of the greatest and efficient suppliers of enterprise information management solutions, for stocks management – computerization, too. The Oracle technology is the basis of data banks designing and achievement standards; the Oracle like programmes and data bases can be found in almost any world industry and within the infrastructure of almost 98 of the companies listed in Fortune 100 in the last years.

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# SOLVING THE FUNDAMENTAL PROBLEM OF THE INTERIOR BALLISTICS USING THE REAL BURNING LAW OF THE PROPELLANT

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**Abstract:** In this paper it is presented a method of solving the fundamental problem of Interior Ballistics, in the classical approach. At the basis of the method presented stands the mathematical model of the projectile movement in the barrel of a ballistic system under the pressure of the gases from the burnt propellant which holds into account the fact that the powder doesn't burn according to the geometric (Vieille) law, but by the real burning law, which allows us to utilize the experimental data obtained in the closed bomb. Experimental data from an existent ballistic system are compared with the results obtained by solving the mathematical model. The meaning and the notations of the parameters used in the paper is that established in the specialty literature [1,2,3].

**Key words:** interior ballistics, fundamental problem, mathematical model, real burning law, closed bomb.

## 1. INTRODUCTION

The mathematical model is based on the real burning law of the powder, which is using the experimental data obtained in the closed bomb (Fig. 1) and it consists of a set of differential and algebraic equations. To solve these equations a computer program was developed in C language. The output of the program is a file with four arrays of data: time, projectile's displacement, projectile's velocity and gas pressure. The variation of gas pressure and projectile velocity versus time and displacement of the projectile within the gun barrel, from the beginning of powder burning, defines the content of the fundamental problem of interior ballistics.



Fig. 1 – Pressure versus time in closed bomb experiments.

The mathematical model also takes into account that the rotating band is continuously cut in the rifling of the gun barrel (Fig. 2) and the heat loss is calculated through the force of the powder.

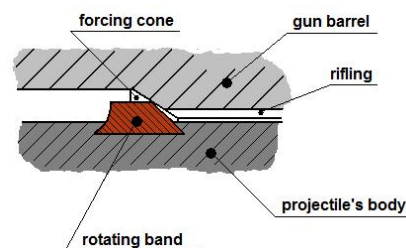


Fig. 2 – The cutting of the rotating band in the rifling of the gun barrel.

## 2. EQUATIONS OF THE MATHEMATICAL MODEL

The governing equations of the mathematical model are obtained from the fundamental equation of interior ballistics, the projectile's translation motion equation and the burning rate law. The burning rate law used to describe the burning of the gunpowder is the Vieille law (1893):

$$u = AP^v \quad (1)$$

To be able to utilize the experimental data obtained during the burning of the powder in the closed bomb, the following assumption has been made: the fraction of the burnt propellant is the same in the ballistic system with the one in the closed bomb.

To simplify the computational part, dimensionless variables were introduced. Through successive transformations the mathematical model was transformed in a system of differential equations [2] that can be integrated through numerical calculations, completed with an algebraic equation to calculate the gas pressure for each step of the independent variable. The system of differential equations is:

$$\left\{ \begin{array}{l} \frac{d\xi}{d\zeta} = \frac{sI_s v_{lim} \eta (a' - b' \psi + \xi) \left(\frac{p}{P}\right)^{1-v}}{f' \omega (\psi - \eta^2) - \theta L_6} \\ \frac{d\eta}{d\zeta} = \frac{sI_s}{\varphi q v_{lim}} \left[ 1 - \frac{s l_0 p_t (a' - b' \psi + \xi)}{f' \omega (\psi - \eta^2) - \theta L_6} \right] \left(\frac{p}{P}\right)^{1-v} \\ \frac{d\varepsilon}{d\zeta} = \frac{sI_s l_0 (a' - b' \psi + \xi)}{t_{lim} [f' \omega (\psi - \eta^2) - \theta L_6]} \left(\frac{p}{P}\right)^{1-v} \\ \frac{d\psi}{d\zeta} = \frac{f I_s \left(\frac{1}{\Delta_b} - \frac{1}{\delta}\right)}{P^3 \left(\frac{f}{P} + \alpha - \frac{1}{\delta}\right)^2} \frac{dP}{d\tau} \end{array} \right. \quad (2)$$

and the pressure is defined by the relation:

$$p = p_a + \frac{f' \omega (\psi - \eta^2) - \theta L_6}{s l_0 (a' - b' \psi + \xi)}, \quad (3)$$

where:  $P$  – is the pressure in the closed bomb;  
 $\tau$  – is the time in the closed bomb when the same fraction of burnt propellant as in the ballistic system is burnt;  
 $L_6$  – is the mechanical work consumed by cutting of the rotating band in the rifling of the gun barrel.

The dimensionless variables introduced are:

$$\eta = \frac{v}{v_{lim}}, \Rightarrow d\eta = \frac{1}{v_{lim}} dv; \quad (4)$$

$$\varepsilon = \frac{t}{t_{lim}}, \Rightarrow d\varepsilon = \frac{1}{t_{lim}} dt; \quad (5)$$

$$\xi = \frac{l}{l_0}, \Rightarrow d\xi = \frac{1}{l_0} dl; \quad (5)$$

$$\zeta = \frac{I}{I_s}, \Rightarrow d\zeta = \frac{1}{I_s} dI; \quad (7)$$

in which:

$$t_{lim} = \frac{\varphi q v_{lim}}{s P'_{max}}; \quad (8)$$

$$P'_{max} = \frac{f' \Delta_b}{1 - \alpha \Delta_b};$$

$$I_s = \int_0^{\tau_s} P d\tau.$$

During the different periods of the ballistic cycle the system of equations is simplified when some variables become equal to 0 (zero), like  $p_t$  and  $L_6$  when the cutting of the rotating band in the rifling of the gun barrel has ended, and others become equal with the unit, like the exponent from the burning rate law,  $v$ , and the fraction of the burnt propellant,  $\psi$ , when the powder has finished burning.

### 3. SOLVING THE MATHEMATICAL MODEL

To completely define the mathematical model we need to assess the initial and boundary conditions. The initial conditions are as follows:

$$\left\{ \begin{array}{l} \xi = \xi_0 = 0; \\ \eta = \eta_0 = 0; \\ \varepsilon = \varepsilon_0 \neq 0; \\ \psi = \psi'_0 \neq 0; \\ \zeta = \zeta_0 \neq 0. \end{array} \right. \quad (9)$$

The values for the variables that are initially different from zero are:

$$\varepsilon_0 = \frac{I_k (1 - \alpha \Delta)}{f' \Delta t_{lim}} \ln \left( \frac{p'_0}{p_a} \right) \quad (10)$$

$$\psi'_0 = \frac{\frac{1}{\Delta} - \frac{1}{\delta}}{\frac{f'}{p'_0} + \alpha - \frac{1}{\delta}} \quad (11)$$

$$\zeta_0 = \frac{I'_0}{I_s} = \frac{\int_0^{\tau'_0} P dt}{\int_0^{\tau_s} P dt} \quad (12)$$

The mathematical model presented here was translated into C language, broken into periods corresponding with the different periods of the firing phenomenon and solved by numerical integration. The methods used to integrate the differential equation system were Runge-Kutta of the 4<sup>th</sup> order for the first four points and afterwards the predictor-corrector method Adams-Krřilov.

#### 4. RESULTS AND CONCLUSIONS

The viability of the mathematical model and the precision of the calculi performed by the C program are verified against some experimental results. The case study material used was the 1942 model of the 76mm gun.

Experiments were conducted in the closed bomb with the powder from the charge of the shot. The characteristics of the powder were computed (Fig. 3) and those characteristics were introduced as input data for the program.

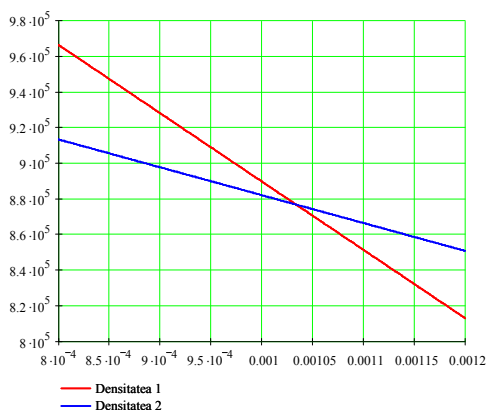


Fig. 3 – Graphical determination of the powder characteristics (co-volume and the force of the powder).

Also, the fictitious mass coefficient,  $\phi$ , which varies throughout the movement of the projectile was computed as a function (Fig. 4) of the projectile’s displacement  $\phi = \phi(l)$ :

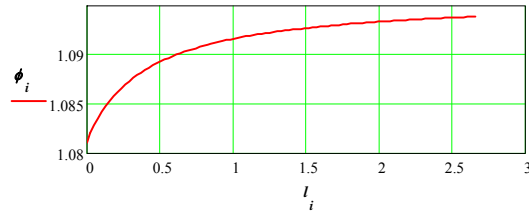


Fig. 4 – The variation of the fictitious mass coefficient with the projectile’s displacement

Through the numerical integration of the differential equation system of the projectile’s movement in the barrel of the ballistic system, the data presented in the diagrams in Fig. 5 and Fig. 6 were obtained.

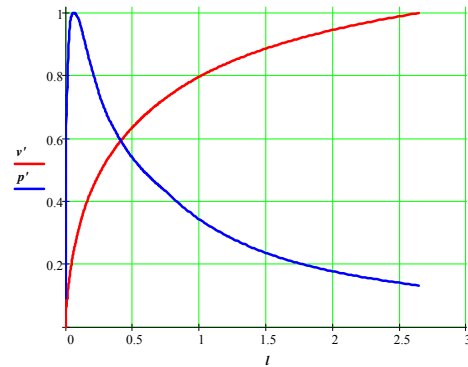


Fig. 5 – The variation of projectile’s velocity and gas pressure versus projectile’s displacement

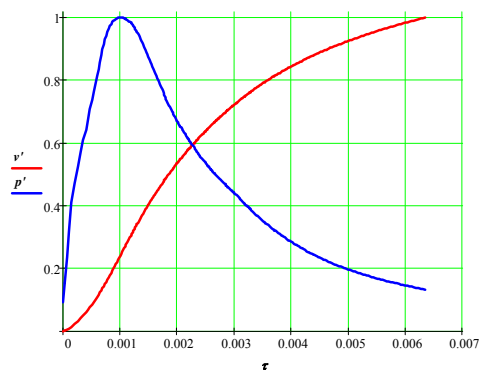


Fig. 6 – The variation of projectile’s velocity and gas pressure versus time

In the charts above, the notations  $v'$  and  $p'$  utilized represent the relative values for veloc-

ity and pressure, obtained by dividing each value obtained with the maximum value for pressure and velocity.

For the maximum pressure in the chamber and muzzle velocity of the projectile the following values were calculated trough solving the mathematical model:

$$p_{\max} = 231.7 \cdot \text{MPa}$$

$$v_0 = 661.86 \frac{\text{m}}{\text{s}}$$

The experimental data consists of the results measured during the firing of a series of 76mm projectiles. The following data set was obtained (Table 1):

Table 1. Experimental Data

Nr. crt.	$V_{25}$ [m/s]	$P_{\max.exp}$ [MPa]
1.	673.06	228.8
2.	671.78	229.2
3.	667.38	229.1
4.	673.14	229.4
5.	671.41	230.5
6.	673.80	231.2

The experimental data are then corrected and averaged. Since the velocity is measured 25 m from the muzzle ( $V_{25}$ ) it is brought by calculus to the muzzle ( $V_0$  is calculated). Afterwards the comparison is undergone (Table 2).

Table 2. Comparison

Parameter	Experimental	Theoretical	Relative error
$P_{\max}$ [MPa]	226.2	231.7	2.4%
$v_0$ [m/s]	682.24	661.86	-2.9%

As observed in Table 2, there are some differences between experimental and theoretical data. Those differences may come in the experimental data from the measuring conditions or the conditions in which the experiments were conducted, or, in theoretical data, from the simplifying hypotheses admitted in constructing the mathematical model of the firing phenomenon.

In spite of the simplifying hypotheses or of the measuring errors the differences between

the theoretical and the experimental results are below 3%, which is considered an extremely satisfying result.

It has been observed [2] that in the case of a powder with a progressive shape, it burns more degressive as it is more progressive in shape (Fig. 7).

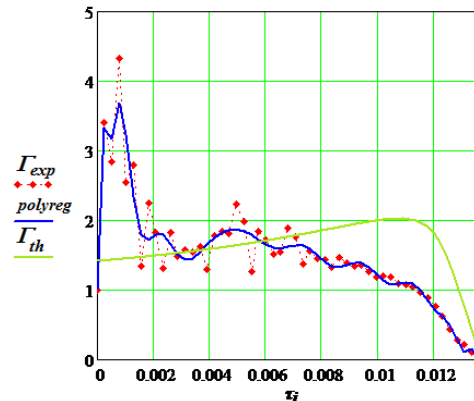


Fig. 7 – Powder vivacity, theoretical and experimental, for a progressive shape.

The main advantage of this method for solving the fundamental problem of interior ballistics is utilizing the whole curve of the pressure obtained in combusting the propellant in closed bomb experiments. It is a known fact that, by doing so, are taken into account all the particularities of the process of powder burning, especially in the case of a powder with progressive burn rate.

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## ADVANCED COMPOSITE MATERIALS FOR NOTAR HELICOPTER FUSELAGE

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**Abstract:** *A composite helicopter fuselage comprises at least one main frame member having two generally vertical side beams joined by generally horizontal top and bottom beams. Each side beam comprises a top hat section bonded to a filler material and the top and bottom beams each comprise two channel sections arranged back to back and bonded to a filler material. An area at each end of the top and bottom beams is devoid of filler and the top hat sections of the side beams are slotted between the channel sections, the parts then being joined by bonding the internal surfaces of the channel sections to the external surfaces of the top hat sections. The fuselage is completed by panels attached to the external flanges of the side and top and bottom beams.*

**Key Words:** *composite materials, fuselage, carbon fiber, orthotropic.*

### 1. Introduction

To fully appreciate the role and application of composite materials to a structure, an understanding is required of the component materials themselves and of the ways in which they can be processed, this article therefore looks at basic composite theory and properties of materials used. Failure behaviour of composite materials presents several characteristics which depend on the materials selected, the manufacturing process used and the state of stress or strain. An important number of strength criteria have been applied to model failure in the last two decades. Each criterion is different and can be used to fit particular experimental results. Up to now, there is no general and systematic approach to describe the failure of composite materials. In this study, a general strength theory based on dual kriging is proposed to model the failure behaviour of composite materials. The theoretical background of the method is first presented, then its application to model failure of composite materials is demonstrated on two examples: a graphite-epoxy composite and

paperboard. The mathematical expression of the criterion can be obtained either through a parametric or an implicit formulation. The parametric formulation is used to predict three-dimensional failure envelopes of graphite-epoxy fabrics and paperboard. The method shows an excellent agreement with available experimental data. Different types of interpolating functions, can be used such as polynomials or trigonometric functions. The results obtained are compared with the tensor quadratic, tensor cubic and parametric criteria. The model can be improved when a nugget effect is added in the kriging equations: the interpolating function does no longer fit the data points. This approach permits incorporating the effect of measurements errors in the interpolation procedure. The intensity of the nugget effect is usually chosen to be proportional to the variance error. The uncertainty of the measurements is thus reflected on the shape of the failure envelope. Note that general tensor polynomial criteria can be derived as a limit case of this approach, and additional experimental data incorporated in the model to refine its accuracy. The proposed methodology can be used as a

general and systematic tool to model effectively a great variety of failure

behaviours.

## 2.Composite Theory

In its most basic form a composite material is one, which is composed of at least two elements working together to produce material properties that are different to the properties of those elements on their own. In practice, most composites consist of a bulk material (the 'matrix'), and a reinforcement of some kind, added primarily to increase the strength and stiffness of the matrix. This reinforcement is usually in fibre form. Today, the most common man-made composites can be divided into three main groups:

\* Polymer Matrix Composites (PMC's) – These are the most common and will be discussed here. Also known as FRP - Fibre Reinforced Polymers (or Plastics) – these materials use a polymer-based resin as the matrix, and a variety of fibres such as glass, carbon and aramid as the reinforcement.

\*Metal Matrix Composites (MMC's) - Increasingly found in the automotive industry, these materials use a metal such as aluminium as the matrix, and reinforce it with fibres such as silicon carbide.

\*Ceramic Matrix Composites (CMC's) - Used in very high temperature environments, these materials use a ceramic as the matrix and reinforce it with short fibres, or whiskers such as those made from silicon carbide and boron nitride.

## 3.Polymer Matrix Composites

Resin systems such as epoxies and polyesters have limited use for the manufacture of structures on their own, since their mechanical properties are not very high when compared to, for example, most metals. However, they have desirable properties, most notably their ability to be easily formed into complex shapes. Materials such as glass, aramid and boron have extremely high tensile and compressive strength but in 'solid form' these properties are not readily apparent. This is due to the fact that when stressed, random surface flaws will cause each

material to crack and fail well below its theoretical 'breaking point'. To overcome this problem, the material is produced in fibre form so that, although the same number of random flaws will occur, they will be restricted to a small number of fibres with the remainder exhibiting the material's theoretical strength. Therefore a bundle of fibres will reflect more accurately the optimum performance of the material. However fibres alone can only exhibit tensile properties along the fibre's length, in the same way as fibres in a rope [1]. It is when the resin systems are combined with reinforcing fibres such as glass, carbon and aramid that exceptional properties can be obtained. The resin matrix spreads the load applied to the composite between each of the individual fibres and also protects the fibres from damage caused by abrasion and impact. High strengths and stiffnesses, ease of moulding complex shapes, high environmental resistance all coupled with low densities, make the resultant composite superior to metals for many applications. Since PMC's combine a resin system and reinforcing fibres, the properties of the resulting composite material will combine something of the properties of the resin on its own with that of the fibres on their own, as surmised in .Orthotropic stress-strain relation for elastic strains has form

$$\varepsilon = \mathbf{S} \sigma$$

$$\mathbf{S} = \begin{bmatrix} \frac{1}{E_1} & -\frac{\mu_{21}}{E_2} & -\frac{\mu_{31}}{E_3} & 0 & 0 & 0 \\ -\frac{\mu_{12}}{E_1} & \frac{1}{E_2} & -\frac{\mu_{32}}{E_3} & 0 & 0 & 0 \\ -\frac{\mu_{13}}{E_1} & -\frac{\mu_{23}}{E_2} & \frac{1}{E_3} & 0 & 0 & 0 \\ & & & \frac{1}{G_{23}} & 0 & 0 \\ & & & & \frac{1}{G_{31}} & 0 \\ & & & & & \frac{1}{G_{12}} \end{bmatrix} \quad (1)$$

Here  $E_1, E_2, E_3$ , is moduli of elasticity

longitudinal in directions 1,2,3 and  $\mu_{ij} = -\frac{\varepsilon_j}{\varepsilon_i}$  is

coefficients Poisson .

Overall, the properties of the composite are determined by:

- \* The properties of the fibre
- \* The properties of the resin
- \* The ratio of fibre to resin in the composite (Fibre Volume Fraction (FVF))
- \* The geometry and orientation of the fibres in the composite

The ratio of the fibre to resin derives largely from the manufacturing process used to combine resin with fibre. However, it is also influenced by the type of resin system used, and the form in which the fibres are incorporated. In general, since the mechanical properties of fibres are much higher than those of resins, the higher the fibre volume fraction the higher will be the mechanical properties of the resultant composite. In practice there are limits to this, since the fibres need to be fully coated in resin to be effective, and there will be an optimum packing of the generally circular cross-section fibres. In addition, the manufacturing process used to combine fibre with resin leads to varying amounts of imperfections and air inclusions.

Typically, with a common hand lay-up process as widely used in the boat-building industry, a limit for FVF is approximately 30-40%. With the higher quality, more sophisticated and precise processes used in the aerospace industry, FVF's approaching 70% can be successfully obtained. The geometry of the fibres in a composite is also important since fibres have their highest mechanical properties along their lengths, rather than across their widths. This leads to the highly anisotropic properties of composites, where, unlike metals, the mechanical properties of the composite are likely to be very different when tested in different directions. This means that it is very important when considering the use of composites to understand at the design stage, both the magnitude and the direction of the applied loads. When correctly accounted for, these anisotropic properties can be very advantageous since it is only necessary to put material where loads will be applied, and thus redundant material is avoided. It is also

important to note that with metals the material supplier largely determines the properties of the materials, and the person who fabricates the materials into a finished structure can do almost nothing to change those 'in-built' properties. However, a composite material is formed at the same time, as the structure is itself being fabricated (figure2). This means that the person who is making the structure is creating the properties of the resultant composite material, and so the manufacturing processes they use have an unusually critical part to play in determining the performance of the resultant structure.

Use of composites in helicopter primary (figure 2) would be adequate but cannot be used. Alternate structures has been steadily increasing over the past designs are needed that may be more efficient in this two decades.



Fig.1 Fuselage composit



Fig.2 NOTAR- body of carbon fiber

Carbon fiber is a form of graphite in which these sheets are long and thin. You might think of them as ribbons of graphite. Bunches of these ribbons like to pack together to form fibers, hence the name carbon fiber.



Fig.3 Carbon fiber

## CONCLUSIONS

Composites have been used extensively in the Rotorcraft Industry since 1970's very successfully. The advantages using composite material are composite designs can achieve better aerodynamics by eliminating joints and rivets in addition to reducing problems of corrosion. Composite design allows an easy way to achieve a low drag airfoil. Composite airplanes are usually faster for a given horsepower than their counterparts because of airfoil shape and smoothness. The process to construct the plug for the mock-up is divided into two parts, fuselage and tail boom sections. Fuselage is the main section in the helicopter structures where the

main components such as cockpit, battery, engine, gearbox, fuel tank, landing skid/gears are located. The layout of these components will eventually stabilized helicopters either during static or flight conditions.

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## ON THE LIFETIME OF RAILWAY VEHICLE SUBSYSTEMS THAT HAVE A BEARING CAPACITY QUALITY

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**Abstract:** *The paper presents a study on the lifetime of railway vehicle subsystems that have bearing capacity quality. A computation of the lifetime is presented on the basis of static measurements of the specific deformations and stresses and, in comparison, results of a series of fatigue tests, with the adequate conclusions.*

**Keywords:** *specific (relative) deformation and stress, lifetime, Wohler curves.*

### 1. INTRODUCTION

Gondola type cars are designed for the transport of bulk goods or other freight, the carbody being composed of a metallic structure covered with sheet metal. During use, the side walls are heavily strained such that a detailed study is imposed on the resistance of the pillars that are part of the lateral walls.

The carbodies of gondola type railway cars contain, within the structure of the lateral walls, two types of pillars:

- Pillars affixed next to the support beam;
- Pillar affixed next to the intermediate beams.

The deformation and stress states have been determined experimentally for the affixing of the pillars next to the support beam, in two variants:

- a. Without welding between the inferior frame and the lateral pillar;
- b. With welding between the inferior frame and the lateral pillar.

The study aims to determine the optimal variant for use, in regards to the resistance of the pillar affixing to the chassis structure.

The testing was conducted on a number of 3 pillars (no. 1, 2, 3) in the option without welding between the inferior frame and the lateral pillar and on a number of 2 pillars (no.

4, 5) for the option with welding between the inferior frame and the lateral pillar [1].

In order to conduct the testing, 5 pillars were produced such that they can be affixed into the testing device (own design). The static testing to determine the specific deformations and stresses was conducted for all 5 variants.

### 2. EXPERIMENTAL STUDY ON THE LIFETIME

Analyzing the experimental results from the static testing conducted, it is observed that the maximum values of the stresses were recorded in the measurement points denoted by TER5 and TER6 (table 1), positioned in an area that constitutes a remarkable stress concentrator.

In order to experimentally determine the specific deformations and stresses, electric resistive transducers (T.E.R.) were placed according to figure fig. 1a and fig. 1b for the options without the welding and with the welding between the inferior frame and the lateral pillar [3].

The applied forces were determined experimentally with a force transducer with a measurement range of 0 – 10 tf, precision class 0,1 type C1 – HBM.

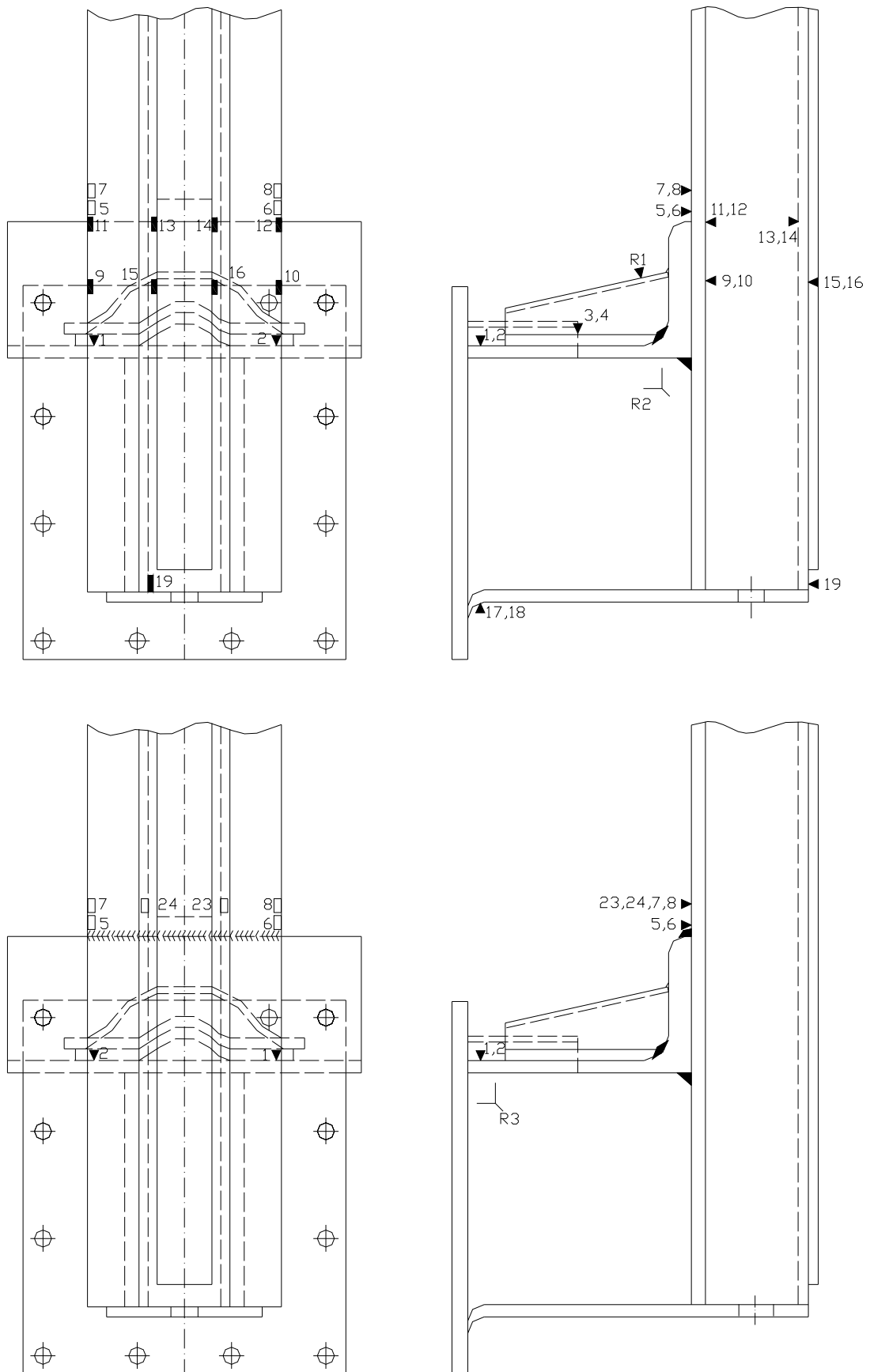


Fig. 1a, 1b Placement of electric resistive transducers

Table 1.

Pillar No.	TER5 - $\sigma$ [N/mm <sup>2</sup> ]			TER6 - $\sigma$ [N/mm <sup>2</sup> ]		
	30kN	45kN	60kN	30kN	45kN	60kN
1	227	351	391	183	257	327
2	170	246	320	143	232	343
3	182	242	326	144	186	292
4	142	210	285	159	231	313
5	194	290	372	159	240	323

Estimation of the lifetime was done using the Wöhler fatigue curves, recommended by the UIC in report [4] ERRI B12/RP60, curves shown in figure 2 and table 2.

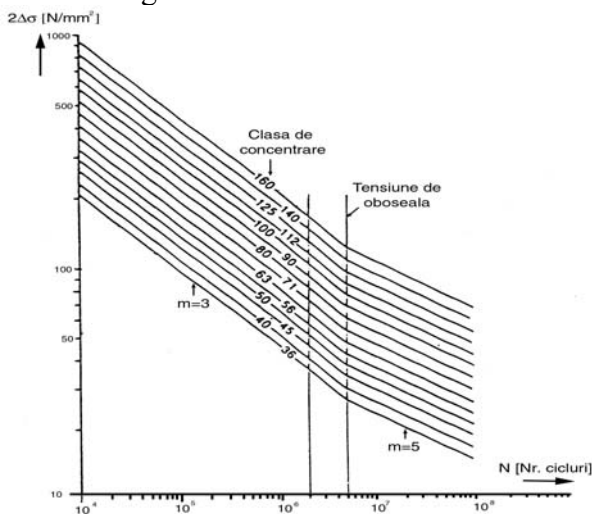


Figure 2.

Table 2.

Concentration Class	log a		Fatigue stress [N/mm <sup>2</sup> ]
	m=3	m=5	
160	12.901	17.036	117
140	12.751	16.786	104
125	12.601	16.536	93
112	12.451	16.286	83
100	12.301	16.036	74
90	12.151	15.786	66
80	12.000	15.536	59
71	11.951	15.286	52
63	11.701	15.036	46
56	11.551	14.786	41
50	11.401	14.536	37
45	11.251	14.286	33
40	11.101	14.036	29
36	11.001	13.786	26

Consequently, we have conducted the lifetime computation using the adequate Wohler curves [2] and the stresses determined experimentally for a load cycle of  $\pm 15$  kN, resulting in a number of cycles predicted until

the appearance of the first fissure (Nf) in the area of transducers TER5, TER6 as being those in table 3.

Table 3.

No.	Pillar no.	Nf
Pillars without welding between the inferior frame and the lateral pillar		
1.	1	387.648
2.	2	223.606
3.	3	454.926
Pillars with welding between the inferior frame and the lateral pillar		
4.	4	862.622
5.	5	564.952

### 3.EXPERIMENTAL FATIGUE TESTING

The fatigue testing was conducted on a research stand adequate to the current purpose, each pillar being applied, dynamically, forces with the load cycle  $F_{med} = 45$  kN,  $\Delta F = \pm 15$  kN and a frequency of 5,83 Hz. Throughout the testing, the time evolutions of the specific deformations and stresses were closely monitored.

The results of the estimations of the lifetime of each pillar for a dynamic exceedent of  $2\Delta\sigma$  corresponding to the load of  $\Delta F = \pm 15$  kN are shown in table 4.

Table 4.

Pillar no.	Nf estimated [cycles]	Nf exp. [cycles]	Nr exp. [cycles]
1	387.648	445.000	740.000
2	223.606	235.000	390.000
3	454.926	483.000	818.000
4	862.622	960.000	1.101.600
5	564.952	830.00	970.000

The testing determined the number of applied cycles until the appearance of the first fissure „Nf” and the number of applied cycles until complete destruction „Nr”.

Figures 3 and 4 show the appearance of the fissure in the area of the stress concentrator which was observed throughout the testing, using the method of penetrating liquids, together with the way of fissuring or breaking of the pillars subjected to fatigue testing.

During the testing it was observed that the measurement points TER5 and TER6 the

values of the stresses have a tendency to decrease in value before the appearance of fissures, due to accentuated degradation of the material in the fissure section.

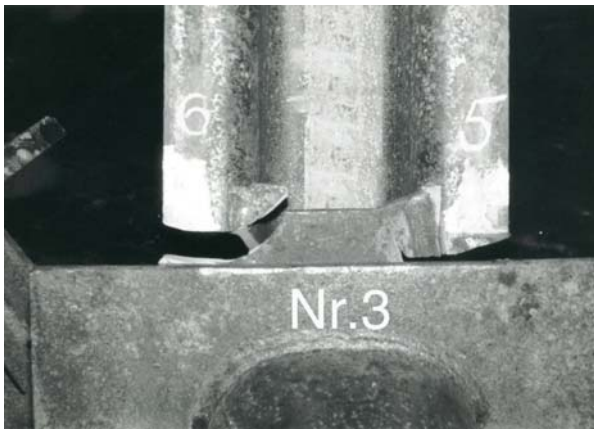


Figure 3.



Figure 4.

#### 4.CONCLUSIONS

Comparing the values of the estimated lifetime to the values of the lifetime until the appearance of the first fissure (determined experimentally), a good correlation is observed between the calculated and experimental values. This fact further ratifies the correct

appreciation of the concentration class in which the area of the transducers TER5, TER6 is classified, and implicitly, the correct choice of used Wöhler curves.

Analyzing the experimental results, it is observed that the lifetime for the pillars with welding between the inferior frame and the lateral beam, both estimated and experimentally obtained, is approximately 100% higher than that for the case without welding between the inferior frame and the lateral pillar. Consequently, the solution used for the pillars with numbers 4 and 5 is imposed to be used in the production process of the railway cars.

It is appreciated that the observed, estimated and experimentally determined, through fatigue testing for considered loads, lifetime is sufficient in regards to the resistance of the lateral wall in the conditions of use of the car, for a duration of a least 25 years.

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## POWDER PROPERTIES RESULTED FROM THE BEARINGS PROCESSING

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**Abstract:** The paper is presenting some of the researches made on sludge resulted after a processing of ball-bearings, by grinding. Due to the high quantity of sludge, it must be considered the powder which can result, because it is already there. The powder from ball-bearing steel is compared with powders produced by famous companies from the world.

**Key words:** powder, sludge, bearing, processing, properties.

### 1. INTRODUCTION

As a result of processing of the component parts from a ball-bearing, there is resulting an important amount of sludge. This sludge is containing particles detached from the rectified piece and also granules from the abrasive disk.

Nearby these components, which are in solid state, the sludge is containing also a fluid component coming from the cooling fluid.

But the most important component is from ball-bearings steel, which is a medium alloyed steel containing a high level of carbon.

In the following passages there are presented some characteristics of the sludge resulted from working processes.

### 2. HOW TO OBTAIN THE POWDER

The studied sludge is obtained during the grinding of the components from the ball-bearings. Grinding is a technological proceeding where the surfaces of features are treated with the help of grinding stones, with the purpose of obtaining a precise dimension and higher quality of the surface.

Grinding stock is eliminated through very fine splinters. Fineness is depending on: grinding regime, cutting oil, working material and the characteristics of grinding stones (granulation, hardness, binding matter).

During rectification, the grinding stones are working as the milling cutter. The difference between these two, is that according to the tooth of milling cutter, hard grains are dispersed in an arbitrary manner, and this is working with very different departure angle [1].

Because, most of grains are cutting with different departure angles, in the cutted surfaces we will find big plastic deformations which will influence the sludge quality. For this study it was used a sludge resulted from rough-grinding and final roughing.

The sludge is containing the following elements:

- particles from the grinding stones; these particles (carbides, SiO<sub>2</sub>, etc) are very hard and there are influencing, in a certain way, the characteristics of the powder obtained from the sludge.

- grinding compound; this fluid, normally, is containing a water emulsion (with 5-10% Na<sub>2</sub>CO<sub>3</sub>, 0,5-1% car oil and a little soap) and has the role of preventing the overheating of the feature, evacuation of falling splinters and grains, and decreasing of friction.

- splinters from the piece, in fact splinters from steel for ball-bearings.

Ball-bearing steels are alloyed steels, with a high percentage of carbon. The chemical

composition of ball-bearing steels (RUL) made in Romania, are presented in Table 1.

**Table 1.** The chemical composition of ball-bearing steels

<i>Chemical composition, [%]</i>	<i>RUL 1</i>	<i>RUL 2</i>
<b>C</b>	0.95-1.10	0.95-1.10
<b>Mn</b>	0.20-0.45	0.90-1.20
<b>Si</b>	0.17-0.37	0.40-0.65
<b>Cr</b>	1.30-1.65	1.30-1.65
S, [max.]	0.020	0.020
P, [max.]	0.027	0.027
Ni, [max.]	0.30	0.30
Cu, [max.]	0.25	0.25

### 3. THE CHEMICAL COMPOSITION OF THE POWDER

The chemical purity of powders is depending on working material and the technological processes for fabrication [3].

The obtained sludge from ball-bearings is containing impurities like:

- hard grains from the grinding stone;
- textil residues, thrown by the workers on the gathering belt;
- film around the splinter, film which is coming from the cooling-fluid;
- particles coming from the bounding material used when the abrasive disk was made.

The impurities can generate different influences:

- *a negativ one* (modifies pressability, is gripping matrix, is providing deformations during sinterisation, there are resulting chemical reactions during sinterisation) by diminishing the final properties of features.
- *a positive one* (less often) by increasing the hardness of features.

The percentage of impurities in sludge is about 14-16% depending on the type of working (smoothing grinding, finish grinding).

The chemical composition of the sludge is depending on working material (ball-bearing steel) grinding regime (with the smoothing grinding the percentage of hard abrasive particles is higher as with finish-grinding), but it is also depending on the processing where the sludge is transformed in powder.

The sludge obtained with ball-bearing processing is containing a series of elements, presented in Table 2.

**Table 2.** Chemical composition of sludge

<i>Chemical composition, [%]</i>	<i>The type of sludge</i>	
	<i>From smoothing grinding</i>	<i>Finishing grinding</i>
<b>C</b>	0.90	0.72
<b>Mn</b>	0.33	0.33
<b>Cr</b>	1.74	1.74
<b>Ni</b>	0.21	0.21
<b>Cu</b>	0.76	0.66
<b>Al</b>	2.64	2.62
<b>Si</b>	1.90	1.70
<b>P</b>	0.03	0.03
<b>S</b>	0.03	0.03
<b>Loss of mass in H<sub>2</sub></b>	6.98	4.33

This percentage presented in Table 2 can be explained like this:

- smoothing grinding is leading to a higher quantity of impurities, which, at there turn, are increasing the percentage of C, Si, Al, Cu; in the case of finishing-grinding, impurities can be found in a lower degree;

- when, from the sludge, there are separated abrasive particles, then the percentage of carbon is decreasing till 0.4-0.6%, and Si it's almost reaching the normal limits of RUL steel, and Al it is also substantially decreasing till 1%.

Researches on sludge were made with spectrochemical analysis, with the help of a

Spectrograph Q24 - with a prism, produced by the Carl Zeiss Company-Germany.

representing the powder from where impurities were cleaned [4, 5].

#### 4. THE SLUDGE HUMIDITY

An important characteristic for further processing of sludge is humidity.

This was determined as following:

- 100 g of sludge ( $m_0=100g$ ) was weight with analytical balance;
- the sludge was dried in oven at a temperature of  $170^{\circ}C$ ;
- the dry sludge was weight ( $m_1$ ) and calculated the humidity ( $u$ ) with the relation (1):

$$u = \frac{m_0 - m_1}{m_0} \times 100, [\%] \quad (1)$$

The sludge humidity have the values between 42% and 48% and it is depending on different factors, like:

- the nature of cooling fluid used for grinding;
- the place where sludge is collected (filtrator or collecting band).

Humidity is not influencing the chemical composition or other characteristics of powder, because at the high temperature of soaking, the possible oil residue what remains, will be burned out.

#### 5. THE CHEMICAL COMPOSITION OF THE POWDER

To be able to use the powder incorporated in the sludge, this must come to a technological process.

The powders chemical composition depends, evidently, on the sludge's composition.

The sludge processing will result in a changing of percentage for a few elements. The results of the chemical analysis are presented in Table 3.

Unseparated powder is representing the powder from where impurities were not separated, and separated powder is

**Table 3.** Chemical composition of powder

<i>Powder</i>	Unseparated powder	Separated powder
<b>%C</b>	0.57	0.40
<b>%Mn</b>	0.33	0.31
<b>%Cr</b>	1.74	1.74
<b>%Ni</b>	0.21	0.20
<b>%Cu</b>	0.50	0.45
<b>%Al</b>	2.32	1.84
<b>%Si</b>	1.60	1.40
<b>%P</b>	0.027	0.014
<b>%S</b>	0.01	0.001
<b>%O<sub>2</sub></b>	0.36	0.20

As a comparison between powders produced by prestigious companies from all over the world, and the chemical composition of these powders obtained from sludge resulted from ball-bearings, there is presented Table 4.

**Table 4.** Chemical composition for different powders

<i>Different powders</i>	RZ 400	ATOMET 4601	RUL separated
<b>%C</b>	0.03	0.003	0.40
<b>%Mn</b>	0.25	0.20	0.31
<b>%Cr</b>	-	0.05	1.74
<b>%Ni</b>	-	1.8	0.20
<b>%Cu</b>	-	0.02	0.45
<b>%Al</b>	-	-	1.84
<b>%Si</b>	0.10	0.003	1.40
<b>%P</b>	0.03	0.01	0.014
<b>%S</b>	0.02	-	0.001
<b>%O<sub>2</sub></b>	0.35	0.10	0.20

As we can observe it from table 4, the RUL powder separated, is similar from chemical point of view with powders produced by famous companies from the world [2, 3].

## 6. CONCLUSIONS

With grinding of ball-bearings there is resulting an important amount of sludge.

This sludge is mostly containing splinters from the rectified part, and also some impurities.

By detaching these impurities there can be obtained a powder, from ball-bearing steel, which from chemical point of view is similar to powders produced by famous companies in the world.

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## A FEW CONSIDERATIONS REGARDING THE GEOHERMAL HEAT PUMPS

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**Abstract:** *Geothermal heat pumps are known also as „GeoExchange” systems or „ground source heat pumps”, to clearly distinguish them from air source heat pumps. It is important to understand that ground source heat pumps draw energy from shallow ground. The energy originates from the sun: none of the energy originates from the centre of the Earth, in spite of the name „geothermal heat pump”. Genuine geothermal energy from the centre of Earth is available only in places where volcanic activity comes close to the surface.*

**Keywords:** *pump, geothermal, heating, refrigeration, water, air.*

### 1. INTRODUCTION

A geothermal heat pump is a heat pump that uses the Earth as either a heat source, when operating in heating mode, or a heat sink, when operating in cooling mode. The source or sink is used to change the state of the refrigeration gas in the refrigeration circuit, which results in the ability of the appliance to remove heat or provide deliverable heat. This is known as a water-source system, and is different from an air source heat pump, that can also be combined with thermal solar cooling, in a geosolar system [1].

Geothermal heat pumps can be characterised as having one or two loops. The heat pump itself, explained more fully in the article on heat pumps, consists of a loop containing refrigerant. The refrigerant is pumped through a vapor-compression refrigeration cycle that moves heat from a cooler area to a warmer one.

In a single loop system, the copper tubing refrigerant loop actually leaves the heat pump appliance cabinet and goes out of the building and under the ground and directly exchanges heat with the ground before returning to the appliance. Hence the name "direct exchange"

or DX. Copper loop DX systems are gaining acceptance due to their increased efficiency and lower installation costs but the volume of expensive refrigerant remains high. DX systems are not gaining acceptance in Canada. Numerous botched installations along with the high cost and liability in Ontario are causing people to shun this technology.

In a double loop system, the refrigerant loop exchanges heat with a secondary loop. This may be an open loop or a closed loop system. In a closed loop system, the loop is made of High-density polyethylene pipe and it contains water and anti-freeze (propylene glycol, denatured alcohol or methanol). After leaving the heat exchanger, the pipe goes out of the building and under the ground below the frost line, and may be submerged in a body of water such as a pond or lake before returning, so the water is exchanging heat with the ground or water. Systems in wet ground or in water are generally more efficient than dryer ground loops since it is less work to move heat in and out of water than solids in sand or soil. In an open loop system the supply piping runs from the machine to a well or body of water (fresh or salt water are ok, but the appliance must be protected from corrosive effect of salt

water by using different metals in the heat exchangers and pumps). The return line runs from the machine to a separate rejection well or body of water. The supply and return lines are placed far enough apart to ensure correct thermal transfer and recharge of the source.

## 2. COMPONENTS

Geothermal systems require a ground loop. Some manufacturers have a separate ground loop fluid pump pack, while some integrate the pumping and valving within the unit and a water-source heat pump. Expansion tanks and pressure relief valves can be installed on the heated fluid side.

The tubing can be installed horizontally as a loop field or vertically as a series of long U-shapes in wells(see below).



Fig.1 An installed liquid pump pack

The purpose of the tubing is to transfer heat to and from the ground. The size of the loop field depends on the soil type and moisture content, the average ground temperature and the heat loss and or gain characteristics of the building being conditioned. Typically, one loop (400 feet (120 m) to 600 feet (180 m)) has the capacity of one ton or 12,000 British thermal units per hour (BTU/h) or 3.5 kilowatts. An average house will range from 3 to 5 tons (10 to 18 kW) of capacity. *The previous two sentences are extremely subjective and may not be applicable in many cases.*

The second component in some cases is a liquid pump pack, which sends the water through the tubing and the water-source heat pump. Some manufacturers have this pumping capacity within the heat pump appliance.

Lastly, the water-source heat pump is the unit that becomes the heating and cooling plant for the building. It can cover space heating, space cooling, (space heating via conditioned air, hydronic systems and / or radiant systems), domestic or pool water preheat (via the desuperheater function, demand hot water all within one appliance with a variety of options with respect to controls, staging and zone control. This is where the heat from the tubing is used to transferred heat in or out of the ground for use in the structure or for water.

Heat pumps have the ability to capture heat at one temperature reservoir and transfer it to another temperature reservoir. An example of an air source heat pump is a refrigerator; heat is removed from the refrigerator's compartments and transferred to the outside. There is no technical barrier to using a water source heat pump system to take the heat out of your leftovers and to put it into the hot water for washing the dishes.

## 3. COMMON SYSTEMS

### 3.1. Closed loop fields

A closed loop system, the most common, circulates the fluid through the loop fields' pipes and does not pull in water from a water source. In a closed loop system there is no direct interaction between the fluid and the earth; only heat transfer across the pipe. The length of vertical or horizontal loop required is a function of the ground formation thermal conductivity, ground temperature, and heating and cooling power needed, and also depends on the balance between the amount of heat rejected to and absorbed from the ground during the course of the year. A rough approximation of the initial soil temperature is the average daily temperature for the region. Although copper and other metals can be used, polyethylene seems to be the most common tubing material used currently by installers. 3/4 inch (19mm) or 1.25 inch inside diameter are common sizes of tubing.

There are four common types of closed loop systems; vertical, horizontal, slinky, and pond. (Slinky and pond loops depicted below.)

### Vertical closed loop field

A vertical closed loop field is composed of pipes that run vertically in the ground. A hole is bored in the ground, typically, 75 to 500 plus feet deep. Pipe pairs in the hole are joined with a U-shaped cross connector at the bottom of the hole. The borehole is commonly filled with a bentonite grout surrounding the pipe to provide a good thermal connection to the surrounding soil or rock to maximize the heat transfer. Grout also protects the ground water from contamination, and prevents artesian wells from flooding the property. Vertical loop fields are typically used when there is a limited area of land available. Bore holes are spaced 5–6 m apart and the length is highly subjective based on ground and building characteristics. Someone thinks they are generally 15 m (50 ft) deep per kW of cooling. During the cooling season, the local temperature rise in the bore field is influenced most by the moisture travel in the soil. Reliable heat transfer models have been developed through sample bore holes as well as other tests.

### Horizontal closed loop field

A horizontal closed loop field is composed of pipes that run horizontally in the ground. A long horizontal trench, deeper than the frost line, is dug and U-shaped coils are placed horizontally inside the same trench. A trench for a horizontal loop field will be similar to one seen under the slinky loop field; however, the width strictly depends on how many loops are installed. Horizontal loop fields are very common and economical if there is adequate land available.

### Slinky closed loop field

A slinky (also called coiled) closed loop field is a type of horizontal closed loop; however, the pipes overlay each other. The easiest way of picturing a slinky field is to imagine holding a slinky on the top and bottom with your hands and then move your hands in opposite directions. A slinky loop field is used if there is not adequate room for a true horizontal system, but it still allows for an easy installation. Rather than using straight pipe, slinky coils, use overlapped loops of

piping laid out horizontally along the bottom of a wide trench. Depending on soil, climate and your heat pumps' run fraction, slinky coil trenches can be anywhere from one third to two thirds shorter than traditional horizontal loop trenches. Slinky coil ground loops are essentially a more economic and space efficient version of a horizontal ground loop [2].



Fig.2 A 3-ton slinky loop prior to being covered with soil. The three slinky loops are running out horizontally with three straight lines returning the end of the slinky coil to the heat pump



Fig.3 Loop field for a 12-ton system (unusually large for most residential applications)



Fig.4 12-ton pond loop system being sunk to the bottom of a pond

### Closed pond loop

A closed pond loop is not as common, but is becoming increasingly popular. A pond loop is achieved by placing coils of pipe at the bottom of an appropriately sized pond or water source. This system has been promoted by the DNR (Department of Natural Resources), who

support geothermal systems and the use of ponds for geothermal systems. A pond loop is extremely similar to a slinky loop, except that it is attached to a frame and located in a body of water versus soil.

### 3.2. Open loop systems

In contrast to the closed loop systems, an open loop system pulls water directly from a well, lake, or pond. Water is pumped from one of these sources into the heat pump, where heat is either extracted or added. The water is then pumped back into a second well or source body of water. There are three general types of systems.

In the first type, water can be pumped from a vertical water well and returned to a nearby pond. In the second type of system, water can be pumped from a body of water and returned to the same body of water. In the third type of system, water can be pumped from a vertical well and then returned to the same well. While thermal contamination (where the ground temperature is affected by the operation of the system) is possible with any geothermal system, with proper design, planning, and installation any loop configuration can work very well for a very long time. Deep lake water cooling uses a similar process with an open loop for air conditioning and cooling. Open loop systems using ground water are usually much more efficient than closed systems because they will be heat exchanging with water always at ground temperature. Closed loop systems, in comparison, have to make do with the inefficient heat-transfer between the water flowing through the tubing and the ground temperature.

One of the benefits of an open loop system is that for most configurations and depending on the local environment you are dealing with ground water at a constant temperature of about 50°F/10°C. In closed loop systems the temperature of the water coming in from the loop is often within 10°F/6°C of the temperature of the water entering the loop showing how little heat was exchanged. The constant ground water

temperatures significantly improve heat pump efficiency.

### 4. STANDING COLUMN WELL

A standing column well system is less expensive and more efficient than a comparably sized closed loop system. Water is drawn from the bottom of a deep rock well, passed through a heat pump, and returned to the top of the well, where traveling downwards it exchanges heat with the surrounding bedrock. The choice of a standing column well system is often dictated where there is near-surface bedrock and limited surface area is available. A standing column is typically not suitable in locations where the geology is comprised of mostly clay, silt, or sand. If bedrock is deeper than 200 feet (61 m) from the surface, the cost of casing to seal off the overburden may become prohibitive.

A multiple standing column well system can support a large structure in an urban or rural application. The standing column well method is also popular in residential and small commercial applications. There are many successful applications of varying sizes and well quantities in the many boroughs of New York City, and is also the most common application in the New England states. This type of Earth-Coupling system has some heat storage benefits, where heat is rejected from the building and the temperature of the well is raised, within reason, during the Summer cooling months which can then be harvested for heating in the Winter months, thereby increasing the efficiency of the heat pump system. As with closed loop systems, sizing of the standing column system is critical in reference to the heat loss and gain of the existing building. As the heat exchange is actually with the bedrock, using water as the transfer medium, a large amount of production capacity (water flow from the well) is not required for a standing column system to work. However, if there is adequate water production, then the thermal capacity of the well system can be enhanced by periodic discharge during the peak Summer and Winter months.



Since this is essentially a water pumping system, standing column well design requires critical considerations to obtain peak operating efficiency. Should a standing column well design be misapplied, leaving out critical shut-off valves for example, the result could be an extreme loss in efficiency and thereby cause operational cost to be higher than anticipated.

## 5. COMMON HEAT PUMPS

There are also different types of water-source heat pumps. A variety of products are available, for both residential and commercial applications; there are water-to-air heat pumps, water-to-water heat pumps and hybrids between the two. Some manufacturers are now producing a reversible heat pump for chillers also.

### Water-to-air

The water-to-air heat pumps are designed to replace a forced air furnace and possibly the central air conditioning system. The term *water-to-air* signifies that the heat pump is designed for forced air applications and indicates that water is the source of heat or cold. The water-to-air system is a single central unit that is capable of producing heat during the winter and air conditioning during the summer months. There are variations of the water-to-air heat pumps that allow for split systems, high-velocity systems, and ductless systems.

### Water-to-water

A water-to-water heat pump is designed for a heating-system that utilizes water for heating or cooling the building. Systems such as radiant underfloor heating, baseboard radiators, conventional cast iron radiators and a dual geosolar (solar thermal-geothermal) system would use a water-to-water heat pump. The water-to-water heat pump uses the water from the loop field to heat or cool the water that is used for conditioning the structure. Just like a boiler, this heat pump is unable to provide air conditioning during the summer months.



Fig.5

Water-to-air heat pump



Fig.6 Water-to-water heat pump

### Hybrid

A hybrid heat pump is capable of producing forced air heat and hot water simultaneously and individually. These systems are largely being used for houses that have a combination of under-floor and forced air heating. Both the water-to-water and hybrid heat pumps are capable of heating domestic water also. Almost all types of heat pumps are produced commercially and residentially for indoor and outdoor applications.

### Geothermal heat pumps in combination with seasonal thermal storage

Heat pumps, combined with aquifers, can be used for heating of greenhouses [3]. In summer, a greenhouse can be cooled with cold ground water, pumped from an aquifer. This

heats the water in the aquifer which can become a warm source for heating in winter [4]. The combination of cold and heat storage with heat pumps can be combined with water/humidity regulation. These principles are used more generally in Interseasonal Heat Transfer [13] to provide renewable heat and renewable cooling to all kinds of buildings. Where an aquifer is not present a thermal bank can be used for seasonal thermal storage and an asphalt solar collector can be used to charge a thermal bank with heat in the summer to allow winter heating to be provided very efficiently with a ground source heat pump.

## **6. DIRECT EXCHANGE**

While this article focuses on water-source systems in which the refrigerant exchanges its heat with a water loop that is placed in the ground, a direct exchange system (often known as DX geothermal) is one in which the refrigerant circulates through a copper pipe placed directly in the ground. This eliminates the need for a heat exchanger between the refrigerant loop and the water loop, as well as eliminating the water pump. These simpler systems are able to reach higher efficiencies while also requiring a shorter and smaller pipe to be placed in the ground, reducing installation cost. DX systems are a relatively newer technology than water-source. DX systems, like water-source systems, can also be used to heat water in the house for use in radiant heating applications and for domestic hot water, as well as for cooling applications. Though corrosion or cracking of the copper loop has sometimes been a concern, these can be eliminated through proper installation. Since copper is a naturally-occurring metal that survives in the ground for thousands of years in most soil conditions, the copper loops usually have a very long lifetime.

## **7. BENEFITS**

Geothermal systems are able to transfer heat to and from the ground with minimal use of electricity. When comparing a geothermal system to an ordinary system, a homeowner

can save anywhere from 30% to 70% annually on utilities. Even with the high initial costs of purchasing a geothermal system the payback period is relatively short, typically between three and five years [5]. Geothermal systems are recognized as one of the most efficient heating and cooling systems on the market.

The U.S. Environmental Protection Agency (EPA) has called geothermal the most energy-efficient, environmentally clean, and cost-effective space conditioning systems available. Heat pumps also offer significant emission reductions potential, particularly in regions with heating and cooling loads - the GHG emissions savings in a given region can be calculated based on the amount of energy used, efficiency factors, and carbon intensity of the electricity used to power the pump. The life span of the system is longer than conventional heating and cooling systems. Most loop fields are warranted for 25 to 50 years and are expected to last at least 50 to 200 years. Geothermal systems use electricity for heating the house. The fluids used in loop fields are designed to be biodegradable, non-toxic, non-corrosive and have properties that will minimize pumping power needed.

Some electric companies will offer special rates to customers who install geothermal systems for heating/cooling their building. This is due to the fact that electrical plants have the largest loads during summer months and much of their capacity sits idle during winter months. This allows the electric company to use more of their facility during the winter months and sell more electricity. It also allows them to reduce peak usage during the summer (due to the increased efficiency of heat pumps), thereby avoiding costly construction of new power plants. For the same reasons, other utility companies have started to pay for the installation of geothermal heat pumps at customer residences. They lease the systems to their customers for a monthly fee, at a net overall savings to the customer.

Geothermal heat pumps are especially well matched to underfloor heating and baseboard radiator systems which only require warm temperatures (40°C) to work well (as compared to wall-mounted radiators which normally require 70°C). Thus they are ideal for

open plan offices. Using large surfaces such as floors, as opposed to radiators, distributes the heat more uniformly and allows for a lower temperature heat transfer fluid; however, wood or carpet floor coverings dampen this effect because the thermal transfer efficiency of these materials is lower than that of masonry floors (tile, concrete).

Undisturbed earth below the frost line remains at a relatively constant temperature year round. This temperature equates roughly to the average annual air-temperature of the chosen location. It is usually 7-12°C (45-54°F) at a depth of six meters in locations where heating is needed in winter. Geothermal heat pumps rely on this near constant temperature as a base temperature that is raised or lowered minimally to create a desirable indoor temperature. Because this temperature remains more constant than the air temperature throughout the seasons, geothermal heat pumps perform with far greater efficiency and are stressed less during extreme air temperatures than fueled or electric conventional air conditioners and furnaces. A particular advantage is that they can use electricity to heat spaces and water much more efficiently than an electric heater.

Geothermal heat pump technology, like building orientation, is a natural building technique (bioclimatic building).

The current use of geothermal heat pump technology has resulted in the following emissions reductions:

- Elimination of more than 5.8 million metric tons of CO<sub>2</sub> annually;
- Elimination of more than 1.6 million metric tons of carbon equivalent annually.

These 1,000,000 installations have also resulted in the following energy consumption reductions:

- Annual savings of nearly 8,000 GWh;
- Annual savings of nearly 40 trillion Btus of fossil fuels;
- Reduced electricity demand by more than 2.6 GW.

The impact of the current use of geothermal heat pumps is equivalent to:

- Taking close to 1,295,000 cars off the road;

- Planting more than 385 million trees;
- Reducing U.S. reliance on imported fuels by 21.5 million barrels (3,420,000 m<sup>3</sup>) of crude oil per year.

## **8. DISADVANTAGES**

The biggest problem with residential retrofits is the cost of getting heat spread throughout the house. Many existing houses with furnaces use a forced hot air system, which is not ideal for a geothermal heat pump, because the water-to-air units cannot heat the air as much as a furnace can. Therefore the existing duct work must be enlarged to get more air to the required room. For homes with baseboard heat, the cost of the retrofit may make it impractical because water-to-water pumps can only heat the water to 120 degrees Fahrenheit, whereas a boiler can reach 180 degrees or more; this makes it possible to double up on baseboards, but results may vary.

Another problem is that while Geothermal heat pumps can generate enough domestic or process hot water, generally the efficiency of the system declines rapidly after heating water above 120 F, so often another solution is used such as electric, fossil fuels, wood boiler, or solar.

## **9. COSTS AND SAVINGS**

The initial cost of installing a geothermal heat pump system can be two to three times that of a conventional heating system in most residential applications, new construction or existing. In retrofits, the cost of installation is affected by the size of living area, the home's age, insulation characteristics, the geology of the area, and location of the home/property. For new construction, proper duct system design and mechanical air exchange should be considered in initial system cost. The additional costs are returned in energy savings in 5–10 years.

The heating efficiency of ground-source and water-source heat pumps is indicated by their coefficient of performance (COP), which is the ratio of heat provided in watts per watt of energy input. Their cooling efficiency is

indicated by the Energy Efficiency Ratio (EER), which is the ratio of the heat removed (in btu per hour) to the electricity required (in watts) to run the unit. Efficient pumps must indicate in the ENERGY STAR label a heating COP of 3.3 or greater and an EER of 14.1 or greater.

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## SOME ASPECTS REGARDING THE WATER BASED TECHNOLOGIES USED ON DIESEL ENGINES FOR THE REDUCTION OF NO<sub>x</sub> EMISSIONS

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**Abstract:** *There is international effort focused on the reduction of gaseous emissions that contribute to global warming and atmospheric pollution. Ships are responsible for a portion of this pollution contributing to environmental degradation. Exhaust from marine diesel engines includes air pollution in the form of nitrogen oxides (NO<sub>x</sub>), carbon oxides (CO, CO<sub>2</sub>), unburned hydrocarbons (THC) and particulate matter (PM). These have been proven to have a negative impact on health and the environment. Increasingly, these marine sources are being targeted for reduction.*

*Modifications to engines can effectively reduce NO<sub>x</sub> emissions. Many manufacturers are altering engine designs to meet worldwide regulatory requirements for low NO<sub>x</sub> emissions. However, when simple engine modifications cannot provide the necessary reductions, more extensive NO<sub>x</sub> emissions reduction technologies are used. Some of the more common methods include Exhaust Gas Re-circulation (EGR), Direct Water Injection (DWI), fuel-water emulsions and Selective Catalytic Reduction (SCR).*

**Key words:** *engine, diesel, naval, pollution, fuels, water, burning*

### 1. INTRODUCTION

NO<sub>x</sub> formation in diesel engines is a very complex process and despite years of experimental research and modeling work it is still not fully understood. The current understanding of these process comes from direct measurements as well as study of flames under simplified conditions. This is then linked to the existing knowledge of diesel combustion.

This paper will present the water based NO<sub>x</sub> emission control technologies used on marine diesel engines. Specifically the following technologies:

- Humid air motor (HAM);
- Combustion Air Saturation System (CASS);
- Direct water injection (DWI);
- Saturation air motor (SAM).

The intent of the paper is to explain the processes, mechanisms, and impacts of water

introduced in the diesel engine, on NO<sub>x</sub> emission reduction and engine operation.

### 2. NO<sub>x</sub> FORMATION

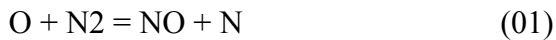
There are a number of different formation mechanisms responsible for NO<sub>x</sub> in combustion processes. The relative importance of these different mechanisms is strongly affected by the temperature, pressure, flame conditions, residence time and concentrations of key reacting species.

#### 2.1. THERMAL NO

The thermal mechanism, also known as "extended Zeldovich mechanism", is responsible for the majority of NO<sub>x</sub> emissions from diesel engines when peak combustion temperatures exceed 2000 K.

Since temperatures of this magnitude are desirable to maximize engine efficiency, this

mechanism has been studied extensively and is fairly well understood. The three chemical reactions that are important in this mechanism are:



The overall reaction rate for this mechanism is slow and it is very sensitive to the temperature. As a consequence, thermal NO only appears in significant quantities in the post combustion. Also, the actual NO concentration from this mechanism deviates significantly from equilibrium concentrations.

This gives this mechanism a very strong time dependence that is important for low speed engines.

## 2.2. PROMPT NO

The prompt NO mechanism, also known as the "Fenimore mechanism", is very rapid and results in NO formation in the combustion zone. The most important pathway for prompt NO is initiated by the rapid reaction of hydrocarbon radicals from the fuel with molecular nitrogen, leading to the formation of amines or cyano compounds that subsequently react to form NO. The most important initiation reaction for prompt NO is:

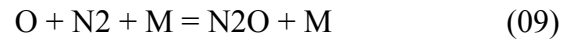


Subsequent rapid conversion to NO is strongly affected by O and OH. Prompt NO is most significant when combustion occurs at fuel concentrations higher than stoichiometry where there is a high concentration of hydrocarbon radicals to form HCN and the concentrations of O and OH are still high enough to cause the HCN to proceed to NO through the following reaction sequence:



## 2.3 N<sub>2</sub>O PATHWAY

Another NO formation mechanism important in combustion is the N<sub>2</sub>O pathway. The initial reaction for this pathway is the three body reaction:



While N<sub>2</sub>O generally reverts back to N<sub>2</sub>, this is not always the case. Under conditions where the air/fuel ratio is lean, NO can form through either of the following two reactions:



This NO formation route is fuel and pressure dependent. At higher pressures and lower temperature, the three-body initiation becomes competitive with the O + N<sub>2</sub> reaction in the thermal mechanism.

These are the most important formation mechanisms.

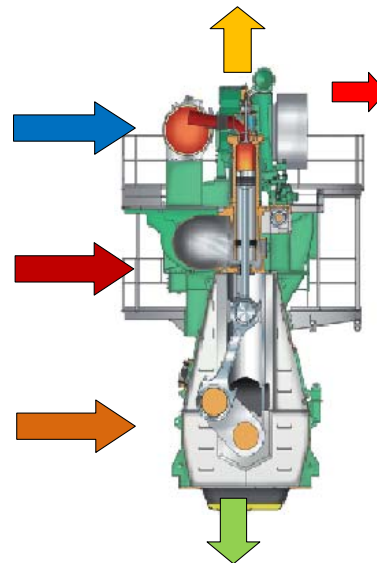


Fig.1 Emissions resulted from the diesel engine

## 3. REGULATIONS

There are a number of national and international regulatory organizations that propose limitations on NO<sub>x</sub> as well as other harmful emissions. The International Maritime Organization (IMO), through the International Convention for the Prevention of Pollution

from Ships (MARPOL, Annex VI) regulates this on a global level. They have developed an approach to reducing green house gas (GHG) emissions, including NO<sub>x</sub>. Member countries of the IMO must therefore adhere to the regulations that they have put forth. However, some organizations have committed to adopting regulations that are more stringent.

The MARPOL, Annex VI, NO<sub>x</sub> emission limits are:

Table 1 Emissions limits

Engine Speed (n)	NO <sub>x</sub> [g/kWh]
n < 130 rpm	17.0
130 rpm ≤ n < 2000 rpm	45 / n <sup>0.2</sup>
n ≥ 2000 rpm	9.8

#### 4. NO<sub>x</sub> REDUCTION

##### 4.1. INTAKE AIR HUMIDIFICATION

Of the different approaches for introducing water into the combustion chamber, humidifying the intake air has the potential to provide the greatest reductions in NO<sub>x</sub>. Water/fuel (W/F) ratios from 1 to 3 are possible (depending on charge air temperature) with this approach if the energy for water evaporation is provided by waste engine heat from either the exhaust or the cooling system.

A number of approaches for intake air humidification have been attempted. While there are some differences in the approaches, the most successful intake air humidification systems take significant steps to ensure that only water vapor enters the cylinder and that liquid water does not carry over into the cylinder and cause cylinder liner corrosion problems. In order to get high NO<sub>x</sub> reductions, this often means that the humidity of the air is near saturation as it enters the engine and that the intake manifold air temperature is as high as the engine can tolerate.

Munters has the propriety of the first intake air humidification system, named the Humid Air Motor (HAM).

The basic design and principles of the Munters Humid Air Motor is described in one of their patents. Next figure shows a diagrammatic of the HAM. A humidification tower is placed between the intake air compressor and the engine. Water that is pre-

heated with waste engine heat is sprayed from nozzles at the top of the column into the air flow entering from the bottom. An amount of water far in excess of that required to saturate the air is supplied. Only 5% to 10% of the water sprayed into the tower evaporates. Water that does not evaporate into the air is collected at the bottom and re-circulated. Supplying excess heated water accomplishes two things. It makes the system self-regulating. The amount of humidity added to the intake air, assuming that the tower is sufficiently sized to allow saturation of the air, is governed by the temperature and pressure of the air during the humidification process. The excess heated water also provides heat for the evaporation process. This minimizes the temperature drop of the air in the humidification tower ensuring that the humidity of the air stays as high as possible. Also by supplying excess water that has been pre-heated from waste engine heat, use of steam that would otherwise need to be generated from higher temperature heat sources can be avoided.

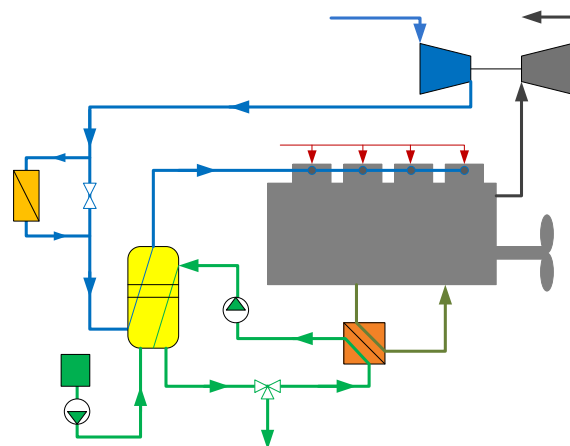


Fig. 2 HAM System

The HAM process designed by Munters was first bench tested on a MAN B&W 3V40/50 prototype 4 stroke medium speed diesel engine in the research and development facilities of S.E.M.T. Pielstick in-service verification was carried out in co-operation with Viking Line on one engine (12 PC2.6, 5,750 kW) onboard the RoRo ferry "Mariella" operating in the Baltic Sea. The HAM system was installed on main engine No. 1 in the

summer of 1999. NO<sub>x</sub> reductions of 60 % were claimed with a final certification value of 4.4 g/kWh NO<sub>x</sub>. The humidification vessel is 4 m long, 1.4 m in diameter and has 3 humidifier stages which humidify and cool the air from approximately 160 °C at the outlet of the compressor down to approximately 65-70 °C. The air reaches about 98 % relative humidity which corresponds to an absolute humidity in the range of 60 to 80 g water/kg dry air. Sea water is used and re-circulated until the salt content increases by about 6 %.

During the year 2000, Marioff, a developer of water mist systems for fire suppression, started to develop the Combustion Air Saturation System (CASS). The key to this system development is the spray nozzle and control system. Air and water in varying ratios are supplied to the nozzle providing water droplet sizes around 50 to 200 μm and W/F ratios from 0.5 to 2.5. The air/water ratio supplied to the nozzle is varied so that the water droplet size is a function of engine load with the smallest droplet sizes produced when the engine load is low and good evaporation is more difficult. Early in 2001, a press release was issued that stated that Marioff and Wärtsilä had formed a partnership. During 2001 and early 2002, full-scale engine tests were carried out at Wärtsilä in Finland. Reduction of NO<sub>x</sub> to less than 3 g/kWh was claimed at the time for starting values of 10-15 g/kWh. Current claims are ~50% NO<sub>x</sub> reduction at W/F ~ 2.0 and saturated air at 50-90 °C.

#### 4.2. DIRECT WATER INJECTION

This method of NO<sub>x</sub> reduction can be carried out with two slightly different variations by injecting water directly into the cylinder head via a separate nozzle, or by alternating fuel and water through a specially designed nozzle. Both of these techniques for adding water are based on the same fundamental concept: injecting water into the system at the combustion cylinder reduces high peak temperatures, which in turn reduces NO<sub>x</sub> formation.

The primary benefit of injecting water directly into the cylinder through a separate

nozzle is that both the amount of water and the timing that the water is injected are variable and can be controlled separately from the fuel. Similarly, the amount of water injected in sequence with fuel from a single nozzle can be varied although the timing of injection is dependent on the W/F ratio. In general, these methods allow for substantial amounts of water to be added to the system, which can, in turn, lead to large reductions in NO<sub>x</sub> emissions. Another attribute of direct water injection into the cylinder is that liquid water can usually be directed towards the flame (combustion zone) more efficiently. The water typically evaporates upon injection, which helps keep liquid water away from the wall as well as create a more homogenous fuel air mixture.



Fig.3 Combined Nozzle Used by Wärtsilä

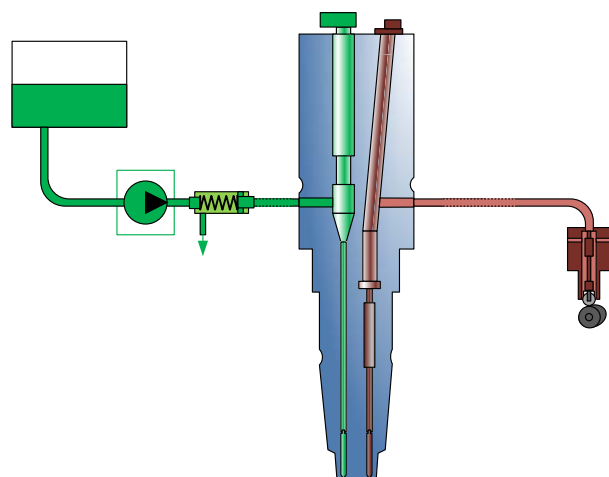


Fig.4 Wärtsilä combined injector

Current DWI systems by Wärtsilä boast NO<sub>x</sub> emission reduction of 50-60 % (without adversely effecting power output),



which translates to 4-6 g/kWh of NO<sub>x</sub> (for Marine Diesel Oil) and 5-7 g/kWh (for Heavy Fuel Oil). The system typically operates at a W/F ratio of 0.40 to 0.70. The Wärtsilä technique for DWI also allows for water shut-off, as the water system is controlled separately from the fuel, so that the engine can be operated with or without water injection. Wärtsilä claims that both investment and operational costs are low and that space requirements for the system is minimal, allowing for easy installation.

### 4.3. SATURATION AIR MOTOR

The SAM system for saturation and cooling of the compressed air from the compressor side of the turbocharger has been tested from an engine performance point of view on the 4T50ME-X research engine. The tests gave promising results with regard to the ability of reducing NO<sub>x</sub> emissions. However, long-term influence of the SAM system on engine components as well as operation with a salt content of up to 3.5% could not yet be investigated.

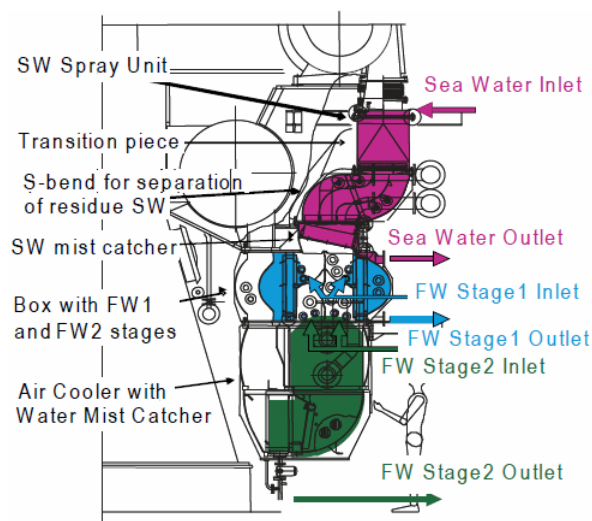


Fig.5 SAM System

The SAM system has a sea water injection stage, where a surplus of sea water is injected for saturation and cooling of the hot air from the compressor. The sea water stage will provide a near 100% humidification of the scavenge air and supply all of the water for humidification.

The freshwater stages 1 and 2 will be near temperature neutral to the scavenge air and create a small freshwater production depending on the operation parameters chosen. The freshwater stages only act as cleaning stages for removal of any salt which may pass with the air from the sea water stage. A continuous accumulation of salt in the freshwater stages would eventually cause the salt content to reach an unacceptably high level. This is counteracted by cooling the saturated air with the air cooler and generating some extra freshwater for stage 2. The extra freshwater is then sent upstream on the tank side of the SAM system, as illustrated in the figure. Thereby the content of salt in the freshwater stages can be controlled.

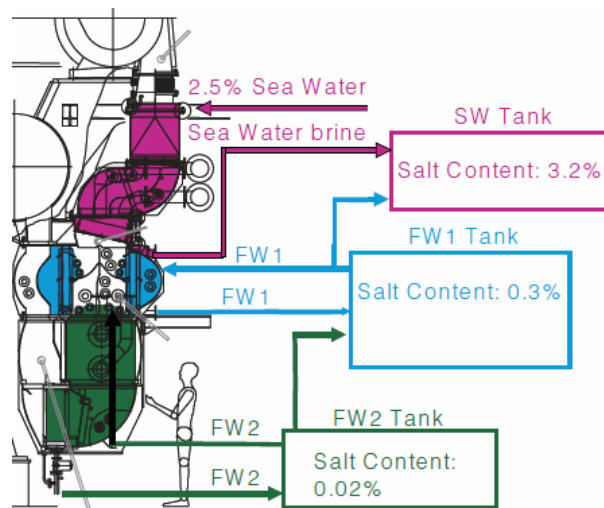


Fig.6 Expected operation data at 100% load and ISO ambient conditions

A vital aspect in ensuring that no or a minimum of salt gets into the engine is a good efficiency of the water drainage. All the water drainage systems are, subsequently, based on the slung principle followed by mechanical water separation in metal foam. Measurements on a small pilot plant has indicated an efficiency as high as 99.6% with this solution. The efficiency of the water drainage for the sea water and fresh water stages is 99%.

### 5. CONCLUSIONS

The precursors to the formation of nitrogen oxides during the combustion process

are nitrogen and oxygen. Together these compounds comprise 99% of the engine intake air. Oxygen will be consumed during the combustion process, with the amount of excess oxygen available being a function of air/fuel ratio with the engine is operating under. The nitrogen remains largely unreacted in the combustion process; however a small percentage will be oxidized to form various oxides of nitrogen. The nitrogen oxides ( $\text{NO}_x$ ) which can be formed include NO and  $\text{NO}_2$ , while the amounts are primarily a function of flame or combustion temperature and, if present, the amount of organic nitrogen available from the fuel. It is also a function of the time the nitrogen and the excess oxygen are exposed to the high temperatures associated with the diesel engine's combustion process. In other words, the higher the combustion temperature (e.g., high peak pressure, high compression ratio, high rate of fuel delivery, etc.), the greater the amount of  $\text{NO}_x$  formation. A low-speed diesel engine, in general, tends to have more  $\text{NO}_x$  formation than a high-speed engine.  $\text{NO}_x$  has an adverse effect on the environment, causing acidification, formation of ozone, nutrient enrichment, and contributes to adverse health effects globally.

Depending on the specific design of the particular engine, different  $\text{NO}_x$  modifications and adjustments are possible and usual. These include the engine parameters as follows: injection timing, injection nozzle, injection

pump, fuel cam, injection pressure for common-rail systems, architecture of the combustion chamber, compression ratio, turbocharger type and build, charge air cooler, charge air pre-heater, valve timing,  $\text{NO}_x$  abatement equipment (water injection),  $\text{NO}_x$  abatement equipment (emulsified fuel, fuel/water emulsion),  $\text{NO}_x$  abatement equipment (exhaust gas recirculation),  $\text{NO}_x$  abatement equipment (selective catalytic reduction).

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## STATE OF THE PRESENT RESEARCH OF THE METALLIC GLASSES AND THEIR PROPERTIES

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**ABSTRACT:** *Metallic glasses amorphous materials have found their ways in science and technology domains. There are many such materials, which are subject to study and their properties. The paper tries to present some aspects concerning the properties of these materials.*

**KEY WORDS:** *metal glass, bulk metallic glass,*

### 1. THEORETICAL ASPECTS:

A solid state Crystalline is obtained by slow cooling of the melt when initial crystal germ are formed then are growing in time. By rapid cooling, with  $10^{10}$  °C/s of the metal melt is prevented germ forming crystallization as well as there growth and is created condition for obtaining metals in amorphous state, metallic glasses.

### 2. OBTAINING METHODS

Today amorphous metals are obtained by:

- The method of high speed cooling of the metal melt;
- Freezing of superficial layers melted by concentrated energy. The method is based on melting of a metal surface on the depths of tens of microns, with a concentrated energy (laser, ion bombardment or other particles) and rapid cooling for realizing the amorphous state;
- Deposition of thin layers in the amorphous state on material support. May be create by chemical or physical processes, the vacuum evaporation of some alloys with certain components and condensation on support surfaces at temperatures

below the temperatures of favorable crystallization. The process takes a few pico-seconds, the cooling has been made with a speed of  $10^{130}$  C/s. The process is laborious and requires the installations of big complexity and have the disadvantage to a bulk impurities and irregularly of the metal glass and a low speed of deposit. Amorphous layers can be obtained on chemical way by electrodeposition using anode copper or nickel on high purity and copper cathode. The quality deposit depends on the composition and quality electrolytic, the current density and temperature. This is the way there were obtained layers amorphous Co - Ni - P with uniform deposits but not always reproducible. Uniform deposition, selective, resistant to corrosion can be obtained by depositing chemical, autocatalytic reaction, from a solution without using electricity. The operation requires maintaining a constant pH and environment temperature. By this method were obtained layers amorphous Co-P. The anodic oxidation is another possibility to obtain layers of amorphous metal oxides.

### 3. PROPERTIES

Thus the alloys obtain certain properties that no other class of substances known may not be obtained.

- Mechanical properties - metal glass, combines ductile behavior in bending, compression and shearing with limited flow and very high hardness and with a limit value of order  $E/50$ , value which is closer to theoretical limits. [1]
- The elasticity constant - the low values of modules  $E$  and  $G$  reflect the diminished resistance to interatomic shearing; the higher value of the volumetric module is correlated with high density metallic glasses[1].
- The break – the breaking energy of amorphous metal alloys is about  $10^8 \text{erg/cm}^2$  while at the polycrystalline material is approx.  $10^5$  [2].

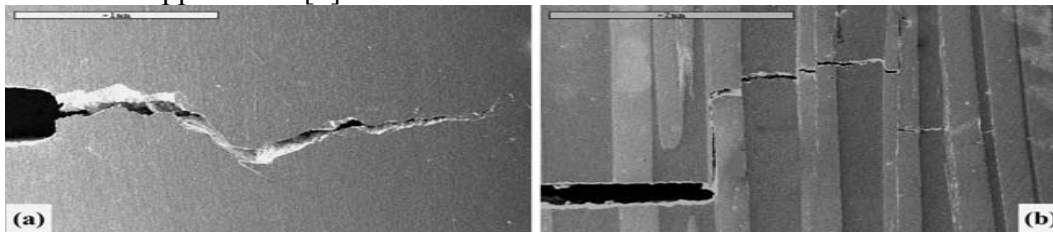


Figure 1 Crack propagation for BMG (a) and BMG reinforced by tungsten fiber (b) under three-point bending test [3]

- The corrosion resistance - the studies made have established that resistance to corrosion is much higher to an amorphous alloy than in a crystalline form with the same composition and is related to the formation of the passivation layer and homogeneous uniform. [2]
- The electrical properties [2] transition superconducting temperature of amorphous metals is comparable or greater than to the corresponding crystalline metals.
- The magnetic properties [2] - the ferromagnetism of amorphous bodies as well as of crystalline

By analyzing in detail of 3 types of metallic glasses it has been proved that

metallic glasses have also an important property such as resistance to breakage.

Three kinds of BMG related materials, i.e., a monolithic phase BMG, BMG with quenched-in crystallites and ductile tungsten fibers were fabricated. Mechanical properties, including cyclic deformation and fracture toughness were investigated. Under symmetrically cyclic stress control, the life of tungsten fiber reinforced amorphous alloy was much longer than that of the monolithic amorphous alloy. Tungsten fiber could retard crack propagation.[3]

-the resistivity: Experimental studies have shown that to an amorphous alloy, the resistivity amorphous phase increases with temperature up to temp of crystallization which decreases brusque, reaching a minimum, then increases again until the temp melting alloy.

-the superconductivity: after studies made it has been determined that the bodies is related to the transition metals presence with incomplete electronic 3d covering.

-the simplest substances amorphous ferromagnetic are transition metals obtained in a very high vacuum, by spraying, thermic, on a support cooled with helium.

-the anisotropic magneto-elastic occurs due to magnetic elongation in the presence of internal tension and occurs in all amorphous substances which are subject to internal or external tensions and which have a magnetic elongation different zero.

- the amorphous alloys meets a high maximum magnetic permeability
- have a high saturation induction
- have a little retentivity
- amorphous alloys presents high resistance

A new class of substances is formed of amorphous alloys ferrimagnetic which consist of transition metals MT and rare earths component PR. The ferrimagnetism phenomenon occurs due to antiparalel orientation of magnetic moments of atoms. The differences between atomic beams of MT and PR conduce the ferrimagnetism and influence the increasing of ferromagnetic alloys stability at hight temperature. The

ferromagnetic amorphous film obtained by various methods can be used successfully for thermomagnetic

recording and also for the transforming information recorded in the visual image (optical).

The magnetocaloric effect is studied very well on metallic glasses but at very low temperature, in the same time experiencing the study of the magnetocaloric effect at temperature close to the environment. Following the studies it has been proved that an important property of metallic glasses is the effect magnetocaloric (MCE) that occurs by changing the temperature of material when this is the subject to a magnetic field.

The magnetocaloric effect was determined by measuring the magnetization  $M$  as a function of the temperature  $T$  and the applied field  $H$ .

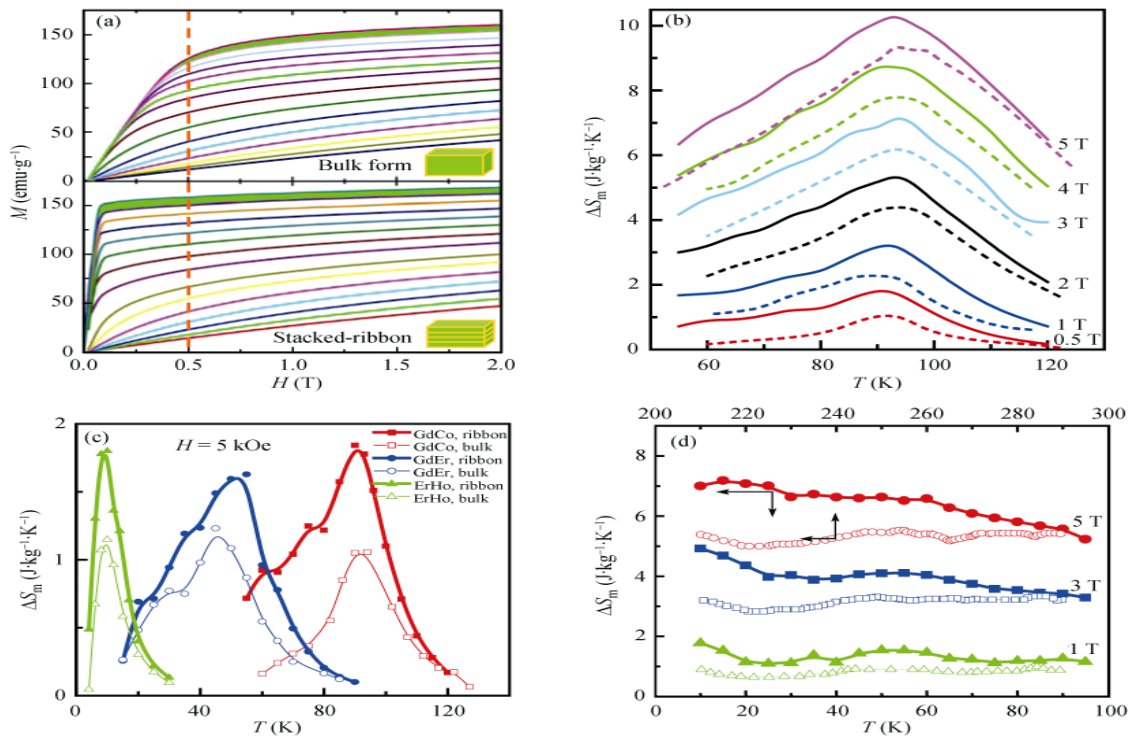


Figure 2 (a) The isothermal magnetization curves  $M$ - $H$  of Gd<sub>53</sub>Co<sub>20</sub>Al<sub>24</sub>Zr<sub>3</sub> metallic glass measured at different temperatures in bulk and stacked-ribbon forms, respectively. The insets show the schematic of the samples for the measurements. (b)

The magnetic entropy change  $\Delta S_m$  vs.  $T$  of  $Gd_{53}Co_{20}Al_{24}Zr_3$  metallic glass under different magnetic fields. The solid line and dash line correspond to  $\Delta S_{ribbon}$  and  $\Delta S_{bulk}$ , respectively. (c)  $\Delta S_m$  vs.  $T$  of three different metallic glasses ( $Gd_{53}Co_{20}Al_{24}Zr_3$ ,  $Gd_{33}Er_{22}Co_{20}Al_{25}$  and  $(Er_{0.7}Ho_{0.2}Dy_{0.1})_{55}Ni_{25}Al_{20}$ ) under 5 kOe in bulk and stacked-ribbon forms, respectively. (d)  $\Delta S_m$  vs.  $T$  of the stacked-ribbon contains three different rare-earth-based metallic glasses ( $Gd_{53}Co_{20}Al_{24}Zr_3$ ,  $Gd_{33}Er_{22}Co_{20}Al_{25}$  and  $(Er_{0.7}Ho_{0.2}Dy_{0.1})_{55}Ni_{25}Al_{20}$ ) with the mass ratio of 1:1:1 (left-down scale), and the left-up scale shows the  $Gd_xDy_{1-x}$  composite containing five constituents with the optimum ratio [4]

#### 4. CONCLUSION

Following carried out research proved that the metallic glasses presents certain properties, mechanical or magnetic, specific. As seen in this paper, metallic glasses presents properties with high resistance associated with a good plasticity, and also chemical, electrical and magnetic properties superior, to metallic materials with crystalline structure. Thus the scope of these metallic glasses is vast and constantly expanding.

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# MATHEMATICAL MODEL OF A HYDRAULIC MODEL WITH APPLICATIONS IN THE VIBRATIONS OF THE MECHANICAL MACHINES

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**Abstract:** *The vibrations of the machines or mechanical systems are admitted or useful when their effect has a purpose like the transport of materials utilized in minerals or cereal sifting, mechanical cutting processes, drilling, striking, processes needed in operating machine tools, etc. But there are also cases when noise and powerful oscillations are produced by these vibrations. Under those circumstances the following actions are required: the control, adjustment of the vibrations, their extinction, absorption or isolation – through vibro-isolation machines or systems – environment protection, of real estate property and machines, the capture (absorption) of the vibrations, regularization and automated control of the sources by instruments of measure and control.*

**Key words:** *hydraulic model, vibrations, mathematical modeling, transfer function, stability*

## 1. INTRODUCTION

The absorptions of the vibrations or their control, required ecologically or admitted for reliability, can be achieved through constructing mechanical, hydro-pneumatic or hydro-electric systems. These vibroisolators are implemented in the mechanical system, in general it is considered a large mass  $M$  (platforms) which vibrates and near by smaller masses ( $m$ ) are installed – dynamic absorbers which are disrupted by  $M$ , or the masses  $m$  are connected at the amortization, resistance, friction systems (fig. 1) [4].

Usually, the vibration source of mass  $M$  operated by the disturbing force  $F(t)$  and mass  $m$  amortized must form a system of forces which acts on the same axis (usually the vertical) because the gravitation force is in most of the cases included in the component of the  $F(t)$  force.

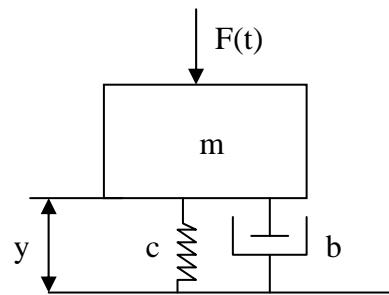


Fig. 1.

The mass  $M$  is the fundament, and the mass  $m$  is the improvement-absorption source. The vibroisolator is located between  $M$  and  $m$ , has a resistance coefficient  $b$  and a vibro-isolation coefficient  $c$  (vibro-isolation rigidity). The rigidity coefficient  $c$  can be determined through equality conditions between the potential energy of the vibro-isolator and the equivalent elastic spring. This can be a non-linear function of coordinate  $y$  (rate) calculated from the equilibrium position. The resistance coefficient  $b$  is determined from the mechanical labor (energy) through the friction in the vibroisolator (amortization) and, in general, it

can be a nonlinear function of  $y$  and  $\dot{y}$ .

$$m\ddot{y} = F(t) + Q(y, \dot{y}) \quad (1)$$

Here,  $Q$  is the vibroisolator reaction. The purpose of the system is to minimize the components from  $Q$  on the coaxial direction  $y$ , with respect to the perturbation  $F(t)$ .

We consider the linear vibroisolator:

$$Q(y, \dot{y}) = -cy - b\dot{y} \quad (2)$$

The movement equation is:

$$\ddot{y} + 2\gamma\dot{y} + \lambda^2 y = \frac{F(t)}{m} = \frac{M}{m} \sin \omega t \quad (3)$$

with the solution

$$y = \frac{M}{m\sqrt{(\lambda^2 - \omega^2) + 4\gamma^2 \omega^2}} \sin(\omega t - \theta) \quad (4)$$

where:

$$\operatorname{tg}(\theta) = \frac{2\gamma\omega}{\lambda^2 - \omega^2} \quad (5)$$

equivalent with:

$$\dot{y} = \frac{M\omega}{m\sqrt{(\lambda^2 - \omega^2) + 4\gamma^2 \omega^2}} \sin(\omega t - \theta) \quad (6)$$

From **(Error! Reference source not found.)** and **(Error! Reference source not found.)** we have the following relation in  $Q$ ":

$$Q = -K_{din} M \left[ \sin(\omega t - \theta) + \frac{\omega b}{c} \cos(\omega t - \theta) \right] \quad (7)$$

where  $K_{din}$  is the dynamic coefficient of the perturbation, equal with the report of the sustained oscillations amplitude and the maximal value of movement  $M/c$  for the static equilibrium of the force:

$$K_{din} = \frac{\lambda^2}{\sqrt{(\lambda^2 - \omega^2) + 4\gamma^2 \omega^2}} \quad (8)$$

we represent **(Error! Reference source not found.)** with the hint:

$$a \sin \alpha + b \cos \alpha = \sqrt{a^2 + b^2} \sin(\alpha + \varepsilon), \quad \text{with}$$

$$\varepsilon = \operatorname{arctg} b/a. \text{ For } a = 1 \text{ and } b = \frac{2\gamma\omega}{\lambda^2}, \text{ we have:}$$

$$Q = -K_{din} M \sqrt{1 + \frac{4\gamma^2 \omega^2}{\lambda^4}} \sin(\omega t - \theta + \varepsilon) \quad (9)$$

where  $\varepsilon = \operatorname{arctg} \frac{2\gamma\omega}{\lambda^2}$ , therefore:

$$Q_{max} = K_{din} M \sqrt{1 + \frac{4\gamma^2 \omega^2}{\lambda^4}} \quad (10)$$

The report from  $Q_{max}/M$  is called the transfer coefficient for the  $K_c$  force and is the same as the dynamic coefficient:

$$K_c = \frac{Q_{max}}{M} = \sqrt{\frac{1 + 4\beta^2 \gamma^2}{(1 - \gamma^2)^2 + 4\gamma^2 \beta^2}} \quad (11)$$

where  $\gamma = \omega/\lambda$  is the frequency coefficient, and

$\beta = \frac{\gamma}{\lambda}$  is the amortization (coupling) report.

The transfer coefficient  $K_c$  is characterizing the quality of the vibroisolation as follows:

- if the link between  $m$  and  $M$  is rigid then  $K_c = 1$
- for  $K_c < 1$  the vibroisolation is efficient; for  $K_c > 1$  the vibroisolation becomes disturbing for foundation  $M$

Alongside  $K_c$  (the forces transfer coefficient) it is also used the effective vibroisolation coefficient  $K_{ef} = \frac{M}{Q_{max}} = \frac{1}{K_c}$

## 2. THE HYDROELECTRIC VIBROISOLATOR SYSTEM

The regulator systems, also called active control systems, are those vibroisolation systems in which the effective isolation against the vibrations is obtained by compensating the disturbing forces (disturbance based compensation) (fig. 2) Vibroisolator for the movement of the  $m$  mass relative to the static position [2], [3].

A particularization of the electrohydraulic vibroisolator: the external perturbation is  $F(t)$ . The vibroisolator is composed from the rigidity  $c$  and the damper  $b$ . The interaction (control) force  $F_y$  is given by the reaction of the hydrocylinder 1 of which piston acts on the object  $m$  through the rod 2 and the complementary elastic spring  $c_y$ . The



movement of the piston through the pneumatic hydrocylinder is controlled with the help of the sensor signals 3 relative with the movement of the  $m$  object and the piston. This signal is transmitted through the amplifier 4, with an electric supply 5. The convector (amplifier) processes the signal and transmits it to the regulator (the debit translator) 6 which adjusts the fluid movement from the convector (pump) 7 through the force cylinder. In the intermediate position both pipes are closed. Through the movement of the valve 6 up, the fluid under pressure in moving in the superior half of the cylinder and the piston goes down, accordingly if the valve goes down, the piston climbs.

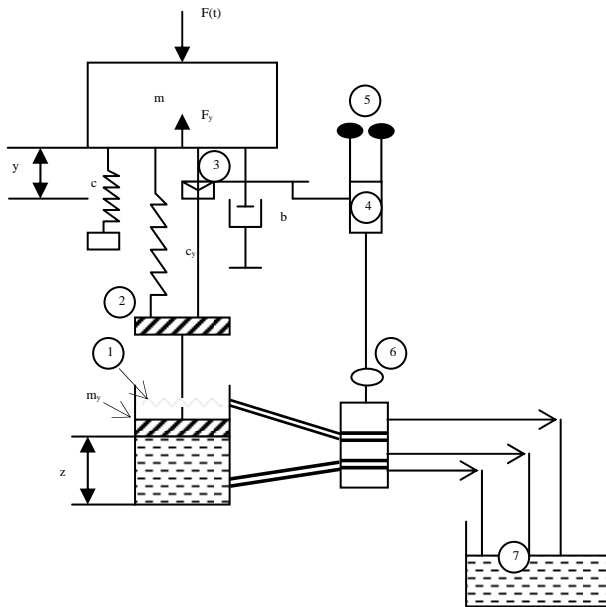


Fig. 2

The movement of the  $m_p$  piston is  $z$  and implies the variation of the elastic force  $F_y = c_y(y - z)$  which acts on  $m$  through the complementary spring  $c_y$ . Through an optimal choice of the vibroisolator parameters, the force  $F_y$  acts opposed (reaction) to the force  $F(t)$  and shrinks the movement  $y$ . This force is called controlled (conducted) interaction force.

The non-holonomous link in the electro-hydrodynamic system.

The generalized coordinates are chosen to

be  $y$  and  $z$  which will determine a link that expresses the dependency of the piston speed  $\dot{z}$  of the movement  $y$ . This link is defined by the variation of the fluid debit  $Q_p$  which passes through a window of the drawer 6, [5].

$$Q_p = S_p \dot{z} \tag{12}$$

where  $S_p$  is the effective area of the piston. We assume that the profile of the drawer's windows is chosen so that the fluid flow that enters in the cylinder is direct proportional with the drawer's opening.

$$Q_p = K_{st} z_{st} \tag{13}$$

with  $K_{st}$ , the proportionality coefficient, depending on the drawer's parameters. This way, the electrical part of the system answers proportionally with the drawer's movement with respect to the movements  $\varphi = y - z$  registered at 3:

$$z_{st} = K_\varphi (y - z) \tag{14}$$

$K_\varphi$  is a proportional coefficient depending on the parameters of the electrical machine; So, from (Error! Reference source not found.), (Error! Reference source not found.), (Error! Reference source not found.) we have:

$$\dot{z} = K(y - z) \tag{15}$$

where  $K = \frac{K_{st} K_p}{S_p}$ . The equation (15) can not be

integrated since we have a non-holonomous link.

The movement equations of the system.

We have two variables in the system,  $y, z$  but due to the link (Error! Reference source not found.), through elimination we'll only have one degree of freedom left,  $y$  or  $z$  and therefore we'll obtain a differential equation. So, we can write the movement equations, [1]:

$$F(t) - cy - c_y(y - z) - b\dot{y} - m\ddot{y} = 0 \tag{16}$$

$$c_y(y - z) - F_p - m_y \ddot{z} = 0$$

where  $m_y$  is the piston mass and,  $F_p$  the pressure force of the piston. We say that  $\varphi = y - z$  and obtain the following system:

$$\dot{y} - \dot{\varphi} = K\varphi$$

$$F(t) - cy - c_y\varphi - b\dot{y} - m\ddot{y} = 0 \quad (17)$$

$$c_y\varphi - F_p - m_yK\dot{\varphi} = 0$$

$$c_y\varphi = F(t) - cy - b\dot{y} - m\ddot{y} \quad (18)$$

$$c_y\dot{\varphi} = \dot{F}(t) - c\dot{y} - b\ddot{y} - m\ddot{\dot{y}} \quad (19)$$

$$m\ddot{\dot{y}} + (b + Km)\ddot{y} + (c + c_y + Kb)\dot{y} + cKy =$$

$$= KF(t) + \dot{F}(t) \quad (20)$$

By applying in (**Error! Reference source not found.**) the Laplace transformation with initial conditions we get:

$$[ms^3 + (b + Km)s^2 + (c + c_y + bK)s + cK]Y =$$

$$= (k + s)X \quad (21)$$

We define the transfer function  $W$  :

$$W = \frac{Y}{X} \quad (22)$$

$$W = \frac{K + s}{ms^3 + (K + Km)s^2 + (c + c_y + bK)s + cK} =$$

$$= \frac{K + s}{P_3(s)} \quad (23)$$

If the function  $F(t)$  is harmonious, meaning that  $F = H\sin\omega t$  then  $X = \frac{\omega}{s^2 + \omega^2}$ . In

this situation we have:

$$W =$$

$$= \frac{\omega(K + s)}{(s^2 + \omega^2)(ms^3 + (K + Km)s^2 + (c + c_y + bK)s + cK)} =$$

$$= \frac{\omega(K + s)}{P_5(s)} \quad (24)$$

In order to retrieve the original  $y(t)$  one can discuss the polynomial  $P_3(s)$  over the roots on the reduced form  $P_3(s) = m(z^3 + pz + q)$  by applying the unknown function replacement  $s = z - \frac{a_1}{a_0}$ .

The effective command (control) coefficient for the vibroisolation  $K_{ef}$  will be defined as the report between the modulus

$|y^o(i\omega)|$  which represents the complex amplitude without the vibroisolator interaction and  $|y(i\omega)|$ , the complex amplitude with the vibroisolator interaction.

$$K_{ef} = \left| \frac{y^o(i\omega)}{y(i\omega)} \right| \quad (25)$$

We choose in (**Error! Reference source not found.**)  $s = i\omega$  and obtain the transfer function in the following form:

$$W(i\omega) =$$

$$= \frac{K + i\omega}{m(i\omega)^3 + (K + Km)(i\omega)^2 + (c + c_y + bK)(i\omega) + cK} \quad (26)$$

which can also be written as:

$$W(i\omega) = \frac{K + i\omega}{cK - (b + Km)(i\omega)^2 + i\omega(c + c_y + bK - m\omega^2)} \text{ or}$$

$$W(i\omega) = \frac{(K + i\omega)(s_1 - i\omega s_2)}{s_1^2 + \omega^2 s_2^2} \quad (27)$$

where we chose:  $s_1 = cK - (b + Km)\omega^2$ ,  
 $s_2 = c + c_y + bK - m\omega^2$

$$W = U + iV,$$

$$U = \frac{Ks_1 + \omega^2 s_2}{s_1^2 + \omega^2 s_2^2}, \quad (28)$$

$$V = \frac{\omega(s_1 - Ks_2)}{s_1^2 + \omega^2 s_2^2}$$

$$|W(i\omega)| = \sqrt{U^2 + V^2} =$$

$$= \frac{\sqrt{(Ks_1^2 + \omega^2 s_2^2)^2 + \omega^2 (s_1^2 - Ks_2)^2}}{s_1^2 + \omega^2 s_2^2} \quad (29)$$

If the hydraulic system is without the vibroisolator action, then  $K = 0, c_y = 0, z = 0$ .

Hence, the movement equation of the damper becomes:

$$m\ddot{y}^o + b\dot{y}^o + cy^o = F(t) \quad (30)$$

getting the new transfer function:

$$W^o = \frac{1}{ms^2 + bs + c} \quad (31)$$

In this case the sequential transfer function is:

$$W^o(i\omega) = \frac{1}{-m\omega^2 + ib\omega + c}, W^o(i\omega) = U^o + iV^o, \tag{35}$$

$$U^o = \frac{c - m\omega^2}{(c - m\omega^2)^2 + b^2\omega^2}, V^o = \frac{-b\omega}{(c - m\omega^2)^2 + b^2\omega^2} \tag{32}$$

$$|W^o(i\omega)| = \frac{1}{\sqrt{(c - m\omega^2)^2 + b^2\omega^2}} \tag{33}$$

$$K_{ef} = \left| \frac{W^o(i\omega)}{W(i\omega)} \right| = s_1^2 + \omega^2 s_2^2 \sqrt{\frac{(c - m\omega^2)^2 + b^2\omega^2}{(Ks_1 + \omega^2 s_2^2)^2 + \omega^2 (s_1 - Ks_2)^2}} \tag{34}$$

To optimize the vibroisolation we have the condition:  $K_{din} < 1 \Rightarrow K_{ef} = \frac{1}{K_{din}} > 1$ , hence the parameters  $b, c, c_y, K$  are chosen so that we have:  $K_{ef} > 1$ . One can perform an analysis in the parameters space. For example:

- we settle  $b, c, K$  and study the variation of  $c_y$
- we settle  $c, K$  and study the variation of the parameters  $b, c_y$
- for  $b = 0$  the damper is missing
- for  $c = 0$  the spring is missing

### The stability study

In the movement equation (**Error! Reference source not found.**) we consider that the free term  $F(t) + K\dot{F}(t)$  is limited because  $F = H\sin\omega t$  the general solution is given by:  $y(y) = y_g^o + y_p^n$ , where  $y_p^n$  is limited. We are interested in the case of the homogenous equation when the free term is not in resonance with the frequency.

#### The stability with the Routh – Hurwitz criterion

$$a_0 r^3 + a_1 r^2 + a_2 r + a_3 = 0, \\ a_0 = m, a_1 = b + Km, a_2 = c + c_y + bK, a_3 = cK$$

In order for the system to be stable it is necessary to have:

$$a_i > 0, \text{ si } a_1 a_2 > a_0 a_3 \Leftrightarrow (b + Km)(c + c_y + bK) > mcK$$

If we consider  $b = 0$  then the damper is missing, we have  $c + c_y > c$  therefore in order to study the stability the spring must exist.

- If  $c_y = 0$  we have full stability  $bc + K^2 mb + b^2 K > 0$
- The general case is satisfied because we the real part of the roots for the characteristic equation is negative  $\Re(r_k) < 0$
- The resonance case: If the algebra equation would admit  $\pm i\omega$  as root, then we'll obtain an impossible condition:  $-bc_y - bK^2 = \omega^2 b$ . Therefore, the system can not have resonance.

#### The stability with the Nyquist criterion The analysis or the structure, functional and spectral analysis of the system

The vibroisolator system is a linear system with a link of input-output type, where the report  $\frac{y}{x}$  implies the analysis  $W = \frac{Y}{X}$ . In this system the input quantity  $x(t)$  is added to or subtracted from  $x_y(t)$  (the piston – spring interaction  $F_y$ ). The signal is transmitted to the output  $y(t)$  through the transfer function  $W_i$ :

$$W_i = \frac{Y}{X \pm X_y} \tag{36}$$

The quantity  $y(t)$ , once found, is used to retrieve the value of  $F_y$  and so, the value of  $x_y(t)$  then after  $X_y$  is determined by constructing the transfer function for the inverse link:

$$W_l = \frac{X_y}{Y} \tag{37}$$

The inverse link is called positive if  $x + x_y$  and negative if  $x - x_y$ . The transfer

function for the entire system is obtained after replacing  $Y$  from (**Error! Reference source not found.**) and  $X$  from (**Error! Reference source not found.**):

$$W = \frac{X_y/W_l}{(Y \mp X_y W_i)/W_i} = \frac{W_i}{1 \mp W_l W_i} \quad (38)$$

The signs are chosen of following manner:  
 - for a system with a positive link and + for a system with a negative link.

Hence, the vibroisolator system looks like:

$$x = F(t), \quad (39)$$

$$x_y = c_y(y - z) = c_y \varphi$$

The movement equation becomes:

$$F(t) - cy - c_y \varphi - b\dot{y} - m\ddot{y} = 0 \quad (40)$$

To this equation we apply the Laplace transformation and obtain:

$$(ms^2 + bs + c)Y = X - X_y \Rightarrow$$

$$W_i = \frac{Y}{X - X_y} = \frac{1}{ms^2 + bs + c} \quad (41)$$

$$sY = K \frac{X_y}{cy} + s \frac{X_y}{c_y}$$

$$W_i = \frac{X_y}{Y} = \frac{c_y s}{s + k}$$

In conclusion, the transfer function has the following form:

$$W = \frac{s + K}{(s + K)(ms^2 + bs + c) + c_y s} \quad (42)$$

For systems without the vibroisolator action  $W^o = W_i$  the following coefficient is obtained:

$$K_{ef} = \left| \frac{W_i}{W} \right| = \left| 1 + W^o(i\omega)W_i(i\omega) \right| =$$

$$= \left| 1 + \frac{c_y i\omega}{(i\omega + s)(-m\omega^2 + bi\omega + c)} \right|$$

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## APPLICATION OF COMPLEMENTARY ENERGY METHOD TO DEFLECTION PROBLEMS

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**Abstract:** Generally deflection problems of mechanical structures are most solved by using energy methods, complementary energy approach although for linearly elastic systems there is no difference between the methods of complementary energy and potential energy since complementary and strain energy then become completely interchangeable. This paper illustrate the method by reference to the deflection of frames and beams which may or may not possess linear elasticity.

### I. THEORETICAL BACKGROUND

The elasticity methods of structural analysis embodies the determination of stresses and /or displacements by employing equations of equilibrium and compatibility in conjunction with the force-displacement or stress-strain relationships. An alternative but equally fundamental approach is the use of energy methods. Modern structural analysis tends to discard Castigliano's theorems type of approach as the basis of energy methods, in favor of the generally applicable methods of total potential and total complementary energy.

#### 1. Strain energy and complementary energy

Considering a structural body subjected to a steadily increasing load  $P$ , the load does work and from the law of conservation of energy, this work is stored in the body as strain energy. The strain energy of a structural body, per unit volume, is the area under the curve of the load-deflection curve,  $OBD$ . The area between the load-deflection curve and the load axis,  $OAB$ , is called the complementary energy. In Fig. 1 is shown the typical load-deflection diagrams for a structural body possessing non-linear elastic characteristics. The strain energy  $W$  produced by a load  $P$  and corresponding extension  $y$  is:

$$W = \int_0^y P dy, \quad (1)$$

and the complementary energy is,

$$W^* = \int_0^P y dP \quad (2)$$

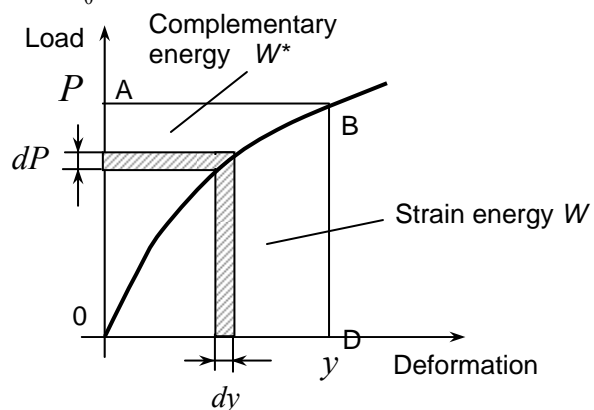


Fig.1 Load –deflection curve for a non-linearly elastic body

Complementary energy, as opposed to strain energy, has no physical meaning being purely a convenient mathematical quantity. It is possible to show that complementary energy obeys the law of conservation of energy in the type of situation usually arising in engineering structures so that its use as an energy method is valid.

Differentiation of equations (1) and (2) with respect to  $y$  and  $P$  respectively gives

$$\frac{dW}{dy} = P, \text{ and } \frac{dW^*}{dP} = y \quad (3)$$

By understanding the mathematical bearing of this relationships, we can consider the interchangeability of strain and complementary energy. Suppose that the curve of Fig. 1 is represented by the function

$$P = by^n \quad (4)$$

where the coefficient  $b$  and exponent  $n$  are constants. Then,

$$W = \int_0^y P dy = \frac{1}{n} \int_0^P \left(\frac{P}{b}\right)^{\frac{1}{n}} dP \quad (5)$$

$$W^* = \int_0^P y dP = n \int_0^y by^n dy \quad (6)$$

Hence,

$$\frac{dW}{dy} = P, \quad \frac{dW}{dP} = \frac{1}{n} \left(\frac{P}{b}\right)^{\frac{1}{n}} = \frac{1}{n} y \quad (7)$$

$$\frac{dW^*}{dP} = y, \quad \frac{dW^*}{dy} = bny^n = nP \quad (8)$$

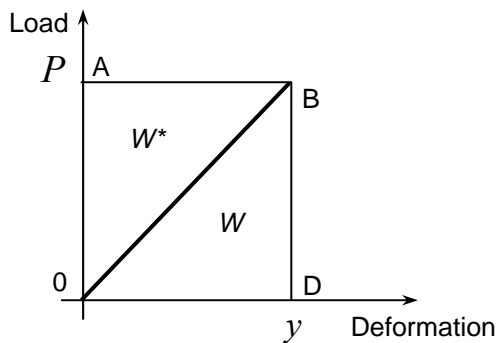


Fig.2 Load –deflection curve for a linearly elastic body

When  $n = 1$

$$\frac{dW}{dy} = \frac{dW^*}{dy} = P$$

$$\frac{dW}{dP} = \frac{dW^*}{dP} = y \quad (9)$$

and the strain energy and complementary energy are completely interchangeable. Such a condition is found in a linear elastic body, and the load-deflection curve is shown in Fig. 2, where is clearly that  $OBD$  area is equal to  $OBA$  area. Equations (9) are the form that is commonly known as Castigliano's first theorem in which the

differential of the strain energy  $W$  of a structure with respect to a load is equate to the deflection of the load.

### 2. Total potential energy

The total potential energy of ea system in its deflected equilibrium state can be defined as the sum of its internal or strain energy and the potential energy of the applied external forces.

$$\Pi = W + V = \int_0^y P dy - Py \quad (10)$$

where,  $V$  represent the potential energy in the deflected equilibrium state and is given by

$$V = -Py \quad (11)$$

For a general system consisting of loads  $P_1, P_2, \dots, P_n$ , producing corresponding displacements in the direction of loads,  $\Delta_1, \Delta_2, \dots, \Delta_n$ , the potential energy of all loads is

$$V = \sum_{r=1}^n V_r = \sum_{r=1}^n (-P_r \Delta_r) \quad (12)$$

and the total potential energy of the system is

$$\Pi = W + V = W + \sum_{r=1}^n (-P_r \Delta_r) \quad (13)$$

### 3. Principle of virtual work

Supposing that a particle is subjected to a system of loads  $P_1, P_2, \dots, P_n$  and their resultant is  $P_R$ . If the particle has a small imaginary displacement, a virtual displacement  $\delta_R$  in the direction of  $P_R$ , then by the law of conservstion energy, the imaginary or virtual work done by  $P_R$  must be equal to the sum of the virtual work done by the loads  $P_1, P_2, \dots, P_n$ .

$$P_R \delta_R = P_1 \delta_1 + P_2 \delta_2 + \dots + P_n \delta_n \quad (14)$$

where  $\delta_1, \delta_2, \dots, \delta_n$  are the virtual displacements in the directions of the loads system produced by  $\delta_R$ , valid for small displacements only. If the particle is in equilibrium, the resultant  $P_R$  of the forces must be zero, and

$$\sum_{r=1}^n P_r \delta_r = 0 \quad (15)$$

Equation (15) is known as the *principle of virtual work* or *the principle of virtual displacements*.

Alternatively, it may be formulate an equation of virtual work by applying small virtual forces to a system in the directions of real displacements. If  $\Delta_1, \Delta_2, \dots, \Delta_n$  are unknown but real displacements and  $\delta P_1, \delta P_2, \dots, \delta P_n$  are virtual forces acting in the directions of the real displacements, then by the law of conservation of energy

$$\Delta_R \delta P_R = \sum_{r=1}^n \Delta_r \delta P_r \quad (16)$$

where  $\Delta_R$  is the resultant real displacements and  $\delta P_R$  is the resultant virtual force.

If the virtual forces  $\delta P_r$  are in equilibrium, then,

$$\sum_{r=1}^n \Delta_r \delta P_r = 0 \quad (17)$$

and the equation (17) is known as *principle of virtual forces*.

#### 4. The principle of the stationary value of the total energy

An elastic body in equilibrium under externally applied loads may be considered to consist of a system of particles on each of which acts a system of forces in equilibrium and for any virtual displacements virtual work done by the forces on any particle is zero. The work will be accompanied by an increment of strain energy  $\delta W$  in the elastic body. This increment in strain energy may be regarded as negative virtual work done by the particles, so that the total work done during the virtual displacement is:

$$\delta W - \sum_{r=1}^n P_r \delta \Delta_r = 0 \quad (18)$$

The loads  $P_r$  remain constant during the virtual displacement and eq. (18) may be

$$\delta W - \delta \sum_{r=1}^n P_r \Delta_r = 0 \quad (19)$$

or, from eq. (14)

$$\delta(W + U) = 0 \quad (20)$$

*The total potential energy of an elastic system has a stationary value for all small displacements when the system is in equilibrium; the equilibrium is stable if the stationary value is a minimum.*

#### 5. The principle of the stationary value of the complementary energy

Consider an elastic system in equilibrium, supporting  $P_1, P_2, \dots, P_n$  forces, which produce real corresponding displacements  $\Delta_1, \Delta_2, \dots, \Delta_n$ . Imposing virtual forces  $\delta P_1, \delta P_2, \dots, \delta P_n$  on the system acting through the real displacements then from the principle of virtual forces for a force system in equilibrium, the total virtual work done by the system is

$$-\int_{vol} ydP + \sum_{r=1}^n \Delta_r \delta P_r = 0 \quad (21)$$

where the first term is the negative virtual work done by the particles in the elastic body and the second term represents the virtual work of the externally applied virtual forces.

Thus, eq. (21) may be rewritten

$$W_i^* + W_e^* = 0 \quad (22)$$

where,

$$W_i^* = \int \int_{vol} ydP \text{ and } W_e^* = -\sum_{r=1}^n \Delta_r P_r \quad (23)$$

$W_e^*$  represent in fact the complement of the potential energy  $V$  of the external loads. The quantity from the eq.(22) represents the total complementary energy  $W^*$  of the system, which for an equilibrium condition has a stationary value.

*For an elastic body in equilibrium under the action of applied forces, the true internal forces and reactions are those for which the total complementary energy has a stationary value.*

#### II. Application of complementary energy method to deflection problems

Consider a simply supported beam ABC shown in Fig. 3, is stiffened by an arrangement of pin jointed bars capable of sustaining axial loads only.

If the cross sectional area of the beam is  $A_B$ , and that of the bars is  $A$  calculate the forces in the members of the frame work assuming that displacements are caused by bending and direct force action only. It observe that if the beam were only capable of supporting direct loads, then the structure would be a simple statically determinate pin jointed framework.

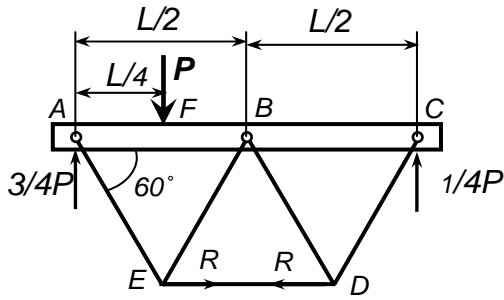


Fig.3 Analysis of a trussed beam by the method of complementary energy

Since the beam resists bending moments (ignoring shear effects) the system is statically indeterminate with a single redundancy, the bending moment at any section of the beam.

The total complementary energy is given by

$$W^* = \int_{ABC}^M d\varphi dM + \sum_{i=1}^k \int_0^{F_i} \delta_i dN_i - P\Delta \quad (24)$$

If the tensile load in the member ED is R, then, for the complementary energy to have a stationary value

$$\frac{\partial W^*}{\partial R} = \int_{ABC} d\varphi \frac{\partial M}{\partial R} + \sum_{i=1}^k \delta_i \frac{\partial N_i}{\partial R} = 0 \quad (25)$$

The system to be linear, than

$$\int_0^L \frac{M}{EI} \frac{\partial M}{\partial R} dx + \sum_{i=1}^k \frac{N_i L_i}{A_i E} \frac{\partial N_i}{\partial R} = 0 \quad (26)$$

The two terms may be evaluated separately that only the beam contributes to the first term while the complete structure contributes to the second.

Evaluating the summation term by a tabular process.

$$\int_0^L \frac{M}{EI} \frac{\partial M}{\partial R} dx = \frac{1}{EI} \left\{ \int_0^{L/4} - \left( \frac{3}{4}Px - \frac{\sqrt{3}}{2}Rx \right) \frac{\sqrt{3}}{2} x dx + \int_{L/4}^{L/2} \left[ \frac{P}{4}(L-x) - \frac{\sqrt{3}}{2}Rx \right] \left( -\frac{\sqrt{3}}{2}x \right) dx + \int_{L/2}^L - \left[ \frac{P}{4}(L-x) - \frac{\sqrt{3}}{2}R(L-x) \right] \frac{\sqrt{3}}{2}(L-x) dx \right\}$$

giving

$$\int_0^L \frac{M}{EI} \frac{\partial M}{\partial R} dx = \frac{-11\sqrt{3}PL^3}{768EI} + \frac{RL^3}{16EI}$$

Than, substitutind in Eq. (26)

Member	N	$\partial N/\partial R$	$(N/A)\partial N/\partial R$
AB	$-R/2$	$-1/2$	$R/4A_B$
BC	$-R/2$	$-1/2$	$R/4A_B$
CD	R	1	$R/A$
DE	R	1	$R/A$
BD	$-R$	$-1$	$R/A$
EB	$-R$	$-1$	$R/A$
AE	R	1	$R/A$

Summation of last column gives:

$$\sum_{i=1}^k \frac{N_i L_i}{A_i E} \frac{\partial N_i}{\partial R} = \frac{RL}{4E} \left( \frac{1}{A_B} + \frac{10}{A} \right)$$

The bending moment at any section of the beam between A and F is:

$$M_{AF} = \frac{3}{4}Px - \frac{\sqrt{3}}{2}Rx,$$

$$\frac{\partial M}{\partial R} = -\frac{\sqrt{3}}{2}x$$

between F and B,

$$M_{FB} = \frac{P}{4}(L-x) - \frac{\sqrt{3}}{2}Rx,$$

$$\frac{\partial M}{\partial R} = -\frac{\sqrt{3}}{2}x$$

and between B and C

$$M_{BC} = \frac{P}{4}(L-x) - \frac{\sqrt{3}}{2}R(L-x),$$

$$\frac{\partial M}{\partial R} = -\frac{\sqrt{3}}{2}(x)L-x$$

Thus,

$$\frac{-11\sqrt{3}PL^3}{768EI} + \frac{RL^3}{16EI} + \frac{RL}{4E} \left( \frac{1}{A_B} + \frac{10}{A} \right) = 0$$

From wich



$$R = \frac{11\sqrt{3}PL^2 A_B A}{48[L^2 A_B A + 4I(A + 10A_B)]}$$

Applying the principle of stationary value of complementary energy it is irrelevant if the system is linear or non-linear since the mechanics of the solution are the same in either case. In this example were choosed that the member of the pin jointed framework are linear elastic and a linear  $M$  and  $\varphi$  relationship.

Substituing for  $R$  in the second column of table, gives the force in each member of the pin jointed framework.

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## ALUMINUM POWDERS USED IN AUTOMOTIVE APPLICATIONS FOR OBTAINING PARTS WITH HIGH TECHNOLOGICAL PERFORMANCES

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**Abstract.** *Industrial Partners and Universities have collaborated over many years to develop a range of special prealloyed aluminum powders for use in transport applications. Gas atomized and granular products are at various stages of development and commercialization. Case studies are presented to illustrate the diverse possibilities for auto parts designers to exploit the unique properties of rapidly solidified powders. Examples are drawn from precipitation-hardening and dispersed-hardening systems, either alone or with SiC reinforcement.*

*Alloy systems have been tailored for high stiffness components such as brake calipers, high temperature service environments, bearing components and superplastically formable (SPF) sheet.*

*Barriers to growth, both technical and economic are discussed.*

**Keywords:** *prealloyed alloys, superplasticity, automotive industry.*

### 1. INTRODUCTION

The majority of atomized aluminum powders are used in non-structural applications such as paints and pigments, metallurgical additives/reductants, chemicals and propulsion. Interest in aluminum powders for structural applications has grown significantly over the past 10 years, driven particularly by the desire for light weighting of vehicles. North American consumption of aluminum in PM was reported as 1200 t in 1998, 1353 t in 1999 and is projected to grow at between (15 – 20) percent in the next 10 years [1].

The big three US Auto producers lead the world in the use of PM parts and in aluminum in particular. Lall [2] reports that to date >27 M camshaft bearing caps have been produced without a single service failure. It is possible

that all cam bearing end caps will be made in PM - Al by 2003. Other components under investigation include pump generators, rotors, con-rods etc.

A market size of 25,000 t parts is envisaged ultimately by some observers. The majority of aluminum powders used in PM are blends of aluminum with minor constituents added elementally or as master alloys. While this has advantages in terms of compaction behavior, there are some potential downsides in flow and segregation difficulties that may lead to non-optimum consistency and mechanical properties [3, 4].

Prealloyed powders are generally less compactable than blends, but can offer distinct advantages in terms of consistency and absolute properties. The rapid solidification inherent in the atomizing process leads to refined microstructures and opportunities for

extended solid solubility versus conventional ingot metallurgy and PM blends. To date this route has been less well developed, primarily on cost grounds. There are, nevertheless, some examples of successful applications of prealloyed aluminum powders and the following will give a flavor of some current activities.

## 2. POWDER PRODUCTION ROUTES

Commercial production of aluminum powders is dominated by Gas Atomization (GA) and smaller quantities are prepared by

centrifugal spinning. The latter produces a relatively coarse product: depending on the rotation rate of the spinner, this can be  $<1\text{mm}$ .

GA may be further sub-divided into air and inert gas atomizing. The former predominates, accounting for  $\sim 90\%$  of powder production which goes into conventional aluminum powder markets (paints and pigments, metallurgical additives/reductants, chemicals). Special spherical powders for propulsion and superfine powders are produced by the more expensive inert gas atomizing. The particle size distribution can be controlled by adjusting the gas-to-metal feed ratio during the atomizing process (Fig.1).

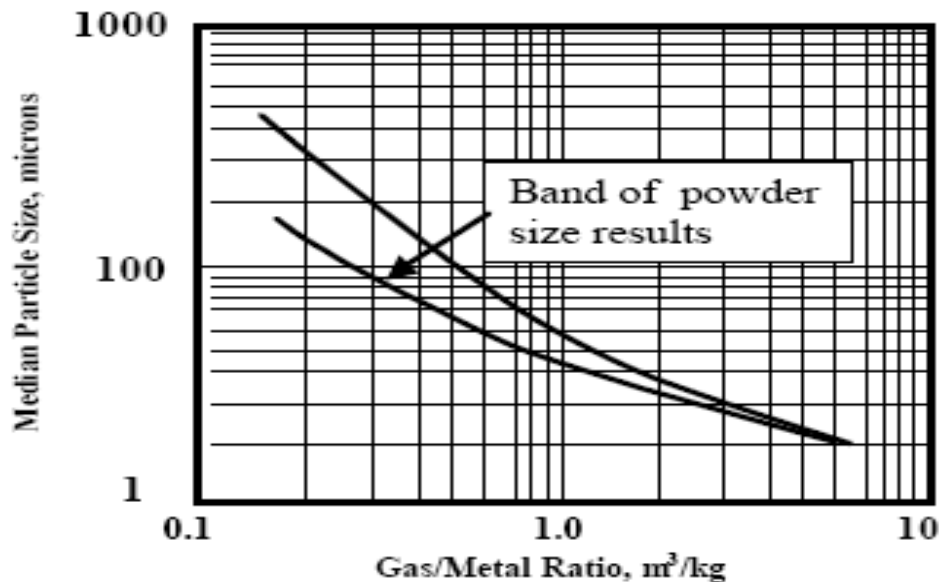


Fig.1. Gas/Metal Ratio vs. Median Al Particle Size for close-coupled atomization processes.

At larger gas flow rates, finer powders can be obtained. The powder size distribution can be varied by selection of atomizing gas (He provides greatest rates of heat transfer), nozzle and manifold design and gas temperature. The different particle sizes result in different cooling rates and hence different levels of micro structural refinement (Fig. 2).

The atomizing environment also dictates the surface characteristics of the powder and indirectly, the morphology of the powder particles. Air atomized powders tend to have thicker oxide layers and greater quantities of adsorbed moisture than inert gas atomized powders. For coarser particles, which take

longer to solidify, differential contraction of the metal core and oxide coating results in a more irregular surface. This has consequences for compatibility, green strength and degassing characteristics, which are important with respect to consolidated properties. It is possible to influence particle shape in inert gas by control of moisture in the gas.

The alloy composition and purity also influence these properties: the presence of alkali metals in particular can lead to defective oxides (e.g. Al-Li, Al-Mg) which result in thicker films. It is interesting to note that air blown granules can have lower oxygen levels than air atomized powders.

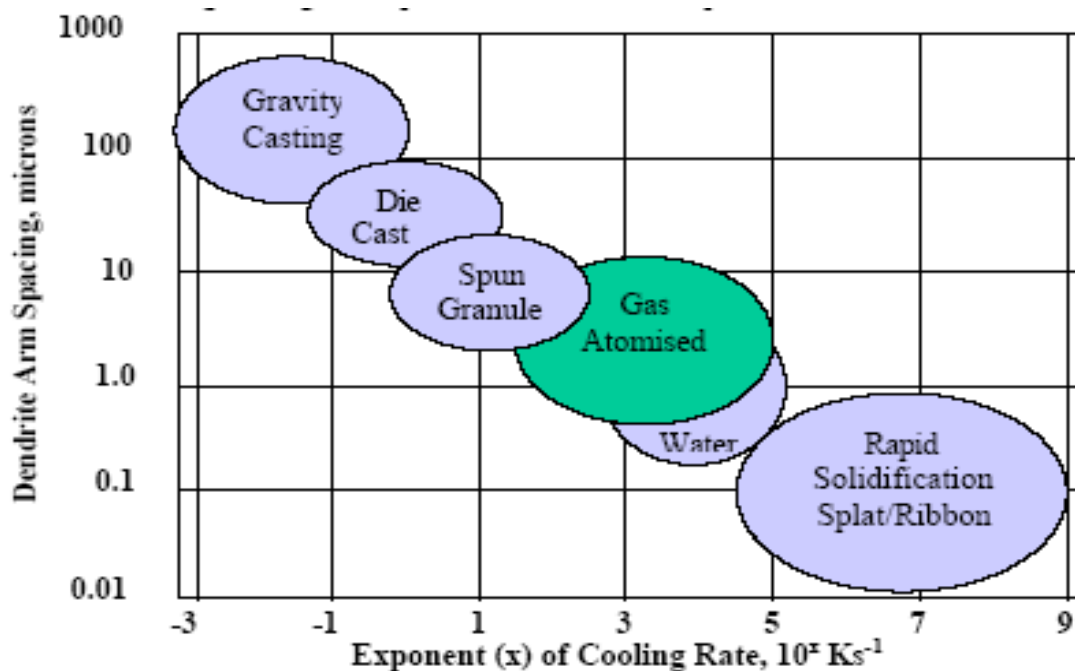


Fig.2. Micro structural refinement vs. Cooling Rate (for different Solidification Processes)

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### 3. METAL MATRIX COMPOSITES (MMCS)

Aluminum-based MMCs are carving out in the transport sector where they can offer cost-effective increases in vehicle performance through increased strength, stiffness, fatigue, wear or thermal resistance. The largest single consumer of prealloyed Al powders in the UK is AMC who have gradually grown their market base for application of MMCs. The largest market is in performance vehicles for Formula 1 and Indy car racing. The majority

of AMC's products are based on inert gas atomized. The initial approach was to atomize alloys and to produce base alloys which complement the reinforcement to give the best combination of stiffness, strength and fatigue. The Al powders are produced deliberately to a fine size range ( $\sim 75\text{nm}$ ) to improve mixing with the fine SiC particulate that confers improved stiffness, wear etc. The manufacturing process involves mechanical alloying of the powders to crush oxide films and ensure homogenization of the mix. This is followed by encapsulation, degassing and hot isostatic processing (HIPing). The HIP'ed billet, after decanting may be extruded, forged, rolled, machined and heat-treated as appropriate to arrive at the finished component.

The components shown in Fig 3 demand high specific stiffness and fatigue resistance approx. double that of the unreinforced alloy.

At larger gas flow rates, finer powders can be obtained. The powder size distribution can be varied by selection of atomizing gas (He - provides greatest rates of heat transfer), nozzle and manifold design and gas temperature.



Fig. 3. Example of current production: Brake caliper.

#### 4. SUPERPLASTIC FORMING (SPF)

The centrifugal spinning process is being developed for the preparation of precursor powders for superplastic alloy production. The SPF technique is relatively expensive (high material manufacturing costs combined with low forming rates) but is economically viable for complex components required in modest numbers. Conventionally cast and rolled SPF aluminum is well established for the manufacture of body panels for special vehicles.

The extrusion was cross-rolled warm to 1.5 mm thickness prior to SPF. The sheet showed approx. 350% elongation at strain rates of 1-10  $s^{-1}$  with a relatively low flow stress of 10 MPa. Increasing %Zr in the range (0.5 - 1.0) % leads to increased SP Formability. The latest material exhibited tensile ductility of 460% (flow stress 20 MPa) at  $10^{-1} s^{-1}$  and 650% (10 MPa) at  $10^{-2} s^{-1}$  strain rate.

#### 5. METALLIC FOAMS

Aluminum foams are a class of materials with considerable interest in the transport

sector for use in energy-absorption applications. There are two main processing routes under commercial development:

- a - Cast foams from gas injection into a melt;
- b - PM, using a gasifying additive, typically  $TiH_2$ .

Consolidation is by either Cold Isostatic Pressing/Extrusion or Conforming followed by controlled thermal treatment in a closed mould to achieve the foamed structure.

Advantages of the PM route include shape versatility, control of density, closed pore structure and the ability to produce sandwich structures. The process is however more expensive than the cast route and it is difficult to control pore size. A key feature of the foam is the consistency and isotropy of properties and a major challenge is to define and maintain cost effective processing windows to make consistent parts. The aluminum powder producer has a vital role to play in this regard. Many of the criteria that apply to best practice in conventional PM to get uniform density/shrinkage are equally valid in production of foams. The benefits in the long

term are to improve lightweighting and crashworthiness of vehicles.

## 6. Al-Si FOR PLASMA WELDING

Joining of wrought aluminum components is important in relation to the use of aluminum in tubular frameworks e.g. for bicycles, aerospace control rods etc. The tenacious oxide film that forms immediately when fresh aluminum surfaces are exposed to air, make this a difficult operation. Industrially, Gas Tungsten Arc (GTAW) and Gas Metal Arc (GMAW) processes are used and laser welding is also increasing in popularity. GTAW gives high quality, but is not easily automated.

Powder Plasma Arc Welding (PPAW) is a relatively new process (Developed by Plasma Modules OY, Finland) that is being investigated with the potential for automating a.c. welding of tubular sections. Research in collaboration with European partners is seeking to establish the potential for a.c. plasma welding with the aid of inert gas atomized Al-Si powders as a filler material.

Key aspects of the powder are the flow characteristics for feeding into the plasma gun and the level of oxygen contamination on the surface of the powder. The technique is being developed for bicycle and auto use and should be another advance towards the increasing use of Al in auto applications.

## 7. CONCLUSIONS

1. A variety of aluminum atomizing processes has been applied to the production of precursor powders for prospective automotive end-users. Prime examples have been drawn from high performance composites, pressed and sintered wear parts

and SPF sheet. The majority of aluminum powders used in PM are blends; prealloyed powders have established specific niches for high performance applications.

2. The powder producer can exercise good control over the atomizing process to achieve the desired powder characteristics. Micro structural refinement conferred by rapid solidification can be beneficial, but to achieve best wear resistance and compressibility for PM, then the degree of refinement needs to be tempered. Very clean powders can be required for applications such as welding consumables and metal matrix composites

3. Key to the economics and ultimately the likely exploitation of these powders are achieving maximum yield of the desired fraction and cost effective consolidation routes.

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## HOT ISOSTATIC PROCESSING APPLIED TO CEMENTED CARBIDES AND CERAMICS

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**Abstract:** HIP is the abbreviation of Hot Isostatic Pressing, which is a technology of isotropic compression and compacting of objective material by use of high-temperature and high-pressure gas as a pressure- and heat-transmitting medium. Fig.1 shows the configuration of HIP equipment. This technology was invented in Battelle Laboratory, USA in 1950s and, with the advance in HIP equipment, has been used for forming, sintering, jointing and removal of defect of various materials such as metal, cemented carbide and ceramics.

A general overview about the technology for obtaining high quality in the field of cemented carbides and ceramics are described.

**Keywords:** HIP, cemented carbides, ceramics.

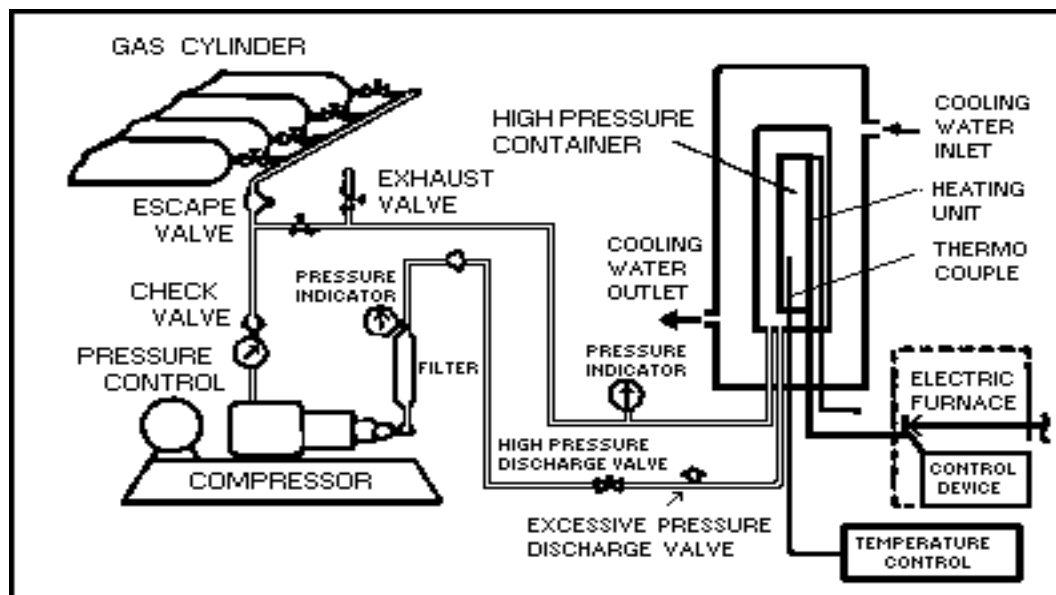


Fig. 1. Schematic drawing of HIP equipment

### 1. CLASSIFICATION OF HIP

The HIP treatment is classified into two categories as shown in Fig.2. The one is a capsule method in which powder is charged

and deaerated in a dense capsule and sintered together with the capsule. The other one, is a capsule-free method in which a relatively dense material (cast material) is directly treated by HIP. The former has an advantage to make dense easily the material that is difficult to compact by an ordinary technology of sintering but has

a disadvantage to require complicated processes such as the forming of capsule, deaeration, and removal of capsule after HIP. The latter is excellent in productivity but requires the preparation of high-dense sintered

body before HIP. Therefore the latter cannot be applied to the powder (spherical powder and ceramics difficult to sinter). The process that is widely adopted in industry at present is the capsule-free method.

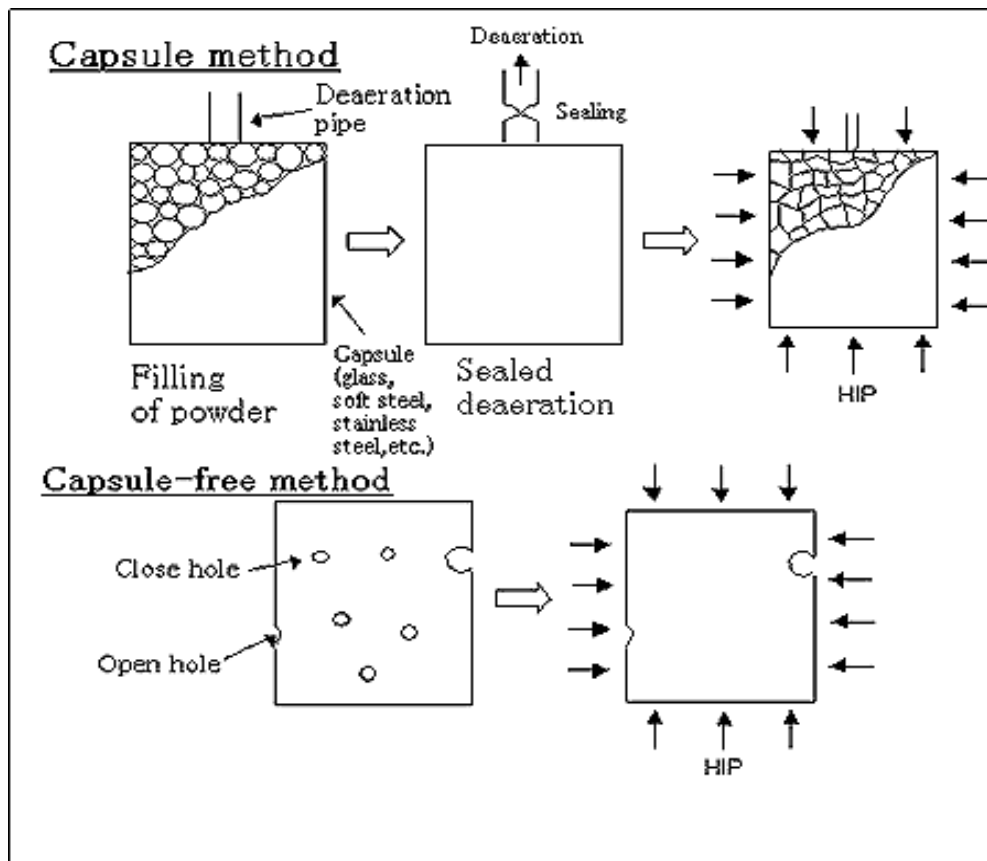


Fig. 2. Conceptual drawing of capsule and capsule-free methods

## 2. APPLICATIONS OF HIP

Let's see the production of cemented carbide and fine ceramics as a concrete example of applying HIP technology. Cemented carbide and fine ceramics are inferior to metals such as steel and aluminum in toughness and very vulnerable to defects such as coarse particle and pore. It is necessary to remove such internal defects in order to make full use of the natural characteristics of these materials, and HIP is the most effective means to eliminate those defects.

## 3. CEMENTED CARBIDES

Since a liquid phase of metal such as cobalt is utilized as a binder phase in the sintering of cemented carbide, it is possible to compact a normal sintered body nearly up to the theoretical density. However there remain fine pores in the sintered body and they act fatally to the cemented carbide to break under a pressure that can be withstood in normal condition. It is the purpose of HIP treatment to eliminate completely a few pores existing in the sintered body.

Table 1 shows the change in mechanical properties by HIP and Fig.3 shows the Weibull plot of bending strength before and after HIP.



Table 1. Effect of HIP treatment on mechanical properties of cemented carbide (G2)

	Before HIP	After HIP
Relative density [%]	nearly 100	nearly 100
Hardness [HRA]	91.0	91.0
Bending strength [MPa]	2450	2940
Fracture toughness [MPa·m <sup>1/2</sup> ]	10	10.5

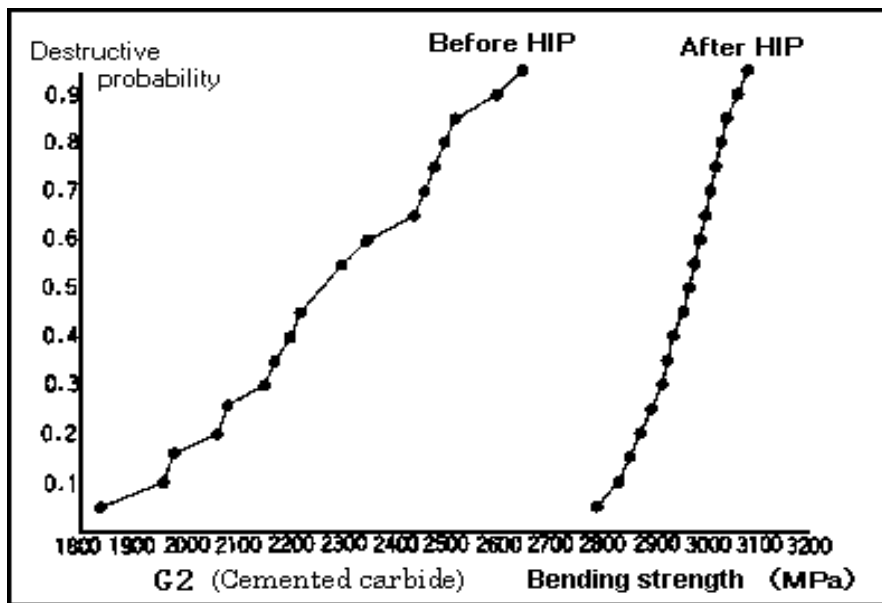


Fig. 3. Weibull plot of bending strength before and after HIP treatment

As shown above, the density and hardness of cemented carbide are not changed by HIP treatment. However, by the removal of fine pores, the bending strength is largely improved and the dispersion in strength becomes very small to increase reliability.

#### 4. CERAMICS

Ceramics are composed of strong crystals created by ionic bond and covalent binding. As a result, ceramics are very hard, strong against deformation and stable under high temperature because, in such a state, movement of atoms is small. To the contrary,

this means that ceramics are difficult to sinter and it is difficult to obtain a compact sintered body of ceramic. If adding a large amount of sintering assistant to improve the sintering effect, it is possible to make a compact ceramic but its original characteristics are lost. Further, though it is possible to lower the porosity by increasing the sintering temperature, crystal particle becomes coarse and mechanical properties are deteriorated. HIP however is possible to produce compact ceramics without raising those problems. Table 2 shows the change in mechanical properties of ceramics by HIP.

Table 2. Effect of HIP treatment on mechanical properties of various ceramics

	Alumina		Zirconium		Silicon nitride	
	Before HIP	After HIP	Before HIP	After HIP	Before HIP	After HIP
Relative density [%]	97.5	99.8	98.3	99.7	95.7	99.7
Hardness [HRA]	93.0	93.7	90.0	91.0	92.5	93.5
Bending strength [MPa]	490	735	980	1568	980	1176
Fracture toughness [MPa·m <sup>1/2</sup> ]	3.0	3.5	7.5	8.0	7.0	7.5

As shown in the table 2, ceramics become compact nearly up to the theoretical density by HIP treatment and the mechanical properties are improved largely. Moreover it is

possible to obtain an extremely flat ground surface by eliminating the residual pores by HIP. Fig. 4 shows an example of improving the surface roughness by HIP treatment.

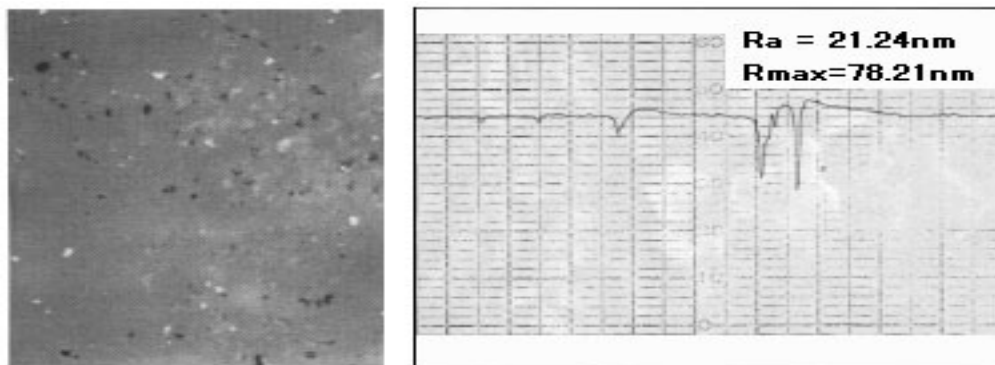


Fig. 4. Surface roughness of silicon nitride ceramics obtained by HIP treatment

As explained above, HIP is a process that is very effective for compacting cemented carbide and ceramics, improving their mechanical properties and reliability. HIP technology is now applied to various products in order to make full use of the original characteristics of raw material.

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## THE INFLUENCE OF CHEMICAL COMPONENTS AND THERMIC TREATMENT ON ALUMINIUM ALLOYS CASTED IN PISTONS FOR THERMIC ENGINES

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**Abstract:** This paper studies, both theoretically and experimentally, two aluminium alloys that are casted in pieces that work at high temperatures (refractory alloys), alloys that possess good technological proprieties.

After the attempt performed by the continuous heating until reaching and then maintaining the temperature of 300°C (the temperature that is reached also on the aluminium alloys casted and used in internal combustion engines) it was obviously revealed that:

1. As the temperature increases,  $R_m$  decreases parabolically manily at samples TT and N, while at samples R the proprieties vary relative to the lines because, in the heating process, within the structure of these, samples no separation phenomena of the secondary phases form ssa appear.
2. The reduction of the tensile resistance is more pronounced at the samples that have been subject to the improvement process, then at those untreated and lastly the ones unbaked
3. A significative fact is that, at 300°C,  $R_m$  is very low and has close values for all the chemical compositions and states of the studied alloys.

**Key words:** alloy, refractory, thermic treatment;

### 1. INTRODUCTION

The XX-th century, also known as the the „century of speed”, imposed the finding of alloys that meet the conditions imposed on parts and subassemblies by their usage. Considering this, the piston casted aluminium alloys had to be refractory and meet other demands like:

- superior mechanical resistances at both ambiantal and working temperature ( $\approx 325^\circ\text{C}$ ) [1] [2] [4] [5] [10] [11];
- lower thermal dilatation coefficient  $\alpha$  [1] [3];
- reduced specific weight;
- constant geometrical dimensions [6] [12];
- good technological proprieties [1] [3];
- good machinability by cutting [7];
- lack of pahse transformations, in order to avoid the swelling of the pistons and causing a crash [8] [9] [12];

- high usage durability without the increase of fuel and oil [12];

These demands were only met by siluminium alloys. These alloys use silicon as main alloy element ( $E_a$ ).

Beside high fluidity when casting, *Al-Si* binary alloys possess reduced mechanical and cutting proprieties [1] [7]. This is why the binary *Al-Si* alloys were alloyed with different other alloy elements, as to obtain satisfactory mechanical proprieties. So appeared aluminium alloys that are refractory and that contain  $E_a$  as: *Mg, Cu, Mn, Ni, Cr, B* and others.

Among the chemical components that are frequently used to cast these alloys in pistons for thermic engines, two major categories are distinguished:

**a** – Al + Si(3%) +  $E_a$ ;

**b** – Al + Si(12%) +  $E_a$ .

In the following table are presented different such alloys used in different countries

Table 1 Characteristic chemical compositions [%]

Alloy category (denotation)	Country	Cu	Si	Mg	Ni	Mn	Ti	Obs
a	Yai	England	3.75 – 4.50	1.10 – 1.20	1.25 – 1.75	1.75 – 2.25	≈ 0.30	-
	AL10V	ex USSR	6.80 – 7.10	4.00 – 4.80	0.30 – 0.36	-	0.33 – 0.48	-
b	KS245	ex GFR	0.50 – 1.50	11.0 – 13.0	0.70 – 1.30	2.00 – 3.00	-	0.25
	GALSilZ CuNi	ex GDR	1.00 – 1.50	11.5 – 13.5	1.00 – 1.50	0.80 – 1.10	0.30 – 0.50	0.15
	CGN 424336	Czechoslovakia	0.80 – 1.30	11.5 – 13.0	0.85 – 1.30	1.00 – 2.00	0.30 – 0.50	-
	LM13	England	0.50 – 1.30	11.0 – 13.0	2.00 – 3.00	-	-	Fe = 0.80
	ASi12 GCN	Italy	0.50 – 1.10	12.4 – 13.0	1.00 – 1.40	2.00 – 2.40	-	0.10 – 0.20
	SAE321	USA	1.00 – 2.00	11.0 – 13.0	0.70 – 1.30	-	0.50 – 0.90	0.25
	AL25	ex USSR	1.00 – 3.00	11.0 – 13.0	0.80 – 1.00	0.80 – 1.30	0.30 – 0.80	0.20
	ATSi12 CuMgNi	Romania	0.80 – 1.50	11.0 – 13.0	1.00 – 1.50	0.80 – 1.30	0.20 – 0.50	-

in order to view the differences and similarities in the chemical compositions of the alloys [1] [3] [12].

Considering these chemical compositions and also the specialists recommendations regarding the mechanical proprieties of these alloys, especially towards the mechanical resistance of duration under load at high temperatures [1] [3] [4] [5] [11], the authors considered there are required additional studies on these types of alloys.

## 2. STUDIES AND EXPERIMENTS

Based on the conclusions of many reasearch [1] [2] [3] [11] [12] [5] regarding the way alloys from the above mentioned categories behave in usage, it was concluded that the most favorable chemical compositions are the ones in *Table 2*. Note that in both categories a higher quantity of *Mn* was used because previous research [14] showed that this fact adds both an economical and technological benefit (less *Ni* was used) and the melt for the development of the alloy for casting in pistons can contain waste less controlled chemical.

### 2.1. Development and casting of alloys

The development of the alloys was done in electric ovens with electrical reluctance. The melt consisted of 90% new matter (blocks of aluminium and siluminium) and 10% waste. These ratios were conditioned by the amount of waste resulted form the casting technological processes.

The prealloys were introduced in the oven melt only in preheated state at about 350°C.

The protection of the melt was ensured with an universal flux consisting of  $50NaCl+30NaF+10KAl+10\%Na_3AlF_6$  [1] (low melting temperature), that is administered when the oven is starting to heat up.

Before the cast, the melt was cleaned of slag, then it has undergone modification with dust sulfur and then it was cleaned again. The modification with dust sulfur was done with a double purpose: obtaining the desired structure (much finer) and maintaining the effect of the modification for a long time [13].

The cast of the alloys was done at temperatures of 680 – 740° C, in the shell (preheated at 300 ° C) provided with three types of samples (*Fig. 1*), in order to determine

Table 2

Category	Si	Cu	Mg	Ni	Mn	Fe	Zn	Al
a	4.80	5.10	0.62	-	0.42	0.61	0.30	The rest
b	12.6	2.01	1.05	0.70	0.35	0.83	0.25	The rest

later the influence of the wall thickness over the mechanical proprieties.

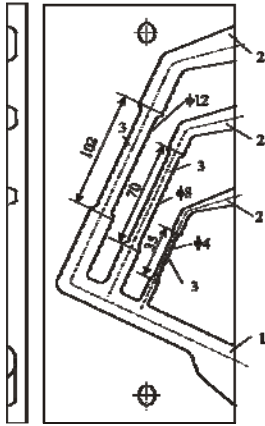


Fig. 1 The iron shell in which the samples (1) were casted through the funnel (2)

For the experiments were used only samples of 12.5 mm in diameter, in three states: casted (not treated thermal – denotation *N*); thermal treated (rebaked – *R*) and artificially aged (hardened and tempered – *I* or *TT*).

**2.2. Thermic treatment**

In order to determine the influence of the thermic treatment over the mechanical proprieties, the samples were heated in an oven with electrical reluctance to obtain structures in equilibrium (rebaking) and for aging (hardening and tempering).

a. The rebaking was done by heating at  $475 \pm 10^\circ\text{C}$  and maintaining that temperature for 10 hours, in order to dissolve the secondary formations (separated in the casting), and then slowly cooling down, in order to separate all of the secondary formations in *ss $\alpha$* .

b. Regarding the aging (hardening and tempering), the heating was done at temperatures comparable with the ones above, following the same purpose, but the cooling was violent (in  $25^\circ\text{C}$  water) in order to mantain complete all of the secondary phases that can be separated from the solid solution of alloy elements dissolved in aluminium (named *ss $\alpha$* ). After the hardening, the samples were subjected to the tempering process by heating

at  $230 \pm 10^\circ\text{C}$  for 5 hours and cooled in the environment.

**2.3. Experiments done on samples of 12.5 mm in diameter**

In order to determine the influence of the states of the samples casted and thermally treated on the mechanical proprieties, two types of experiments were done: dilatometric and of stabilization of the alloys structure for different temperature levels.

The samples in the three states – casted and not treated (*N*), rebaked (*R*) and aged (*I*) – were continuously heated, in an UDDA type dilatometer, at an average speed of  $5^\circ\text{C}$  per minute until they reached the temperature of about  $300^\circ\text{C}$ . Then they were mantained at this temperature for 240 minutes in order to complete the phasic transformation processess – the separation of secondary formations from *ss $\alpha$* , obtaining the absolute dilatometric curves in Fig. 2.

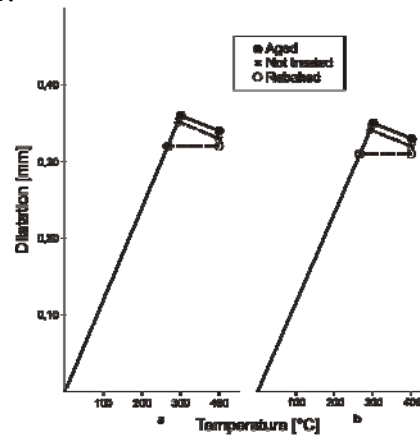


Fig. 2 The dilometric curves for the alloy samples in different states:

a. ATSi<sub>5</sub>Cu<sub>5</sub>MgFe alloy, b. ATSi<sub>12</sub>CuMgNi alloy

The amplification was chosen so that there would be a dilatation variation (on Y) at a scale of 75.5 mm for a 0.1 mm variation of the sample length of 50 mm. So, the measurement sensitivity *K* was the one in formula (1).

$$K = 75.5/0.1 = 755 \tag{1}$$

The tubes temperature was measured with a thermocouple introduced in the tube head.

Table 3 Values of the linear thermal dilatation coefficients

Alloy	Thermic treatment	Heated at 325° C		After mantaining at 325° C		
		$\Delta R$ [mm]	$\alpha_i$ [1/°C]	Time [min]	$\alpha_f$ [1/°C]	$\alpha_r = \alpha_f - \alpha_i$ [1/°C]
a	R	0.355	23.29	-	-	-
	N	0.358	23.59	185	23.00	0.59
	I	0.374	24.57	240	23.40	1.17
b	R	0.332	21.80	-	-	-
	N	0.347	22.78	180	22.55	0.23
	I	0.352	23.08	200	22.25	0.83

The following aspects can be deduced from the curves values in Fig. 1 and from the coefficient values in Table 3:

1.  $\alpha_a > \alpha_b$  (2)
2.  $\alpha_i > \alpha_f$  (3)
3.  $\alpha_{iI} > \alpha_{iN} > \alpha_{iR}$  (4)
4.  $\alpha_{fI} \approx \alpha_{fN} \approx \alpha_{fR}$  (5)
5.  $\alpha_{iRa} \approx \alpha_{iIb} \approx \alpha_{iNb}$  (6)
6.  $\alpha_{iNa} > \alpha_{iNb}$  and  $\alpha_{fIa} > \alpha_{fIb}$  (7)
7.  $\alpha_{iNb} \approx \alpha_{iIb}$  and  $\alpha_{fNb} \approx \alpha_{fIb}$  (8)

### 3. CONCLUSION

Considering the thermal dilatation coefficients, in both alloys cases (in all their states) the values are very close after the continuous heating from 20 to 325°, and they remain close even after the structural stabilization maintaining.

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## OPTIMIZED THE GRASPING MECHANISM, SPECIFICALLY TO THE INSPECTION ROBOTS IN HAZARDOUS ENVIROMENTS

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**Abstract :** *The global function of grasping mechanism is to integrate the manipulate object in the robotic mechanical system. The orientation object inside of the grasping mechanism implies contact between the characteristic points of the object and other characteristic point of the jaw elements mechanism. Those characteristics points are parts of the grasping object surfaces, named orientation surfaces, which can be grasping points. Theoretical, the maximum number, enough and necessary of those characteristic contact points must be six, sited in differed three planes, perpendiculars, in concordance with the six points rule, and in this case all the grasping surface objects, respectively characteristics points and lines occupied determinates uniform positions, this grasping named complete. If the number of characteristic contact points is less of six the grasping named incomplete. Actually, contact between the object and jaw made on surfaces and points, particularly in points (contact sphere – plan), important is that the characteristics contact points will be a part of those geometric elements. Ordinarily, in hazardous environment the shape of the object are cylindrically or parallelepipeds. Important is that characteristic point and characteristic line of the grasping objects will be inside of the grasping mechanism, else we have specific grasping error.*

**Key words :** *robot, parallel jaws, multifunctional jaws*

### 1. OPTIMUM DESIGN

The design analyze suppose an optimized through the dimension of the element must be realized a safety grasping and ensured a proper grasping force. Generally, the motion jaws could be rotary or translation motion, but the optimum motion of the jaws is the plane roto-translation, which assure minimum alignment errors.

Therefore, the structure of the grasping device need to be adapt for the shape and the dimension of the object that will be manipulate [2], such as the jaw-object contact to be enough for ensure a safety grasp.

In fact, a disadvantage of the gripper device with rotary motion of the jaw is practically these have alignment errors.

When gripping parallelepiped object with jaws rotary or translation motion (figure 1 a,b), the safety grasping is assurance by the device who have jaws parallel position with the surface object. This position is obtained with the jaws with translation motion (figure 1 b), in this case we need to know the position of the manipulated object. If the distance  $x$  grow up the safety grasping send down.

When gripping cylindrically object, the contact between jaws and object represent a contact line. We observed that the jaws-object contacts are two linear contacts, and in this case the object can round between the jaws.

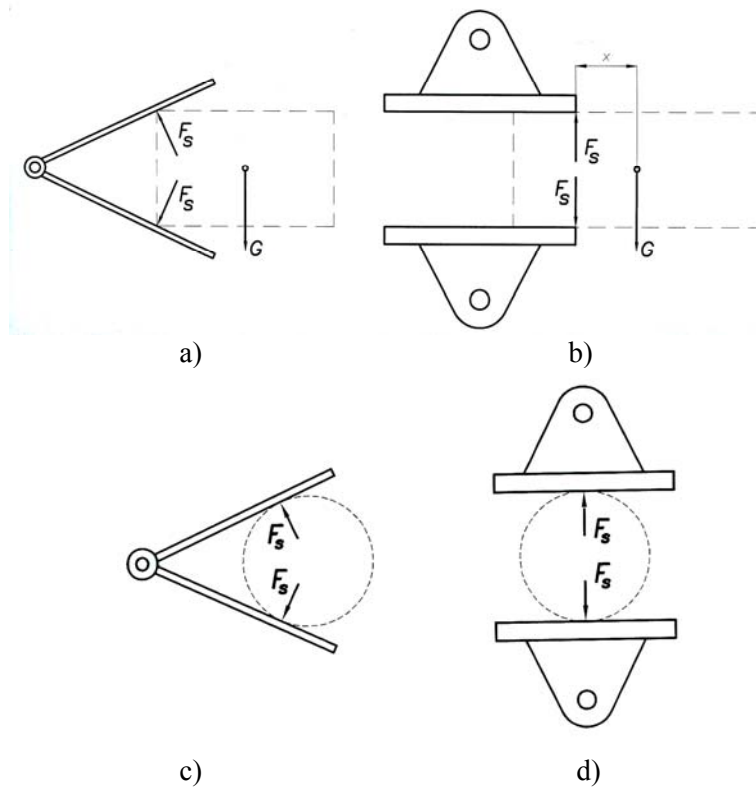


Fig. 1 Grasping the object with two parallel jaws  
a,b - parallelepiped objects;c,d - cylindrically objects.

An original solution for the jaws is represented in figure 2, this solution can grasp in safety condition parallelepiped object and cylindrically object, in the same time without change the jaws of the gripper device.

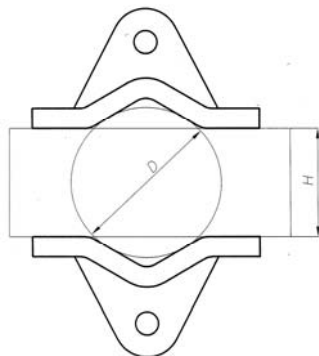
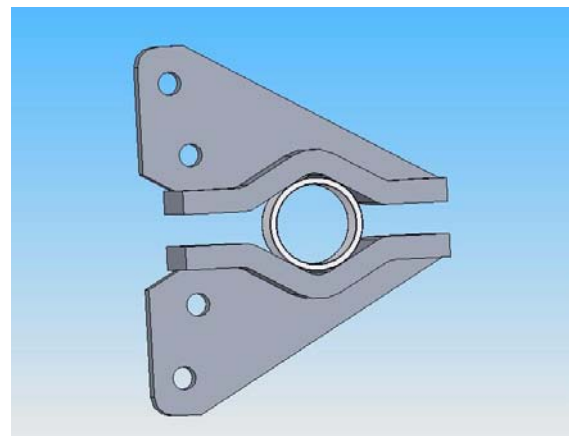
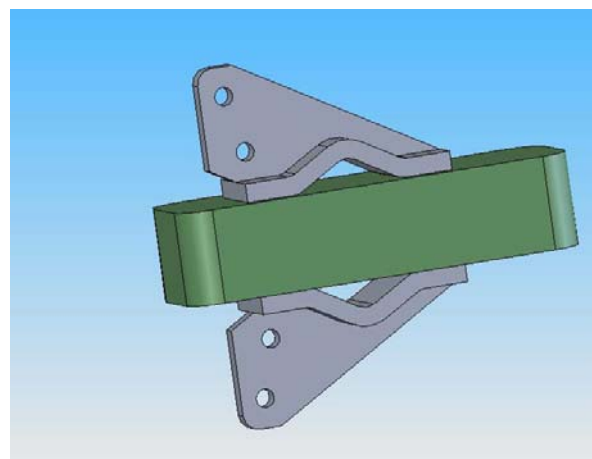


Fig. 2 Multifunctional jaws

For the geometric and cinematic analyze we use SolidWorks and CosmosWorks program, in this way was optimized the jaws to grasp cylindrical and parallelepiped objects, this is shown in the figure 3.



a)



b)

Fig. 3 Grasping the cylindrical (a) and parallelepiped (b) object



After geometric optimized with this jaws a robotic gripper can grasp safety cylindrical object with  $\Phi$  17mm and plane object with 0,1mm thickness. In figure 4 are shown the prototypes of these jaws.



Fig. 4 The prototypes of multifunctional jaws

A robot gripper (figure 5) which uses multifunctional jaws is designed for gripping cylindrical and parallelepiped object.

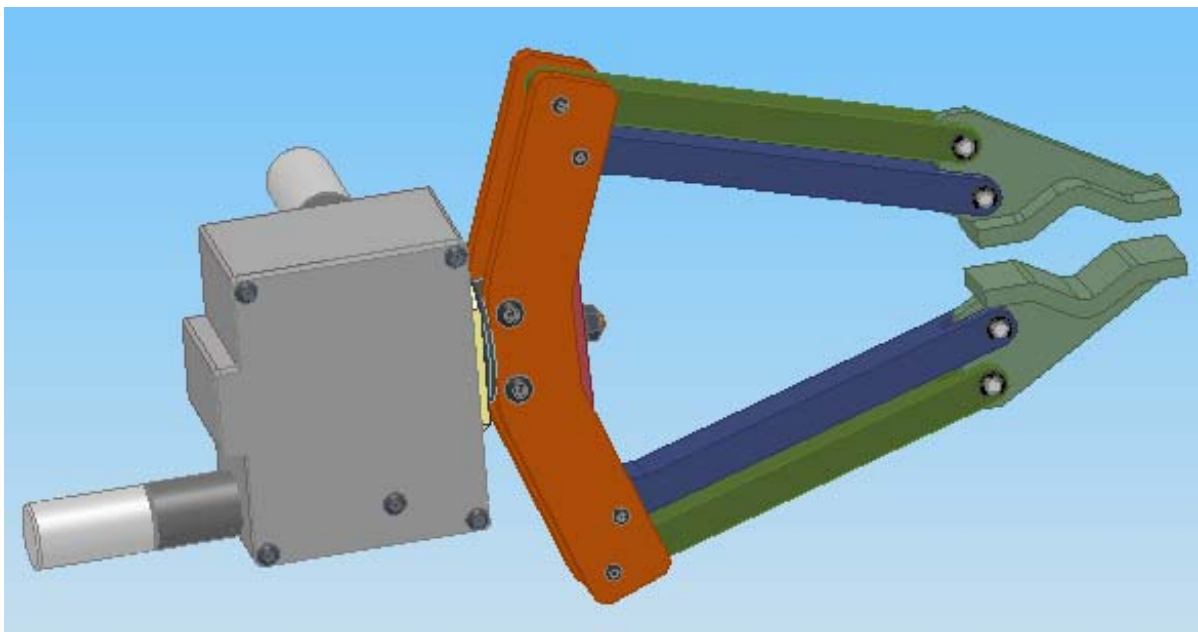


Fig. 5 Parallel robot gripper with multifunctional jaws

## 2. CONCLUSION

To ensure a safety grasp, the structure of the robotic gripper needs to be adapted at the dimension and the shape of the object.

In this paper was presented an original concept for multifunctional jaws who can grasp cylindrically and parallelepiped object.

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## PIERCING INCENDIARY BULLETS' IMPACT PHENOMENON. EXPERIMENTAL RESULTS AND NUMERICAL DATES

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**Abstract:** This paper proposes the analysis of experimental and numerical results in response to accomplishment of some experimental tests. Experimental tests have consisted in executed experimental firing into a rifle range. Materials used to experimental firings are : armament, ammunition, armoured skin and ballistic protection equipment. Armament consist in Barinov ballistic barrel, Levaşov ballistic barrel and 14,5 mm calibre machine gun mounted on armoured amphibious transporter (MTB). Ammunition is represented by 7,62x54, 12,7x108 and 14,5x114mm calibre piercing – incendiary bullets. Armoured skin consist in 6 mm thickness armour plate. Ballistic protection equipment is constituted by bulletproof jacket. The impact process between 14,5x114mm calibre piercing – incendiary bullet and 6 mm thickness armour plate was moulded by „Ls-Dyna” support, which is a finite elements program for dynamics analysis of structures.

**Key words:** piercing – incendiary bullet, bulletproof jacket, armoured skin

### 1. INTERACTION TYPES BETWEEN PROJECTILE AND ARMOUR

Failure modes of targets and projectile are dependent on impact velocity, angle of obliquity, projectile shape, relative dimensions of projectile and target in addition to material properties and their fracture behaviors [1].

The failure modes of plates impacted may be complex, involving several modes.

Fig 1 shows typical failure modes of impacted plates used in this study :

- 1) Fragmentation ;
- 2) Ductile hole enlargement ;
- 3) Compression fracture ;
- 4) Radial fracture ;
- 5) Spal ;
- 6) Plug ;
- 7) Face petalling ;
- 8) Back-up petalling.

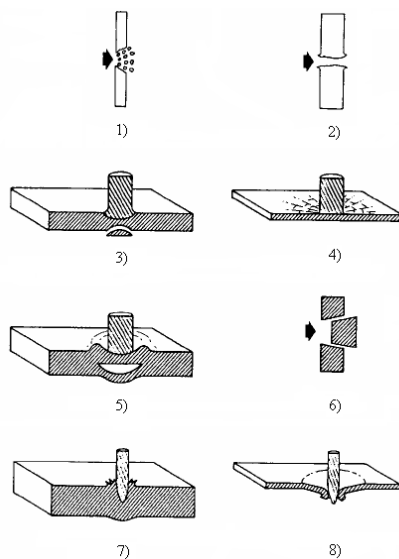


Fig. 1 Typical failure (penetration) modes of impacted plates

### 2. THE EXPERIMENTAL TESTS

The purpose of experimental tests was the behaviour's analysis of some configuration constituted by armour and ballistic protection equipments, in response to firings execution by short calibre bullets.

The experimental tests consisted in 7,62 x 54 mm, 12,7 x 108 mm and 14,5 x 114 mm calibre piercing incendiary bullets firings against some configurations consisting of 6 mm thickness armour plate and bulletproof jacket situated at 50 metres from firings arms.

First of all, firings have been executed against a 6 mm thickness armour plate. After bullets have penetrated the armour, the bulletproof jacket was fitted up

on a device and placed at 0,3 metres distance from the armour.

The next 3 pictures show the effect of bullets used regarding configuration specified.



Fig. 2 Impact between 7,62 x 54 mm calibre piercing incendiary bullets and configuration constituted by 6 mm thickness armour plate and bulletproof jacket



Fig. 3 Impact between 12,7 x 108 mm calibre piercing incendiary bullets and configuration constituted by 6 mm thickness armour plate and bulletproof jacket

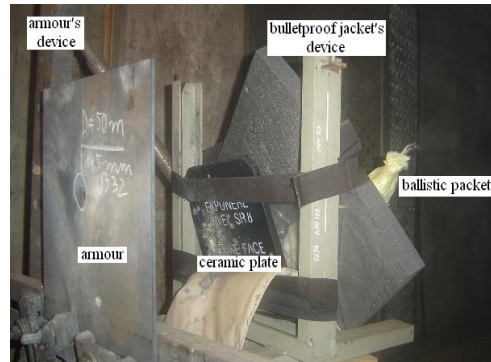


Fig. 4 Impact between 14,5 x 114 mm calibre piercing incendiary bullets and configuration constituted by 6 mm thickness armour plate and bulletproof jacket

Technical dates of the armament and ammunition used at experimental tests are presented in the following tables.

Table 1 Important technical dates of the armament used at experimental tests

Nr. crt.	Armament			
	Technical dates	Ballistic barrel Barinov	Ballistic barrel Levasov	M.T.B.
1.	Calibre	7,62 mm	12,7 mm	14,5 mm
2.	Barrel Length	755 mm	1.005 mm	1.276 mm
3.	Total length	900 mm	1.200 mm	1.480 mm

Table 2 Important technical dates of the ammunition used at experimental tests

Nr. crt.	Bullets			
	Characteristics	7,62 x 54 mm cal. piercing incendiary	12,7 x 108 mm cal. piercing incendiary	14,5 x 114 mm cal. piercing incendiary
1.	Velocity of barrel muzzle	830 m / s	820 m / s	945 m / s
2.	Energy of barrel muzzle	337 kgf m	1520 kgf m	2.910 kgf m
3.	Mass of bullet	9,6 g	51 g	64 g
4.	Core of bullet	Steel	Steel	Steel
5.	Mean mass of fling charge	3,00 – 3,30	16,00 – 17,00	31,00 – 33,00

The bulletproof jacket provide ballistic protection from bullets and fragments of conventional weapons. The components are ceramic plate and ballistic packet.

The ceramic plate protect the vital organs and abdomen and is composed from multi tile ceramic plates, covered with

aramid fibres and resin, thicker to the human body to attenuate the impact with bullets or fragments.

### 3. ANALYSIS OF OBTAINED RESULTS

The experimental obtained results are presented in the next table.

Table 3 Obtained results in response to experimental tests

Ammunition used	7,62 x 54 mm calibre piercing incendiary bullet				12,7 x 108 mm calibre piercing incendiary bullet		14,5 x 114 mm calibre piercing incendiary bullet	
	Shot "1"		Shot "2"		Bulletproof jacket		Bulletproof jacket	
Target	Bulletproof jacket		Bulletproof jacket		Bulletproof jacket		Bulletproof jacket	
	Ceramic plate	Ballistic packet	Ceramic plate	Ballistic packet	Ceramic plate	Ballistic packet	Ceramic plate	Ballistic packet
Obtained results	Amprent	Unpenetration	Amprent	Partial penetration	Amprent	Partial penetration	Complete penetration	Complete penetration
Observations	-	-	-	11 penetrated fibres	-	21 penetrated fibres	-	33 penetrated fibres
Protection grade of each bulletproof jacket's component	50%	100 %	50%	66,7 %	50%	36,4 %	0 %	0 %
Protection grade of bulletproof jacket	75%		58,4%		43,2 %		0 %	
	67 %							

Even if armour doesn't offer maximum protection for the fighter from armoured vehicles, this mark has great enough importance, because, in response to the impact, it reduces the bullet's mass and penetration power.

Very grand importance of ceramic plate is remarked, because, containing high

toughness ceramic plates, it sometimes stops the bullet to penetrate the target, or in other situations causes bullet's ricochet [1].

The ballistic packet has two very important tasks. First, to absorb shells sprinter formed in response to bullet-target impact and, second, to retain bullets ricocheted from the ceramic plate.

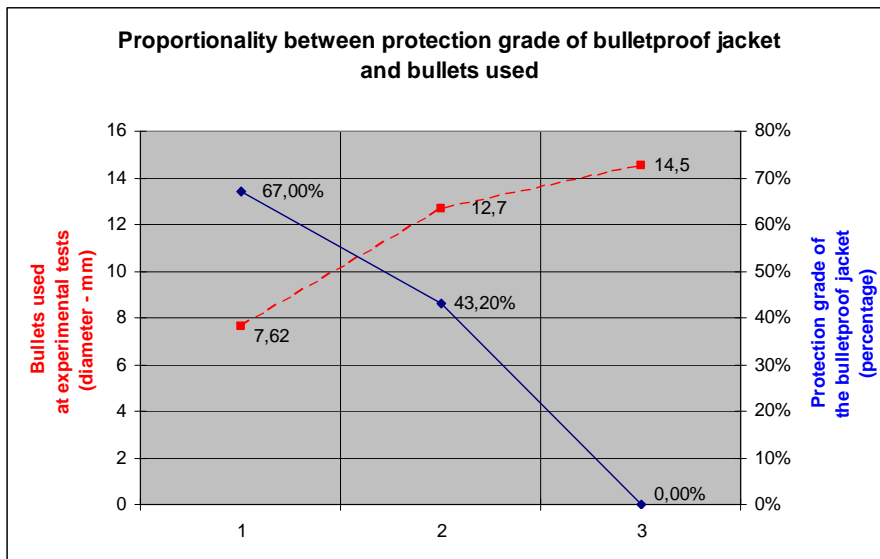


Fig. 5 Proportionality between protection grade of bulletproof jacket and bullets used at experimental tests

From the previous figure, it can deduce that protection grade of bulletproof jacket, presented through the blue continue line is reverse proportional with bullets used

at experimental tests, represented through the red dotted line.

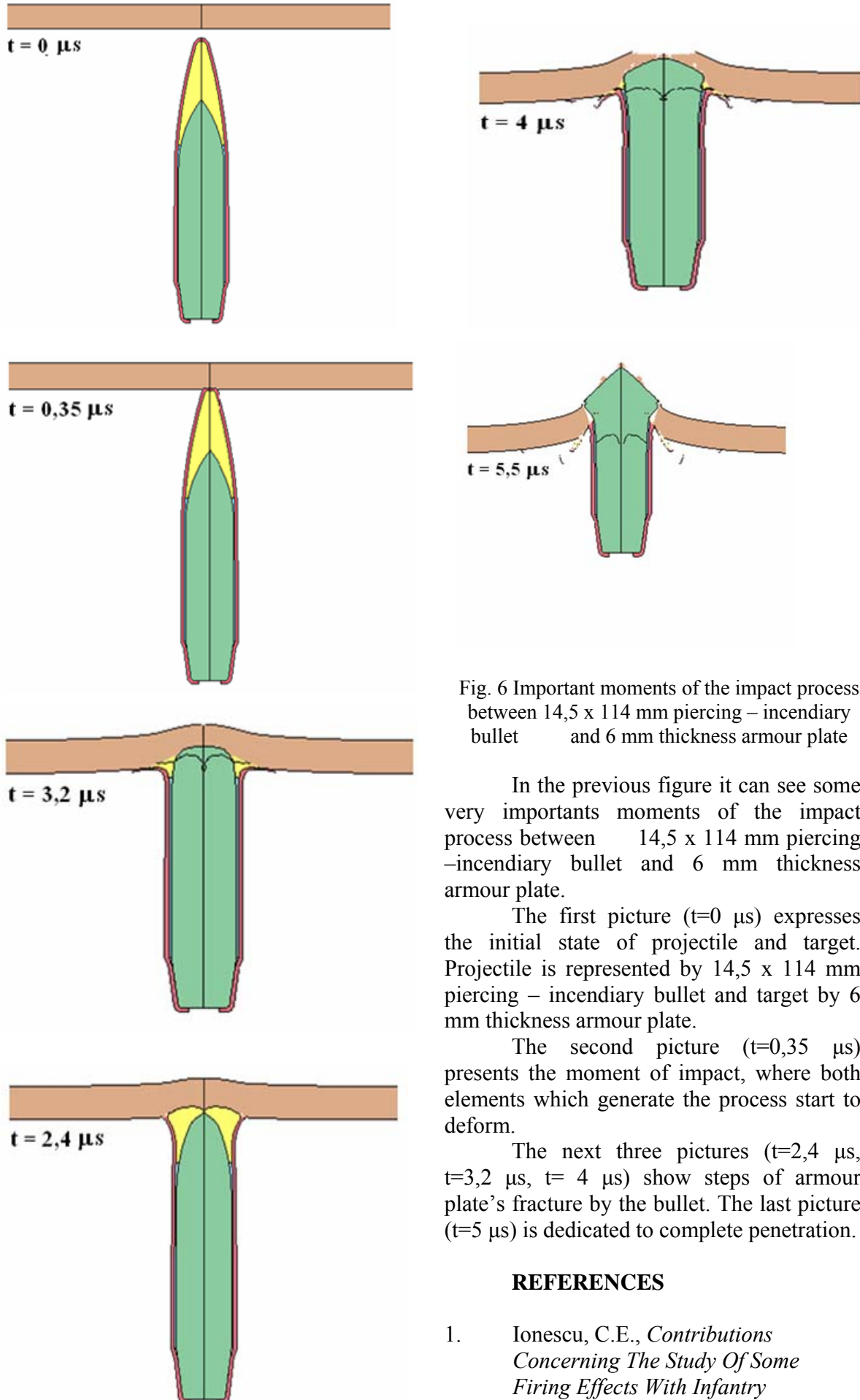


Fig. 6 Important moments of the impact process between 14,5 x 114 mm piercing – incendiary bullet and 6 mm thickness armour plate

In the previous figure it can see some very important moments of the impact process between 14,5 x 114 mm piercing – incendiary bullet and 6 mm thickness armour plate.

The first picture ( $t=0 \mu s$ ) expresses the initial state of projectile and target. Projectile is represented by 14,5 x 114 mm piercing – incendiary bullet and target by 6 mm thickness armour plate.

The second picture ( $t=0,35 \mu s$ ) presents the moment of impact, where both elements which generate the process start to deform.

The next three pictures ( $t=2,4 \mu s$ ,  $t=3,2 \mu s$ ,  $t=4 \mu s$ ) show steps of armour plate's fracture by the bullet. The last picture ( $t=5 \mu s$ ) is dedicated to complete penetration.

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## THE METALS DEFORMING THROUGH THE PLASTICITY CRITERIA

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**Abstract:** *The elasticity hypothesis, admitted in calculations, isn't totally fulfilled in the real cases of loaded bodies; thus presents interest the conditions in which the crossing (of metallic body) from elastic state in plastic state of stress appears.*

*The laws that characterized the plastic deforming in metal cold workings are presented; the deforming strength and plasticity of various materials depends of state of stress (maximum tangential stress, respectively of slipping deformation energy during the mechanical workings) are shown in this paper).*

**Key words:** *real cases, plastic deforming, metal cold workings, tests.*

### 1. INTRODUCTION

Usually the completely elastic behavior, admitted as premise of calculus, isn't total fulfilled in majority of the real loading forms of the mechanical structures or technologies . As known as the stresses state complexity in the loaded body it may obtain a qualitative estimation concerning the deforming behavior of any metallic material. For practice, namely technological workings, a distinct importance the establishment of conditions in which solid body begin/continue the plastic deformation shows, respectively the conditions in which solid body cross from elastic at plastic state of stress.

### 2. GENERATION OF THE PLASTIC STATE IN METALS COLD WORKING

The plastic properties of materials are important for various technological workings (hardening, forging, mill rolling, press-forming) or for establish bearing capacity of structure.

The plasticity conditions (criteria) indicate the relations which must to be among stresses and strains (deformations), or among the stresses from one body point and its mechanical properties.

Through theoretical and experimental tests[1,3,4,9] established a series of laws that characterize the plastic deformation, namely:

- The volume stability law

$$\varepsilon_x + \varepsilon_y + \varepsilon_z = \varepsilon'_x + \varepsilon'_y + \varepsilon'_z \cong 0$$

in which

$$\varepsilon'_x = \varepsilon_x - \varepsilon_m \quad \varepsilon'_y = \varepsilon_y - \varepsilon_m \quad \varepsilon'_z = \varepsilon_z - \varepsilon_m$$

when  $\varepsilon_m$  are unit strains (deformations) through the simple change of body shape and  $\varepsilon_m$  are average unit strain).

- The law of elastic strains presence during the plastic deforming

At the cold compressing the values of the elastic strains are very important, fact that must be in mind at the operating processes and the technological equipments.

- The law of minimum strength

For various processes of plastic deforming, the final maximum deformation will make on the minimum strength trajectories of a loaded body, e.g.: the cold heading of parallelepipedic tests and metal zones of yield [3,6,7,8 ], the cold pressing with spews and so on.

- The law of residual stresses

In any plastic deforming process in loaded body appears additional stresses which it can reciprocal balance, through big volumes of body, through different crystalline grains and so on, or can remain within the body in form of remanent (residual) stresses; these may bring additional deforming, may cause micro or macro cracks, may reduce the plasticity and increase the metal brittleness.

In accordance with volume stability law the deforming states are possible only through three deformational forms, one plane (Fig.1.a) and two spatial (Fig.1.b and c).

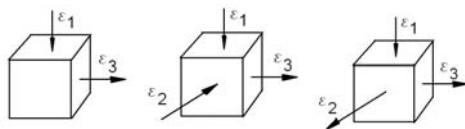


Fig. 1. Forms of deforming state

At the scheme with one positive deformation and another two negative (Fig.1.a) and equal in value, it obtain more easily an uniform longitudinal fiber; in this case the moulding of structure and the cold-hardening of worked material are more intense.

On the scheme with two positive deformations equals in value and one negative (Fig.1.b and c) the grains will be flattened on the negative deformation direction, while the longitudinal fiber will be orient on the direction of another two positive directions.

These forms give some indications concerning at change manner of the material physical-mechanical properties : indicate the fiber direction in mechanic parts, evaluate the size and the direction sense of grains and so on, but don't give data about plasticity and deforming strength of materials.

### 3. PLASTICITY CRITERIA

For some plastic cold working in fig.2 are shown [6,7,9] the mechanical forms of deformations, respectively the given stress-state through principal stresses.

Nr. crt.	Deforming methods	Process outline	Mechanical forms of deformations	
			State of stress	State of deformation
1.	Retightening a) homogeneous b) local		 $\sigma_2 = \sigma_3 = 0$	 $\varepsilon_1, \varepsilon_2, \varepsilon_3$
2.	Cold heading a) light (open) b) without spread			
3.	Forcing			

Fig.2. Mechanical forms of deformations

The plastic deforming begin/continue only if the slipping deformation energy reaches the given critical value; this condition is possible to write with relation:

$$dD_\varepsilon = \frac{3}{2} d\lambda D_\sigma \tag{01}$$

where  $D_\varepsilon$  is the deformation deviator tensor,  $D_\sigma$  is the stress deviator tensor, or wrote in form with tensor:

$$\begin{bmatrix} d\varepsilon_x - d\varepsilon_m & \frac{d\gamma_{yz}}{2} & \frac{d\gamma_{zx}}{2} \\ \frac{d\gamma_{xu}}{2} & d\varepsilon_y - d\varepsilon_m & \frac{d\gamma_{zy}}{2} \\ \frac{d\gamma_{xz}}{2} & \frac{d\gamma_{yz}}{2} & d\varepsilon_z - d\varepsilon_m \end{bmatrix} = \frac{3}{2} d\lambda \begin{bmatrix} \sigma_x - \sigma_m & \tau_{yx} & \tau_{zx} \\ \tau_{xy} & \sigma_y - \sigma_m & \tau_{zy} \\ \tau_{xz} & \tau_{yz} & \sigma_z - \sigma_m \end{bmatrix} \tag{02}$$

From the volume stability law we have the infinitesimal scalar quantity - (named usually the plasticity modulus) is proportional with rate of infinitely effective plastic deformation on the effective (real) normal stress.

Through the evolution equation with tensor (02) we obtain Levi- Mises plasticity equations for spatial stress state:

$$\begin{aligned} d\varepsilon_x &= d\lambda \left[ \sigma_x - \frac{1}{2}(\sigma_y + \sigma_z) \right] \\ d\varepsilon_y &= d\lambda \left[ \sigma_y - \frac{1}{2}(\sigma_x + \sigma_z) \right] \\ d\varepsilon_z &= d\lambda \left[ \sigma_z - \frac{1}{2}(\sigma_x + \sigma_y) \right] \\ d\gamma_{xy} &= 3d\lambda \cdot \tau_{xy} \\ d\gamma_{yz} &= 3d\lambda \cdot \tau_{yz} \\ d\gamma_{zx} &= 3d\lambda \cdot \tau_{zx} \end{aligned} \tag{03}$$

From these, scalar quantity, this depends of the loading and/or the deforming state; the stresses are proportional with the growth of the pure plastic deformation or of the total deformation; the  $\lambda$  coefficient is the same for all metals and its alloys.

#### 4.EXPERIMENTAL TESTING OF THE PLASTICITY CRITERIA

In practical solving for real problems which appear at the metals working through cold plastic deforming presents distinct interest experimental testing of the plasticity criteria. On the basis of the scientific researches made of Lode, Taylor and Quinney about the stress-strain state for the thin wall tube axial loaded and at the interior hydrostatical pressure, had result an another math form of the energetic plasticity criterion written so:

$$\frac{\sigma_1 - \sigma_3}{\sigma_c} = f(\mu_\sigma) \tag{04}$$

in which

$$\mu_\sigma = \frac{\sigma_2 - \frac{1}{2}(\sigma_1 + \sigma_3)}{\frac{1}{2}(\sigma_1 - \sigma_3)} \tag{05}$$

Figure the dependence (05) will obtain the diagram from Fig.3, on which were represented some experimental data;

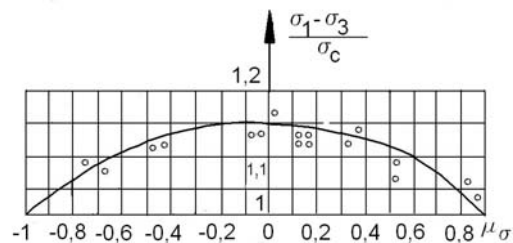


Fig.3.The variation of the size  $\frac{\sigma_1 - \sigma_3}{\sigma_c}$

depending on the  $\mu_\sigma$

results thus that transition of any solid body for the first limit state depends of the normal stress value.

In the case of complex load (tensile and torsion) above a thin wall tube, principal normal stresses remain parallel with the axis of tube, respectively with the radial or tangential direction on wall.

Through the comparison of the plasticity criteria( Tresca, Saint - Venant, respectively



Huber-Hencky-Mises) were performed, Fig.4, analytical and experimental,

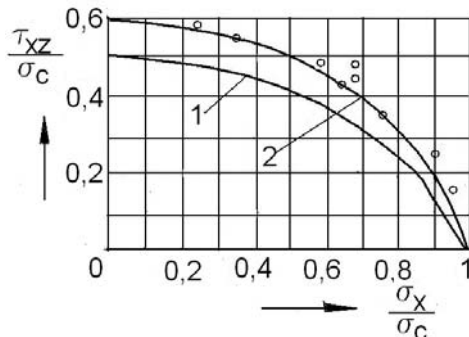


Fig.4. Comparison through the maximum tangential stress criteria (1) and energetic criteria (2)

then were drawing two ellipses of stresses,

$$\left(\frac{\sigma_x}{\sigma_c}\right)^2 + 4\left(\frac{\tau_{xz}}{\sigma_c}\right)^2 = 1 \quad (06)$$

for first criterion and

$$\left(\frac{\sigma_x}{\sigma_c}\right)^2 + 3\left(\frac{\tau_{xz}}{\sigma_c}\right)^2 = 1 \quad (07)$$

for second criterion named above; experimental data validate the energetic plasticity criterion.

For the case of this investigated tube the differences through the both plasticity criteria (maximum tangential stress criterion and changing shape energy criterion) are so much greater but only for the plane deformation state; for the spatial state case these differences are negligible.

## 5. CONCLUSIONS

Known the stress states complexity within the loaded bodies it may obtain a qualitative estimation concerning the deforming behavior of any metallic material.

The experimental tests about plasticity criteria are eloquently shown through the variation of normal stresses ratio related of --- coefficient,

these validate the theoretical results of plasticity energetically criterion.

By the use of plasticity criteria, approximately results are obtained so that for analyze of metals plastic deforming are necessary detailed verifications through experimental way.

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## THE TRACTOR'S CAB STRUCTURE, BEHAVIOR IN ELASTICO- PLASTIC FIELD

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**Abstract:** The paper treats the theoretical results of the numerical simulation about the behavior of the strength structure of tractor cab in an accidental situations from operation. In correspondence with the international standards demands, regarding the tractor driver protection, were made the simulations on the models of structures through finite elements method (FEM).

Were studied some models of spatial structure cab with various fasten modalities: all fixed, semi-fixed or only on the one direction fixed.

The numerical simulation with ANSYS program allowed the establishment of the nonlinear static response of proposed frames (strength structures) and the viewing of the dangerous zones in the case of the most restrictive test - the lateral impact - of the tractor cab.

### 1. INTRODUCTION

As it is known, in many situations from actual reality, elastic limit is exceeded either through the concentrating of stresses (in zones in which are applied the loads, or in the diminished zones around the holes and at the abrupt modifications of section), through additional loadings (eccentric applied loading, eccentric fixing of beams at nodes), or because of in-elastic materials behavior.

#### 1. THE PREMISES OF CALCULUS IN ELASTICO-PLASTIC FIELD

In the last decades, in the world was realized a considerable volume of the special books concerning at the assessment of some calculus methods which to consider the structures behavior in the elastic - plastic field. At the undetermined static structures, for example, the strength structure (frame) of the tractor cab, worked from materials having a long yield plateau, the elastic-plastic calculus is necessary and justified.

Using the effective characteristic curve, Fig.1.a, where  $E_{pl} = (10-15)E_{el}$ , the usually schematizations that of Prandtl type, Fig.1.b, or so near at reality, the schematization from Fig.1.c, with one limited yield plateau followed with strengthening zone.

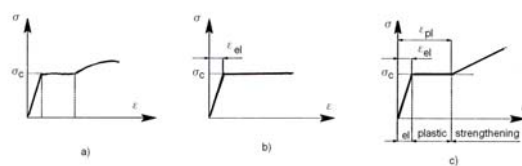


Fig. 1 Real and schematization characteristically curves

#### 2. ASSUMPTIONS AT THE NUMERIC ANALYSE OF STRUCTURE

About the strength of one structure in elastic-plastic field, this reaches the limit point when in the extreme fiber of more loaded section, the stress  $\sigma_{max}$  become equal with  $\sigma_c$  value from Prandtl curve; therefore the touching of the yield limit from extreme fiber

of one section doesn't exhaust the supporting power of this structure, it suggests to know the evolution of the structure behavior, to know the order of plastic joints development at the different increasing values of applied loads. For the structure (frame) made from straight beams (girders) were considered three fasten modalities, models A<sub>1</sub>, A<sub>2</sub> and A<sub>3</sub>, predominant loaded at bending.

Were allowed the assumptions:

- the cab, is one structure (frame) having a great degree of static undetermined, worked from beams with constant section, rigid jointed in nodes;
- the dynamic loading is substitute with an equivalent static loading about the same deformation (changing) energy of the system;
- the external loads acts only at nodes, thus the maximum internal forces appears only at nodes;
- strain- stress characteristic of materials is in type of Prandtl curve, Fig.1.b, or 1.c;
- the proportional loading are considered, the exterior loads increase in the same ratio;
- the limit point of elastic behavior ( $M_i = \sigma_c \cdot W_z$ ) coincides with the forming of the first plastic joint.

The dependence of moment – curvature keep the same schematization (Prandtl), the node suddenly cross into plastic stage, with another words, the joint is punctiform the structure has an elastic behavior in interval from successively forming of two plastic joints.

### 3. NUMERICAL MODELLING, THE DEVELOPMENT OF THE PLASTICAL ZONES

On the base of the metallic structures studies concerning at the tractors cabs were achieved some more common or more complex models of these. For a certain calculus model, under shape of beams spatial structure, were proposed three modalities of gripping (fasten) on the

tractor, then were determined the order of appearance and evolution of the plastic nodes, Fig.2, in which:

- A<sub>1</sub>, calculus model, all structure links with exterior being spatial fixed ends (embedded);
- A<sub>2</sub>, calculus model, spatial fixed ends at the front, while at the back of structure being common embedded only on the Ox axle;
- A<sub>3</sub>, calculus model, all structure links, in front and back through commons fixed ends (on those three axes).

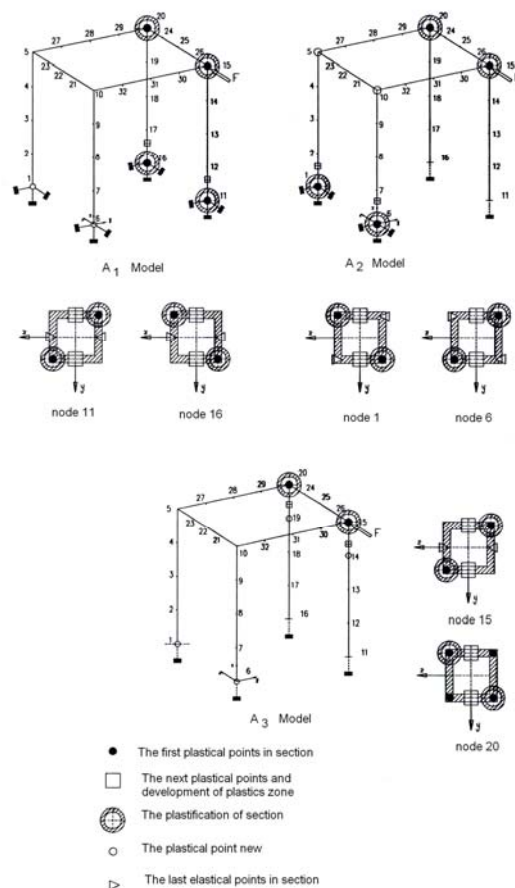


Fig.2. The structure of tractor cab, numerical simulation, elastic -plastic field

In the Fig.2, was drawn the spatial structure, the beams were meshing through nodes, then were shown, the first plastic points in the sections with maximum normal stresses, the evolution of the plastic zone on the section, for the three considered models; in fact was achieved the lateral impact simulation for a tractor cab, the more restrictive test according

with the international standards, through single force  $F$ , with increasing values.

Through processing of the obtained results with ANSYS program were drawn:

- plastic first points in section;
- plastic second points and the evolution of plastic zone;
- plasticizing of section;
- new plastic points;
- lasts elastic points in section.

## 5. CONCLUSIONS

For the tractor cab, from the finite element library of the ANSYS program on the simple spatial structure (frame), with constant section, were realized the influence of the fasten (fixed or semi-fixed) cab on tractor about the appearance and evolution of the plastic zones in the nodes, and in the dangerous sections of this structure.

At the  $A_1$  and  $A_2$  models, with lateral static loading, the simultaneous appearance and evolution of the plastic zones, especially on the embedded gripping (fasten) nodes are observed.

At the same time, for all three models considered, for an asymmetrical load, the plastic evolution has symmetrical character on structure, or on section.

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## ESTABLISHING RELIABILITY OF ANGULAR COUPLINGS USED TO ENABLE TRANSMISSION TO THE ANTITORQUE ROTOR FOR IAR 316B HELICOPTERS

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**Abstract:** Flexible-disks couplings are used in the engineering mechanical transmission torque to the tail rotor. These allow axial, angular, and parallel misalignment, with some torsional compliance but little or no backlash. This paper presents a probability method to design these flexible-disks couplings.

**Key words:** constant mobile coupling, flexible intermediary element, sectional groove disks reliability indicator, overall reliability

### 1. INTRODUCTION

Flexible-disk couplings with flexible intermediary elements are rigid couplings that function as connectors of two shafts and transmitters of the moment of twisting, yet, as they have a constructional form they can take over in relatively small amounts construction and assembling errors that can occur on a quaquaversal, axial, angular direction, or, in less fortunate cases, as a combination of these.

These types of angular couplings (hinge couplings) are used for small angular deviations as they have the advantage of constructional simplicity as well as that of less volume weight. Their constructional features recommend angular couplings with flexible elements to be used in the aeronautical industry.

The transmission of the moment of twisting from the main transmission box of a helicopter, generally formed by two inserted planetary reducers, to the antitorque rotor is carried out by some tubular shafts, propped up by roller bearings and linked to each other by angular couplings with flexible intermediary elements. In the great majority of the analyzed cases the constructional variant of sectional groove disks has been used.

In order to make the connection between semi-couplings, angular couplings with flexible groove disks have a pile of metal, elastic, intermediary disks the cut-out of which depends on the number of bolts on a semi-coupling (Fig.1).

### 2. SUGGESTED METHOD TO ESTIMATE THE RELIABILITY OF ANGULAR COUPLINGS WITH FLEXIBLE ELEMENTS

The first step is to identify loadings that occur [1],[2], that is:

– The crush between bolts and seatings in the pile of sectional elastic disks:

$$\sigma_s = \frac{2M_{tc}}{D_0 z k b d_0} \leq \sigma_{as} \quad (01)$$

– The shear of bolts:

$$\tau_f = \frac{8M_{tc}}{\pi D_0 z d_0^2} \leq \tau_{af} \quad (02)$$

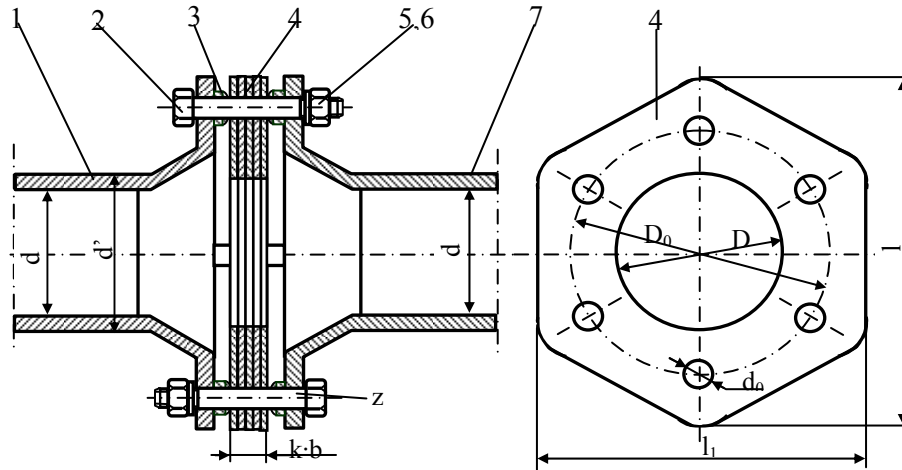


Fig. 1 Angular coupling with elastic, sectional elements  
1,7 – tubular shafts which also function as semi-couplings 2 – bolts 3 –bushing,  
4 – pile of elastic sectional disk, 5 – circlip, 6 – nut

– Bending of the boltss:

$$\sigma_i = \frac{32kbM_{tc}}{\pi D_0 z d_0^3} \leq \sigma_{ai} \quad (03)$$

– Torsion in the active sections of sectional elastic disks:

$$\sigma_t = \frac{4M_{tc}}{D_0 z k b (l_1 - D)} \cos \frac{\pi}{2z} \leq \sigma_{at} \quad (04)$$

When calculating normal and tangential stress, (1...4) there are quantities identified as constant during the run and others considered undifferentiated variables. The constant quantities are:

- z – number of bolts in a coupling;
- k – number of sectional elastic disks

in the pile.

The other quantities within calculations (1...4) can be considered undifferentiated ones.

Supposing that the allotment of dimensions follows a normal law, 99,72% of the value of variables  $D_0, D, b, l_1, d$  is situated within the range of:

$$\Delta_{D_0} = 6\sigma_{D_0} = (m_{D_0} - 3\sigma_{D_0} ; m_{D_0} + 3\sigma_{D_0}) \quad (05)$$

$$\Delta_D = 6\sigma_D = (m_D - 3\sigma_D ; m_D + 3\sigma_D) \quad (06)$$

$$\Delta_{l_1} = 6\sigma_{l_1} = (m_{l_1} - 3\sigma_{l_1} ; m_{l_1} + 3\sigma_{l_1}) \quad (07)$$

$$\Delta_{d_0} = 6\sigma_{d_0} = (m_{d_0} - 3\sigma_{d_0} ; m_{d_0} + 3\sigma_{d_0}) \quad (08)$$

$$\Delta_d = 6\sigma_d = (m_d - 3\sigma_d ; m_d + 3\sigma_d) \quad (09)$$

in which :  $m_{D_0}, m_D, m_{l_1}, m_{d_0}, m_d$  represent the average,  $\sigma_{D_0}, \sigma_D, \sigma_{l_1}, \sigma_{d_0}, \sigma_d$  standard deviations of undifferentiated variables  $D_0, D, b, l_1$  and  $d$ .

Average values for the tensions caused by the four types of stress are [7]:

– for the crushing stress:

$$m_{\sigma_s} = \frac{2m_{M_{tc}}}{zkm_{D_0}m_b} \quad (10)$$

– for the shearing stress:

$$m_{\tau_f} = \frac{8m_{M_{tc}}}{z\pi m_{D_0} m_{d_0}^2} \quad (11)$$

– for the bending stress:

$$m_{\sigma_i} = \frac{32km_b m_{M_{tc}}}{z\pi m_{D_0} m_{d_0}^3} \quad (12)$$

– for the torsion stress:

$$m_{\sigma_t} = \frac{4m_{M_{tc}}}{zkm_{D_0} m_b (m_{l_1} - m_D)} \cos \frac{\pi}{2z} \quad (13)$$

Standard deviations of tensions are calculated by particularizing the expression:

$$\sigma_Z = \sqrt{\sum_{i=1}^n \left( \frac{\partial Z}{\partial X_i} \right)^2 \sigma_{X_i}^2} \quad (14)$$

where:  $Z$  – is an undifferentiated variable function on  $n$  undifferentiated, independent variables;

$\sigma_{X_i}$  – the standard deviation of undifferentiated variable  $X_i$ .

Standard deviations for the analyzed case are given by the ratio [7]:

$$\sigma_{\sigma_s} = \sqrt{\left( \frac{\partial \sigma_s}{\partial M_{tc}} \right)^2 \sigma_{M_{tc}}^2 + \left( \frac{\partial \sigma_s}{\partial D_0} \right)^2 \sigma_{D_0}^2 + \sqrt{\left( \frac{\partial \sigma_s}{\partial b} \right)^2 \sigma_b^2 + \left( \frac{\partial \sigma_s}{\partial d_0} \right)^2 \sigma_{d_0}^2}} \quad (15)$$

$$\sigma_{\tau_f} = \sqrt{\left( \frac{\partial \tau_f}{\partial M_{tc}} \right)^2 \sigma_{M_{tc}}^2 + \sqrt{\left( \frac{\partial \tau_f}{\partial D_0} \right)^2 \sigma_{D_0}^2 + \left( \frac{\partial \tau_f}{\partial d_0} \right)^2 \sigma_{d_0}^2}} \quad (16)$$

$$\sigma_{\sigma_i} = \sqrt{\left( \frac{\partial \sigma_i}{\partial M_{tc}} \right)^2 \sigma_{M_{tc}}^2 + \left( \frac{\partial \sigma_i}{\partial D_0} \right)^2 \sigma_{D_0}^2 + \sqrt{\left( \frac{\partial \sigma_i}{\partial b} \right)^2 \sigma_b^2 + \left( \frac{\partial \sigma_i}{\partial d_0} \right)^2 \sigma_{d_0}^2}} \quad (17)$$

$$\sigma_{\sigma_t} = \sqrt{\left( \frac{\partial \sigma_t}{\partial M_{tc}} \right)^2 \sigma_{M_{tc}}^2 + \left( \frac{\partial \sigma_t}{\partial D_0} \right)^2 \sigma_{D_0}^2 + \sqrt{\left( \frac{\partial \sigma_t}{\partial b} \right)^2 \sigma_b^2 + \left( \frac{\partial \sigma_t}{\partial l_1} \right)^2 \sigma_{l_1}^2 + \left( \frac{\partial \sigma_t}{\partial D} \right)^2 \sigma_D^2}} \quad (18)$$

In ratios (11...18) all component terms have known values allowing their tensions, which appear in the component elements of the analyzed coupling, to be defined as undifferentiated variables:

$$\begin{aligned} & (m_{\sigma_s}, \sigma_{\sigma_s}) ; (m_{\tau_f}, \sigma_{\tau_f}) ; \\ & (m_{\sigma_i}, \sigma_{\sigma_i}) ; (m_{\sigma_t}, \sigma_{\sigma_t}) \end{aligned} \quad (19)$$

Since admissible tensions for the above mentioned stresses can be considered undifferentiated variables as well by the form:

$$\begin{aligned} & (m_{\sigma_{as}}, \sigma_{\sigma_{as}}) ; (m_{\tau_{af}}, \sigma_{\tau_{af}}) ; \\ & (m_{\sigma_{ai}}, \sigma_{\sigma_{ai}}) ; (m_{\sigma_{at}}, \sigma_{\sigma_{at}}) \end{aligned} \quad (20)$$

the reliability of the sectional groove disk coupling can be determined based on the stress, in the following way [7]:

– for the crushing stress:

$$R_s(t) = \frac{1}{\sigma_{y_s} \sqrt{2\pi}} \int_0^\infty e^{-\frac{(y_s - m_{y_s})^2}{2\sigma_{y_s}^2}} dy_s \quad (21)$$

– for the shearing stress:

$$R_f(t) = \frac{1}{\sigma_{y_f} \sqrt{2\pi}} \int_0^\infty e^{-\frac{(y_f - m_{y_f})^2}{2\sigma_{y_f}^2}} dy_f \quad (22)$$

– for the bending stress:

$$R_i(t) = \frac{1}{\sigma_{y_i} \sqrt{2\pi}} \int_0^\infty e^{-\frac{(y_i - m_{y_i})^2}{2\sigma_{y_i}^2}} dy_i \quad (23)$$

– for the torsion stress:

$$R_t(t) = \frac{1}{\sigma_{y_t} \sqrt{2\pi}} \int_0^\infty e^{-\frac{(y_t - m_{y_t})^2}{2\sigma_{y_t}^2}} dy_t \quad (24)$$

Admissible tensions for these stresses can reach the following values [2], [3]:

– admissible tension for the crush between disks and boltss:

$$\sigma_{as} = (0,30 \dots 0,40) \sigma_{02} \quad (25)$$

– admissible tension for the shearing of the boltss:

$$\tau_{af} = (0,40 \dots 0,45) \sigma_{02} \quad (26)$$

– admissible tension for the bending of the boltss:

$$\sigma_{ai} = (0,45 \dots 0,55) \sigma_{02} \quad (27)$$

– admissible tension for the torsion of the material used for the flexible disks:

$$\sigma_{at} = (0,45 \dots 0,55)\sigma_{02} \quad (28)$$

Randoms variables:

$$\begin{aligned} Y_s &= \sigma_{as} - \sigma_s, & Y_f &= \tau_{af} - \tau_f, \\ Y_s &= \sigma_{ai} - \sigma_i, & Y_s &= \sigma_{at} - \sigma_t \end{aligned} \quad (29)$$

Are also normal randoms variables their means values resulting form the ratio:

$$\begin{aligned} \bar{z}_{y_s} &= m_{\sigma_s} - m_{\sigma_{as}}; & \bar{z}_{y_f} &= m_{\tau_f} - m_{\tau_{af}}; \\ \bar{z}_{y_i} &= m_{\sigma_i} - m_{\sigma_{ai}}; & \bar{z}_{y_t} &= m_{\sigma_t} - m_{\sigma_{at}} \end{aligned} \quad (30)$$

The functional reliability of the angular couplings with flexible elements is determined by the ratio:

$$R = R_s \cdot R_f \cdot R_i \cdot R_t \quad (31)$$

in which:  $R_s$  represents reliability due to the crushing stress,  $R_f$ - reliability due to the shearing stress,  $R_i$ - reliability due to the bending stress,  $R_t$ - reliability due to the torsion stress.

### 3. CONCLUSION

The classical designing of based on the safety factor is widely used due to its maximum reliability, yet, with an excessive use of material because of the overdimensioning. When analysing the reliability of a constructional solution, the conclusion has to be drawn that an optimum safety in operation can be obtained from the

point of view of materials, production and time. The elements that should be considered are those connected to the statistical probability of admissible and effective tensions as well as factors influencing them.

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## APPLICATIONS OF SHAPE MEMORY MATERIALS

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**Abstract:** *The shape memory materials possess attractive characteristics as sensing and actuation elements. In the first part of the paper there are described the smart or intelligent materials and shape memory alloys, shape memory polymers, magnetic shape memory materials and their operating principle is emphasized. They are capable of transforming thermal, electrical or magnetic energy into mechanical work, thus their most familiar applications are as actuators. Some details concerning the design of electrical actuators based on shape memory alloy are given and some projects developed by the authors' research team are largely described.*

**Key words:** *shape memory, alloy, actuator*

### 1. INTRODUCTION

The today high performance systems include elements made of so-called *intelligent* or *smart* materials that are capable of sensing changes in their state or in their environment and responding to these changes, bringing them closer to biological systems [1].

In accordance with [2,3,4,5], the *piezoelectric* materials (e.g. lead-zirconate-titanate ceramic – PZT, that has the largest longitudinal piezoelectric coefficient) due to the inverse piezoelectric effect, when are placed in an alternative electric field, a tensile mechanical stress is induced that elongates and contracts the material. Closely analogous to piezoelectric behaviour is the *magnetostrictive* one: the material exhibits mechanical strain when subjected to a magnetic field. Magnetostrictive alloys (e.g. terbium-dysprosium-iron - Terfenol-D) are recommended for precise movements in the nanometre range and very high reaction speeds. *Electrostrictive* materials that exhibit a large shape-changing strain proportional with the applied electric field (e.g. lead-magnesium-niobate ceramic – PMN) and *photostrictive* materials (lead-lanthanum-zirconium-titanium ceramic - PLZT) are also used in the structure of the smart systems. *Electrorheological*

liquids change their viscosity under the influence of an electric field and switch from a liquid to a plastic state within a few milliseconds. In the presence of a magnetic field, *magnetorheological* fluids change from a fluid state to semi-solid state that is directly proportional to the magnetic field applied. Interest in above-mentioned controllable fluids is given by their ability to provide simple, rapid-response interfaces between electronic controls and mechanical systems. *Hydrogen absorbing alloys* are capable of storing as much hydrogen gas as approximately 2000 times their own volume. By heating the alloy hydrogen is desorbed, whereas by cooling it, hydrogen is absorbed (thus is possible to utilize the energy of hydrogen gas pressure by manipulating heat). The characteristic of the *electroactive polymers* is their operational similarity to biological muscles, particularly their large actuation strains: application of electric field makes them contract or expand. The *auxetic materials* increase in cross-section when they are stretched because of their negative Poisson ratio. Although they are not commercialized, *self-repairing polymers* and *bioactive sol-gel glass* (that can absorb and release proteins in response to changes in temperature and pH) have been developed.

Among other advanced functional materials, there are the *shape memory materials* (SMM) which possess attractive characteristics as sensing/actuation elements.

## 2. SHAPE MEMORY MATERIALS

The shape memory capability of a material is its ability to trigger a predefined shape change by exposure to an external stimulus. Usually, the shape memory applications can be divided into four categories: *free recovery* (includes applications in which the sole function of SMM element is to cause motion or strain); *constrained recovery* (includes applications in which the SMM element is prevented from changing shape and generates a stress); *superelastic* or *pseudoelastic* applications are isothermal and involve the storage of potential energy and *actuator* are those applications in which there is motion against a stress and thus work is being done, [6]. All applications are performed by different SMM: shape memory alloys, shape memory polymers, magnetic shape memory materials, composite materials.

**Shape Memory Alloys (SMAs)** The thermal shape memory effect is the property of some metallic materials and alloys of recovering their previous shape or size when subjected to a heating procedure. The shape memory alloys can be plastically deformed at low temperature and upon exposure to higher temperature, return to the shape prior to the deformation. The basis of this effect is that the materials can easily transform to and from martensite. When cooled below the transformation temperature, the SMA material transforms to its martensitic phase, enabling easy deformation, while when reheated above the transformation temperature, it will resume its memorized austenitic shape. This process is fully reversible. NiTi alloy, invented in the late of 1960s, is most suitable shape memory alloy for applications requiring controllability, high work per unit volume, high number of cycles, biocompatibility and low current for activation. The generic name for the family of NiTi alloys is *NITINOL*. They contain an almost equal mixture of nickel and titanium. Current Cu-based SMAs are derived from

three binary alloy systems: Cu-Zn, Cu-Al and Cu-Sn, [6]. Cu-Sn alloys suffer from a rapid degradation of shape memory properties during aging at even moderate temperatures and their martensitic deformation is not ideally thermoelastic. Cu-Zn-base alloys containing Al, Si, Sn, Ga or Mn and Cu-Al-base alloys with alloying elements Ni, Be, Zn or Mn have been explored for their shape memory properties. The studies have been extended to quaternary alloys as Cu-Zn-Al-Ni, Cu-Zn-Al-Mn and Cu-Al-Ni-Mn. The commercial Cu-based SMAs contain additives such as B, Co, Fe, Ti and Zr.

One drawback for shape memory alloys is that the maximum deformation they can undergo is only about 8%. They are much more expensive than polymers.

**Shape Memory Polymers (SMPs)** There are some polymers whose qualities have been altered to give them dynamic shape memory properties. Using thermal stimuli, shape memory polymers can exhibit a radical change from a rigid polymer to a very elastic state, and then back to a rigid state again. In its elastic state, it will recover its memorized shape. While pliable it can be stretched, folded or conformed to other shapes, tolerating up to 200% elongation, [7]. Some of SMPs are biocompatible or biodegradable. Thermally, light- and magnetically induced SMPs were developed for biomedical applications, [8].

**Magnetic Shape Memory Alloys** There is another type of shape memory alloys that exhibit large changes in shape and size in an applied magnetic field, called ferromagnetic shape memory alloys (FSMAs). The magnetic response is faster and more efficient than temperature - induced responses. The magnetic field moves microscopic parts of the material (twins) that leads to a net shape change. The magnetic memory effect allows 50 times greater strains than in magnetostrictive materials. Ni-Mn-Ga is currently the best and the most well-known FSMA, [9]. Other magnetic shape memory materials are: Co-Mn-Ga, Fe-Pt, Co-Ni and Fe-Ni-Co-Ga.

The SMM have already gained an important position in following fields [10,11]: coupling and fasteners, actuators, adaptive materials and hybrid composites, fashion,

decoration and gadgets, smart clothes, automotive applications, aeronautic industry, fire protection, air conditioners, robotics, orthopaedics implants, orthodontics, endoscopic instrumentation, stents, catheters, sutures, etc.

### 3. ACTUATORS BASED ON SMAs

The most familiar applications of SMM are as actuators. The advantages of these actuators are: small size, light weight, high power to weight ratio, smooth and silent operation, long life, precise controllability. The slow response on cooling, the restricted energy efficiency and nonlinear properties are their drawbacks.

The actuators based on shape memory alloys are generally of two types: thermal and electrical. The first ones are driven by changes in ambient temperature. Electrical actuators are actuated via direct current. Designing these actuators is an interdisciplinary approach covering the design of components (Fig. 1).

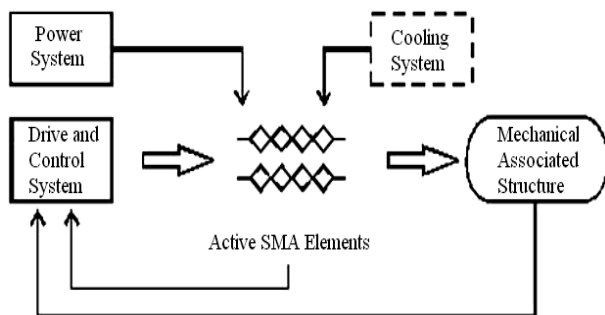


Fig. 1 The structure of SMA actuators

The power system provides energy to heat the active elements and to operate the control and drive circuitry. The control systems provides “on” and “off” control to operate the active elements. Control circuits can range from simple to complex (manual control circuits, open-loop control circuits which automatically cycle on and off or activate the SMM elements and closed-loop circuits which use a sensor to regulate the action of the actuator). The driver system limits the power to the active elements and protects them from damage due to overheating. The driver circuits may be passive circuits (limiting the current

with a fixed resistor), active current regulators (providing a constant current for any length of the active element) and PWM circuits (which rapidly turn the current flow to regulate the power through the active elements). The active elements provide the action. Selection of a suitable alloy is a function of transformation temperature, size of memory effect, hysteresis, and number of cycles.

The mechanical associated structure supports the active elements, permitting to act in the desired manner and protects them from overstretching, sharp bends. For the SMA components equipped with one – way shape memory effect, the actuators mechanisms ensure the force that opposes the contraction force (named relaxation force).

### 4. THE DEVELOPED APPLICATIONS WITH SMAs

Within our research group, the activity in the field of SMA actuators was conducted in last ten years. Following, some projects will be described, according with [12, 13, 14].

The active elements of the miniature grippers in Fig. 2 are SMA wires. When heated over the phase transformation temperature, the wires will contract with an amount of 3-5% of the length. One end of the wire is fixed on the mobile finger. For example presented in Fig. 2a, the closing of the mobile finger is active; the opening is assured by the elastic force of lamellar spring, which represents the rotational elastic (compliant) joints. The same force assures the *relaxation* of wires (wires is stretched in the cooling phase). For the solution presented in Fig. 2b, the closing of the mobile finger is passive assured by the lamellar spring and the shape memory alloy makes the opening. In Fig. 2c there is presented a mini gripper with two mobile fingers. Depending on the geometry of the manipulated objects, the fingertips may have different profiles.

Considering the geometrical characteristics of the elastic joints, we determined: the range of the movement, the minimum size of the manipulated object, and the amount of the force needed for the relaxation of the wire.

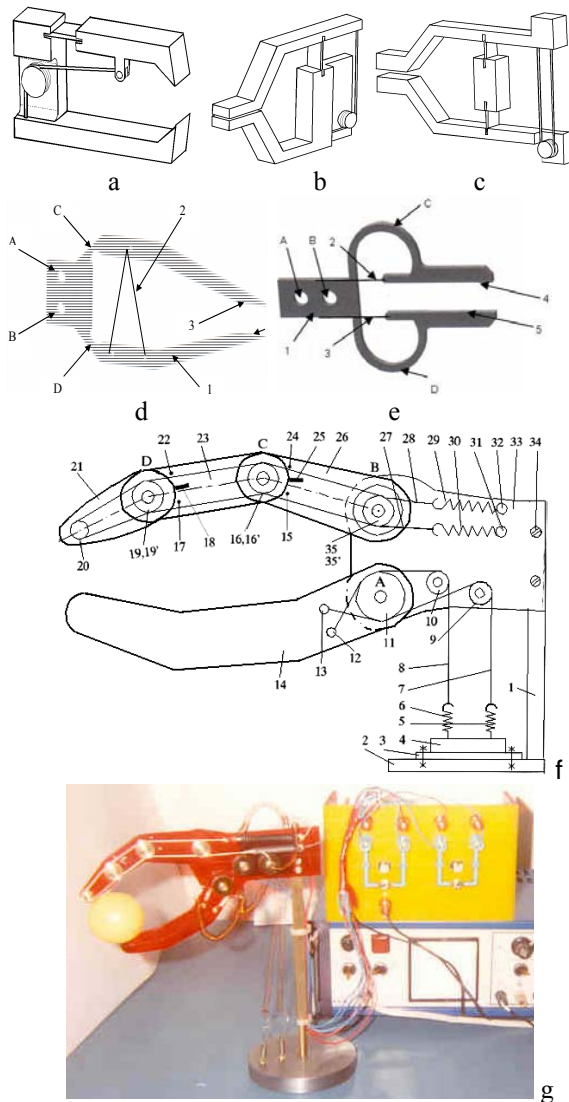


Fig. 2 Gripping devices actuated by SMA wires

The overall dimensions of the prototype given in Fig. 2d are 40mm x 20mm, the maximum opening of the finger tips is 5 mm and the thickness is 1mm. We note: A, B – holes for fixing, C, D – elastic joints; 1 – lower finger, 2 – SMA wire for actuating, 3, 4 – the gripping surfaces in contact with the grasped objects. By heating the wire, it contracts and both fingers are simultaneously actuated (the fingers move to each other due to the elasticity of joints D and C). For an experimental study, three micro grippers as in Fig. 2e, having different overall dimensions (20mm x 30mm, 10mm x 15mm, 10mm x 12mm) were designed. The maximum dimensions of the grasped objects are 4mm, 3mm, respectively 2mm. Designing the mechanical structure of mini and micro grippers based on compliant

mechanisms, several advantages are considered: compact and monolithic construction, reduced wear and no need for lubrication, possibility of miniaturization.

In figures 2f and 2g is presented a prototype of a two-finger anthropomorphic robotic hand. Each finger has one degree of freedom. An actuator based on shape memory alloy drives the finger corresponding to the index with two-antagonist helical spring active element, through tendon cables. Three parallel axis joints provide flexion-extension of the phalanx. The finger corresponding to the thumb is actuated via an actuator based on shape memory wires.

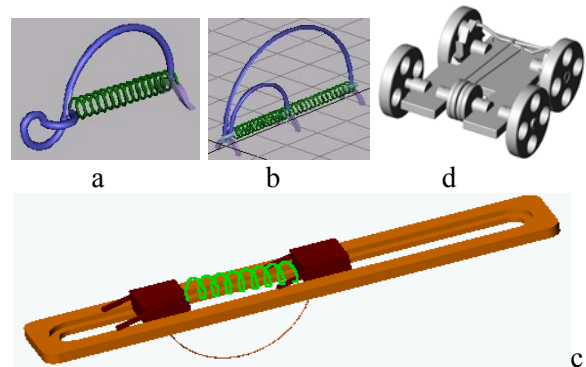


Fig. 3 Mobile mini robots based on SMAA

Next examples belong to mobile mini robots. Our first work consists in modeling very simple insect-like inchworm structures (Fig. 3a, b). The developed inchworm minirobot (Fig. 3c) needs a special guide surface which can be configured according to the desired trajectory. As actuator, it uses a SMA wire (length: 70 mm, diameter: 0.25 mm) educated as a semicircle with 20 mm radius. The active element recovers this defined shape when subjected to a heating procedure, so the shape memory effect determines the extension of the actuator. The restoring or relaxation force which contracts the SMA semicircle at low temperature is assured by a helical spring. The leaning legs are placed at the both ends of the active element. The transformation temperature is 78°C and is obtained through the Joule effect (recommended current is 1A). The heating duration is 0.1 sec. and the free cooling duration to relax the element is 5.5 sec.

Considering the length of one step is 25 mm, results an average speed 4.4 mm/sec. The weight of the locomotion system is about 0.5 grams. The mobile platform (Fig. 3d) is actuated by two shape memory wires. Each wire actuates a pawl, elastically connected with the frame. The pawl acts on a ratchet that is glued with the wheel. A pulley ensures the necessary wire length. By successive actuation of the wire, a trajectory could be followed.

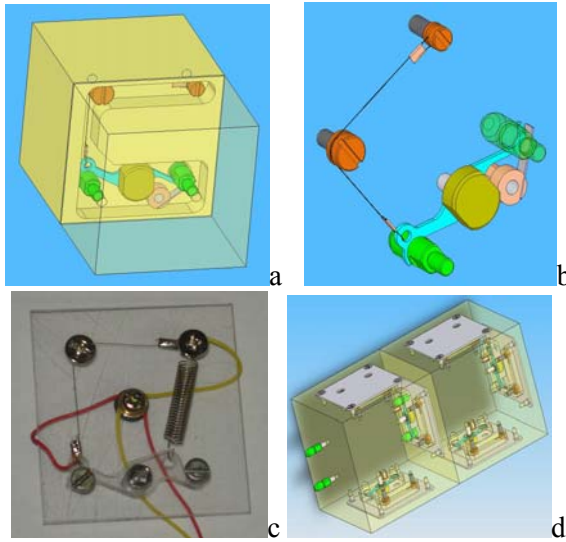


Fig. 4 Connection mechanisms for modular reconfigurable robotic systems

A *self-reconfigurable modular robotic system* is composed of identical modules. Its reconfiguration ability implies that the modules contain *connection mechanisms*. In Fig. 4 the geometrical model and the prototype of the authors' connection mechanism is presented. The male component placed on one face of a cubic module consists of two special shaped docking pins. The female connector, placed on one face of the second cubic module consists of two holes for accepting other module's docking pins. The female connector has a locking / releasing mechanism behind the holes. In the non-active state, it can accept and lock the incoming pins through an intermediary oscillatory element. In the activated state, it can release the lock due to the action of an actuator based on a shape memory wire. One end of the wire is fixed and another one is connected with the mobile locking element. When a current pass the wire, it is heating and pulls the oscillatory element disengaging the modules. A wire made of Ni-

Ti alloy called *FLEXINOL* was considered in our design. Its diameter is 150  $\mu\text{m}$ . The recommended current to heat the wire (up to the transformation temperature 70°C) in half of a second is 180 mA. The recovery force developed on heating is 3.23N. The recommended shape memory effect of 4% was taken into account to determine the necessary length of the wire (50mm, meaning 2mm contraction on heating—enough to disengage the mechanism).

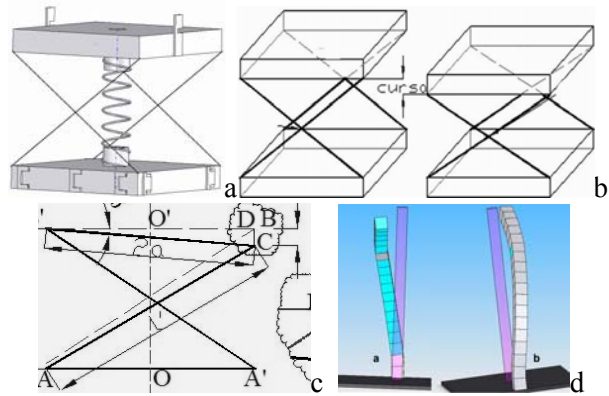


Fig. 5 Multi-actuator artificial muscle based on SMA

In a multi-actuator artificial muscle, the elementary actuator works on axial contraction – extension, thus the system can contract or bend. The active elements are four shape memory alloy wires (Fig. 5a). Both ends of the wires are fixed: one on the base of the actuation unit, and other on the mobile platform (connected with the next actuator), so the shape memory effect is used for the contraction of the elementary actuator. For dimensions of the base and mobile platform (35x35x5) mm<sup>3</sup>, and height of the elementary actuator 25mm, results the length of the shape memory wires 43 mm. Taking into account a shape memory effect of 4%, the shortening of the wires is 1.72 mm, and thus the contraction of the elementary actuation unit is 3.1 mm (Fig. 5b). If only one side two SMA wires are resistively heated, the upper platform is leaned like in Fig. 5c. According to the above mentioned dimensions, the leaning of the actuation unit is around 5°. In figures 5d, a system composed of 18 actuation units, able to avoid an obstacle, is modeled.

One of our objectives is to develop a family of linear SMAA, designed in several

dimensions, in a compact design. These actuators are designed as piston-like or translational stage linear actuators (Fig. 6a, b). They are conceived in few typo dimensions, as a family of actuators with different values of input / output parameters.

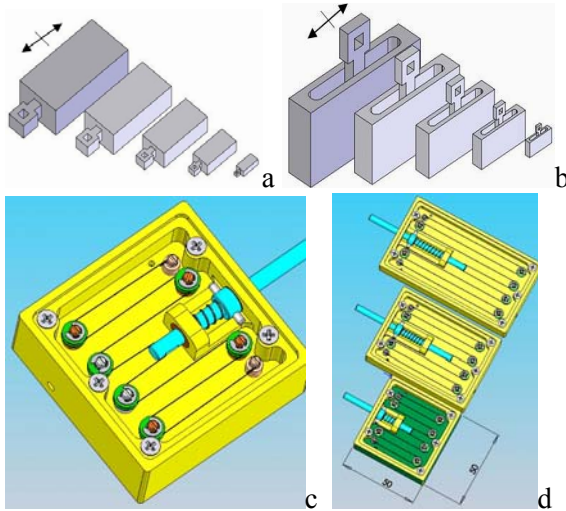


Fig. 6. Family of linear SMA actuators

The operation principle of the proposed linear actuator is illustrated in figure 6c: a pulley system fits the wire into the hull. A bias spring is provided to preload the wire and to elongate the wire after the shape memory contraction. Both ends of the wire are connected to the housing. Heating resistively the wire, it contracts and acts toward the output element pulling it.

## 5. CONCLUSIONS

The SMA actuators represent an alternative to the existing actuation principles. They have a higher power to weight ratio combined with a compact structure. Changing some constructive dimensions and some parameters specific to the SMA elements, it is possible to obtain different output parameters (stroke and force) and thus a family of actuators in different typo-dimensions can be developed. Our future developments will concentrate on the improvement of the actuating and control system as well as on the integration of the required sensors on the developed systems.

**Acknowledgements** This work is supported by PNII - IDEI Project, ID 1076: *Development*

*of a modular family of linear and rotary actuators based on shape memory alloys.*

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## MULTILAYERED STRUCTURES ZIRCONIA BASE IN AEROSPATIAL FIELD

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### **Abstract**

*In the case of aviation turbine, the gas temperature increases at 1500<sup>0</sup>C÷1600<sup>0</sup>C.*

*The TBC layers remain the most efficient thermal insulation and the development focused on partial stabilized zirconia 7-8 YZS.*

*The HVOF, HVOF (bonding layer) and APS (multilayered ceramics) techniques are utilized to obtain TBC structures.*

*The behavior evaluation in extreme thermal conditions of the elaborated nanostructures layers was performed on a quick thermal test shock installation (heating/cooling speed till 100<sup>0</sup>C/sec.) conceived before papers.*

*SEM, TEM investigations evidence the effect of the thermal load on the structural modification dynamics induced in the elaborated multilayered protection.*

**Keywords:** *multilayered structures, quick thermal shock, zirconia.*

### **1. INTRODUCTION**

For the combustion chambers, turbine and turbo reactive engines, the utilization of protection systems are imperative due to a very hard service. It is quoted that in about one hour in the combustion chamber of a turbine can be burn 318.000 kg of air and 6800 kg of fuel and the exhausting gas can reach temperatures over 1900°C.

### **2. MATERIALS AND OBTAINING METHOD**

#### **Materials**

The materials utilized for the burning chambers are choose taking into account the heating temperature of parts during the turbo engine working. In the burning chamber the compressed air is mixed with the fuel, producing by burning the gas temperature higher than 1600°C. Due to the residual air flow at the contact with the burning chamber

wall, the low temperature can reach maximum values between 1000-1300°C.

TBC layer types achieved:

1. **Duplex layers - MeCrAlY/ZrO<sub>2</sub> •20%Y<sub>2</sub>O<sub>3</sub>** - with higher potential at thermal test shock versus those stabilized only with 8%Y<sub>2</sub>O<sub>3</sub> or CaO, MgO from the classical class.

2. **Triplex FGM type** – functionally graded materials- utilizing an intermediate layer ZrO<sub>2</sub> MgO between NiCoCrAlY bonding layer and ceramic layer, with a mediate chemical composition (magnesium, composite from mixed power from zirconium, nickel, chromium, aluminum) in order to decrease the effect of the thermal expansion coefficients difference of the two materials and of the induced stresses during the thermal shock. The experimental solution could induce also a higher structural homogeneity against the duplex layers.

3. **Triplex layers type:**

**MeCrAlY/MeCrAlY90% +  $Al_2O_3$  10%/ZrO<sub>2</sub>•Y<sub>2</sub>O<sub>3</sub>** – having as objective the increasing of thermal fatigue resistance. As result of some laboratory researches performed at Lewis Research Center, Cleveland Ohio was demonstrated that an improved bonding layer by metallic layers incorporation, ceramics or cermets the thermal fatigue resistance of TBC layers deposited by plasma jet is increasing by a factor, two or many. In this system, the second layer of the bond coat incorporates a fine dispersion of the second phase particle (in our case alumina) in a MeCrAlY matrix.

4. **NiCoCrAlY/  $Al_2O_3$  /ZrO<sub>2</sub>Y<sub>2</sub>O<sub>3</sub>** – increase the resistance at thermal shock. The intermediate layer works as a thermal barrier and can reduce significant the expansion of the oxidation.

5. **NiCoCrAlY/  $Al_2O_3$  +ZrO<sub>2</sub>Y<sub>2</sub>O<sub>3</sub>/ ZrO<sub>2</sub>Y<sub>2</sub>O<sub>3</sub>** – by incorporating some  $Al_2O_3$  particles in ceramic matrix of an intermediate layer the mechanical properties are increasing, the hardness layer increase with about 40%, residual stress are decreasing and the oxygen penetration is stopped.

6. **NiCoCrAlY/ZrO<sub>2</sub>Y<sub>2</sub>O<sub>3</sub> nano** – nanometer ceramic layer deposit, increases the protection system performance by considerable increase of mechanical and physical properties.

7. **Duplex NiCoCrAlY/ZrO<sub>2</sub>Y<sub>2</sub>O<sub>3</sub> CeO<sub>2</sub>, NiCoCrAlY/ZrO<sub>2</sub>Y<sub>2</sub>O<sub>3</sub> TiO<sub>2</sub> types layers** – resistant at thermal shock and high temperatures.

The wears factors associated to the “hot parts” of turbo engines:

- Temperatures >1000°C;
- Quick thermal shock
- Erosion with pyrolitic particles over 3 Mach speed
- Hot corrosion
- Slipping friction.

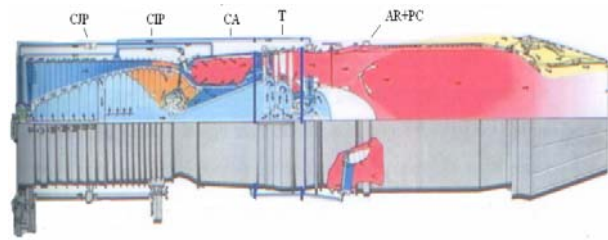


Fig. 1 Thermal champ in an turbo engine: CJP – low pressure compressor; CIP – high pressure compressor; CA – burning chamber; T- turbine; Ar+PC – reaction nozzle and post combustion chamber

**Obtaining method**

The utilized method for protection layer deposit was plasma jet spraying metallization. This process is efficient and economic to obtain some layers with superior properties. The structural bonding between ceramic layer and metallic support, in plasma jet deposit, permit the obtaining of some adherent deposits, with dense and flat structure and thick between 0,2mm ÷ 3mm, depending on the application.

General parameters of the plasma jet spraying metallization are:

- Plasma temperature : 16.000°C;
- Jet temperature jet: 3000°C;
- Jet speed : 600-800 m/s;
- Power agents: H<sub>2</sub>, O<sub>2</sub>, Ar
- Layers thickness: 0.2 ÷ 3mm.



Fig. 2 Samples realization - APS technique



### 3. TESTS AND INVESTIGATIONS

#### Quick thermal shock tests

Main parameters of the QTS installation are:

- Test temperature-till 1500<sup>0</sup>C (on specimen) and 1700<sup>0</sup> C (in furnace);
- Specimen heating and cooling speed - max 100° C/sec;
- Manual and automatic functional cycles,
- Function parameters monitoring;
- Quick and continues measuring of specimen temperature.



Fig. 3 Quick thermal test shock installation QTS

#### SEM (scanning electronic microscopy) investigations

Electronic microscopy investigations evidence the morphostructure modifications of the protection layers. In fig. 4 and 5 are presented SEM images of the nanostructured ceramic protection layers ZrO<sub>2</sub>Y<sub>2</sub>O<sub>3</sub> types after deposit and after thermal cycling. In the micrographics presented is evidenced a morphostructure homogeneity. An agglomeration of semi melted particles agglomerations in layer can be noticed both after deposit and after cycling. In fig. 4 is evidenced very well the porosity of the layer before and after cycling.

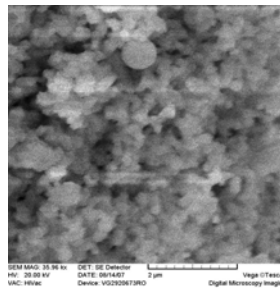


Fig. 4 SEM image - compact layer with superficial cracks and with semi melted particles zone; without thermal shock

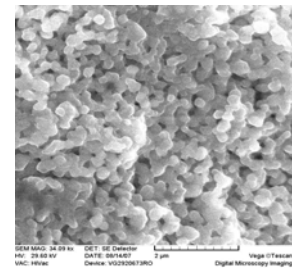


Fig. 5 SEM image - ZrO<sub>2</sub>Y<sub>2</sub>O<sub>3</sub> particle semi melted agglomerate; thermal shock at 1000<sup>0</sup>C

#### TEM investigations-transmission electronic microscopy

Sample preparation was made by FIB- FEI (FIB – Focused Ion Beam), and the microscopic investigations with TEM EM300-UT, FEI microscope. In the presented images is evidenced that the connection between the ceramic layer / bonding layer is quite well. In the 7 image can be observed ceramic zones materials (white areas) and metallic substrate zones (dark areas).

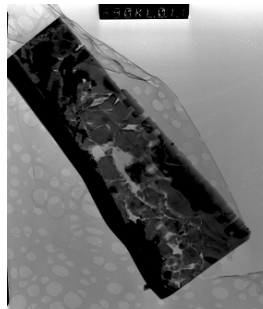


Fig. 6 TEM image NiCrAlY/ZrO<sub>2</sub>Y<sub>2</sub>O<sub>3</sub> nanostructure layer

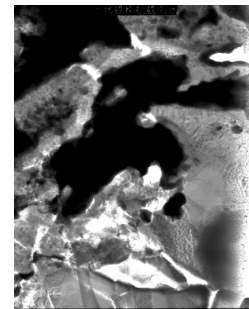


Fig. 7 TEM image of NiCrAlY/ZrO<sub>2</sub>Y<sub>2</sub>O<sub>3</sub> - interface of the bonding layer and nanostructure ceramic layer

#### Real parts

The obtaining solutions are concretized by deposit of selected coatings on two hot parts of turbo engines – burning chamber and diffuser (fig. 8, fig. 9).

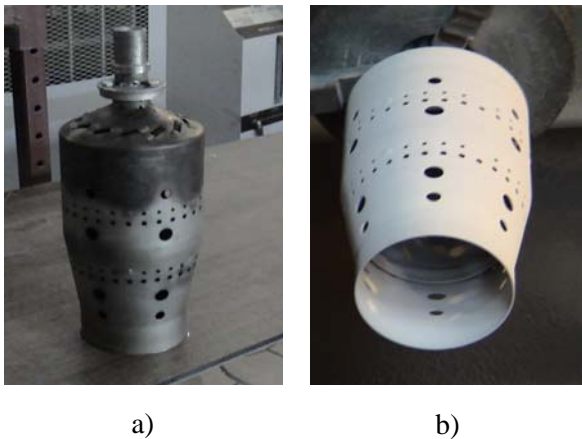


Fig. 8 Burning chamber a) before deposit b) after deposit

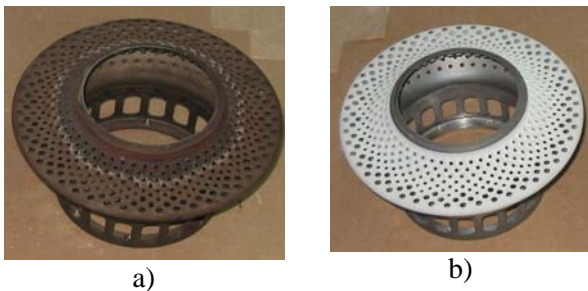


Fig. 9 Diffuser a) before deposit b) after deposit

## 5. CONCLUSIONS

- The wears factors associated to the “hot parts “of the turbo engines acts complex, hard and simultaneously.
- Within the experimental stage were elaborated by plasma jet metallization 7 types of multilayered structures, TBC (thermal barrier coatings), FGM (functionally graded materials) and for the first time, nanostructure zirconia based.
- For testing in extreme conditions of the elaborated materials was conceived and achieved a quick testing shock installation. The installation and testing method elaborated by INCAS are included in the JRA activities of the FP7 contract proposal for infrastructure, elaborated together with researches institutes and universities in the field of the aerospace in Europe – CIRA –

Italy, DLR - Germany, CRMHT - France, ARC - Austria, IABG – Germany.

- Following to the investigations and specific tests were selected multilayered protection solutions to be applied on real parts- type nimonic support with NiCoCrAlY bond layer, successive ceramic layers with compositional gradient.
- SEM and TEM investigations evidence the thermal shock effect induced on the structural modifications dynamic as well as on the relamination mechanism by forming of a micronic layer from complexes oxides (thermally grown oxide);
- The project is finalized by elaboration of two solutions of ceramics multilayered protection and the technological parameters associated to the achievement of two vital parts of the turbo engines.

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# SOME ASPECTS REGARDING THE SELF GENERATED TORQUE WITHIN THE 4WD DRIVETRAIN

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**Abstract:** This work is dealing with the self-generated torque that occurs within a 4WD military special automotive drivetrain. The mathematical model stated in this paper is confirmed by the means of multiple tests developed in real conditions. The tests were developed in order to reveal both transversal and longitudinal self-generated torque within the drivetrain, on different road surfaces.

**Keywords:** 4WD transmission, self-locking differential, viscous coupling, self-generated torque

## 1. INTRODUCTION

The all-wheel driven transmission yet has a big problem: the self generated torque that occurs inside the driveline. The only way to override the wind-up torque, occurred inside of a normal drivetrain, is to increase the power delivered by the engine. On the other hand, this power loss can't be used as a traction power for the automotive. Hence, it leads to extra fuel consumption, supplementary wear of the drivetrain's components and of the tires. Nevertheless, decreased maneuverability should be taken into account.

## 2. THEORETICAL APPROACH

Generally speaking, if one wants to talk about the self-generated power flows within an automotive driveline he shall consider both the wind-up torque, occurred at the axle's level (transversal self-generated torque) and the one occurred at the inter-axle level (longitudinal self-generated torque).

The main reasons that cause the self-generated torque are:

- different dynamic tire radii;
- cinematic slip between the wheels or between the axles;
- cornering conditions.

Equation (1) gives the power balance within the transmission, at the longitudinal level, and also makes a good analysis of the components of the power flow inside the driveline for the specific driving conditions. In this formula  $P_{mot}$  is the power that comes from the vehicle's engine,  $\eta_{T M-S}$  is the "engine-rear

$$P_{mot} \eta_{T M-S} = \varphi Z_S r_s \omega_r - (\varphi Z_S - \sum R) r_f \omega_r \eta_{T F-CD} \quad (1)$$

$\uparrow$   
 Power  
delivered  
by engine

$\uparrow$   
 Grip  
power

$\uparrow$   
 Self  
generated  
power

axle" circuit's efficiency,  $\eta_{T F-CD}$  is the "front axle-central differential" circuit's efficiency,  $\varphi$  is the adherence limit,  $Z_S$  is the rear axle's vertical load and  $\omega_r$  is the wheel's angular

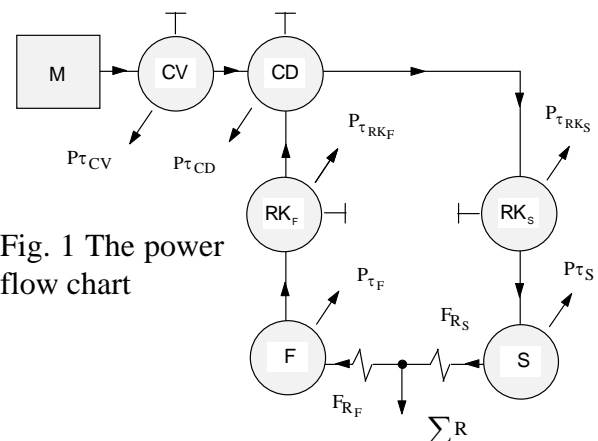


Fig. 1 The power flow chart

speed. On the other hand, the power flow driven to the front axle is given by (2).

$$P_F = \frac{r_r \eta_{T_{F-S}}}{1 + \cos \alpha} \left[ \sum R - \frac{r_c}{k_e} (1 - \cos \alpha) \right] \omega_r \quad (2)$$

As can be noticed, equation (2) gives the magnitude of the self-generated power during cornering (the most important one)

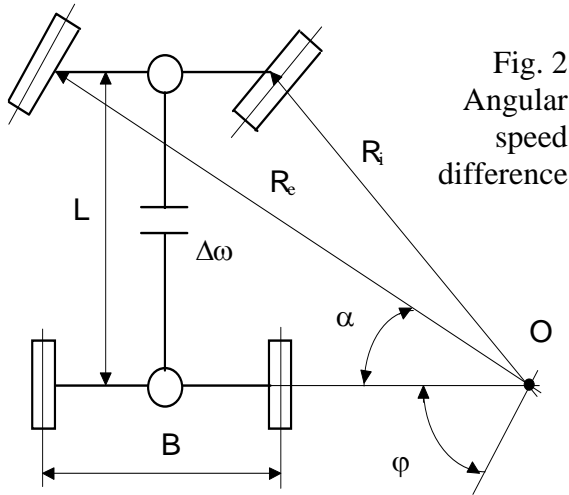


Fig. 2 Angular speed difference

induced by the front axle and sent to the rear axle. In this formula  $\alpha$  is the steering angle, according to the power flowchart given by fig. 1.

If the vehicle has a center self-locking differential, is very important to determine the angular speed difference on its output shafts during cornering. Considering fig. 2, the difference is given by:

$$\Delta \omega = \frac{v}{r_r} \left( 1 - \frac{R_e \sqrt{1 - \frac{L^2}{R_e^2} - \frac{B}{2}}}{\sqrt{\frac{B^2}{4} + R_e^2 - BR_e \sqrt{1 - \frac{L^2}{R_e^2}}} \right) \quad (3)$$

In eq. 2,  $B$  is the wheel track,  $L$  is the wheelbase,  $v$  is the vehicle's speed and  $R_e$  is the outer wheel's cornering radius. However, this paper will deal only with the transversal self-generated torque.

### 3. SOME ASPECTS OF THE SELF-GENERATED POWER FLOW WITHIN DIFF'S AND VISCOUS COUPLINGS DRIVETRAIN

Even the average differential has its own internal friction. This internal friction can be found in:

$$c_b = \frac{M_1}{M_2} = \frac{\frac{M_0}{2} + M_f}{\frac{M_0}{2} - M_f} \quad (4)$$

that defines the self-locking coefficient  $c_b$ . This coefficient's main feature is perfectly illustrated in fig. 3. So, even having a differential inside of a drivetrain, wind-up torque can appear inside the insensitive domain. The bigger  $c_b$  is the larger the insensitive domain becomes.

Fig. 4 gives a general evaluation of the self-locking qualities of any high positive locking differential. The curves were drawn based on the equation (5) where  $\mu$  is the friction coefficient and  $A$  is a geometrical and technological dependant factor.

A big category of traction control

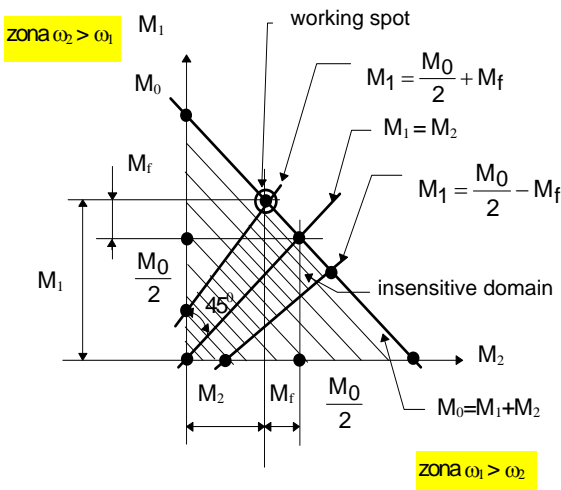


Fig. 3 Torque balance inside a self-locking differential according to the angular speed difference

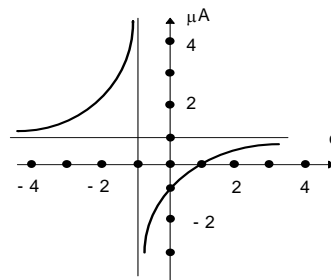


Fig. 4 Self-locking coefficient vs. geometrical index

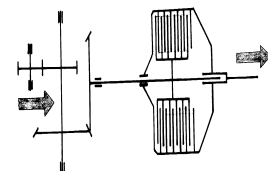


Fig. 5 Viscous transmission

$$c_b = \frac{1 + \mu A}{1 - \mu A} \quad (5)$$

improvement devices consists of the viscous couplings.

A method could be developed to calculate the necessary viscous torque for a specific passenger car drivetrain. According to this method, the necessary viscous torque is given by:

$$M = M_0 + p (\Delta n)^q \quad (6)$$

where  $p$  and  $q$  have some specific expressions, pending on the slipping conditions and the torque necessary to be developed for the best propulsion of the car. The correspondent speed difference has a linear variation.

#### 4. TESTING EQUIPMENT

To achieve the goals, some transducers were mounted on different components of the driveline (fig. 6). So, on the shaft between the engine and the central differential were mounted a Wheatstone bridge to get the engine's torque and an inductive angular speed transducer. On the shafts between the rear and the front axle, on one hand and the central differential on the other hand, were also mounted Wheatstone bridges to get the torque and optical angular speed transducers. At last, in the final gears were also mounted Wheatstone bridges to get the driving torque. The wheels' angular speeds were got using

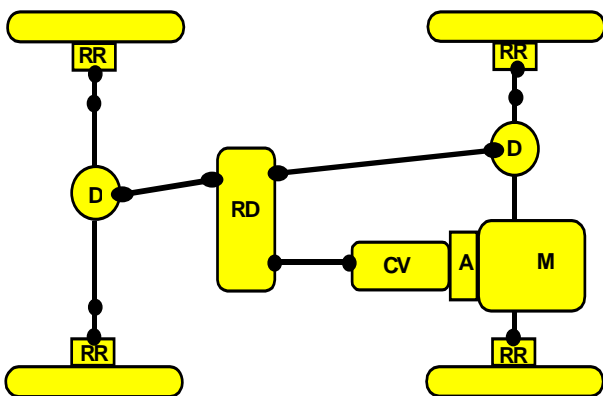


Fig. 6 Cinematic scheme of TAB-C 79 drive

also optical angular speed transducers. To get the instrumentation revealed, an Hottinger-Baldwin-Messtechnik complex system driven by an Apple Computer, Macintosh Power Book laptop computer has been used.

#### 5. TRANSVERSAL SELF-GENERATED TORQUE

The vehicle's axles have some increasing friction devices incorporated; thus supplemental torque at the axle's level is susceptible. The experiments developed revealed this axle level self-generated torque under two different circumstances: straight driving with different tire radii at the axle's

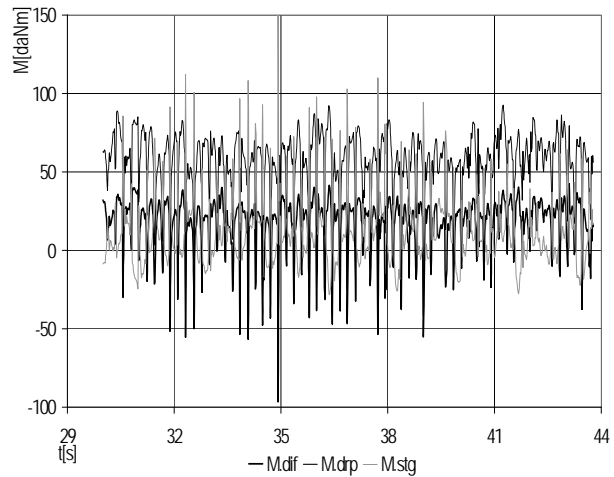


Fig. 7 Torque differential's case and wheels

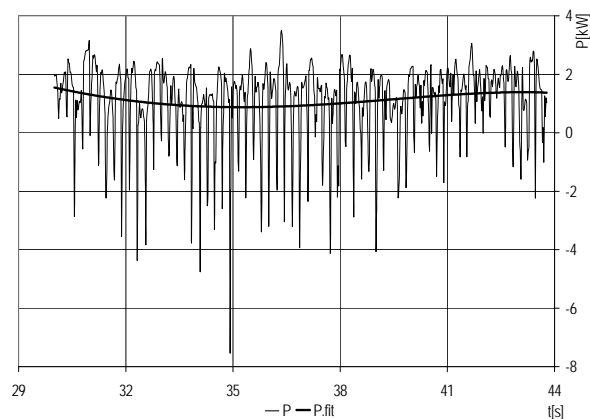


Fig. 8 Supplemental power at rear axle

Engine output: 2,20 kW

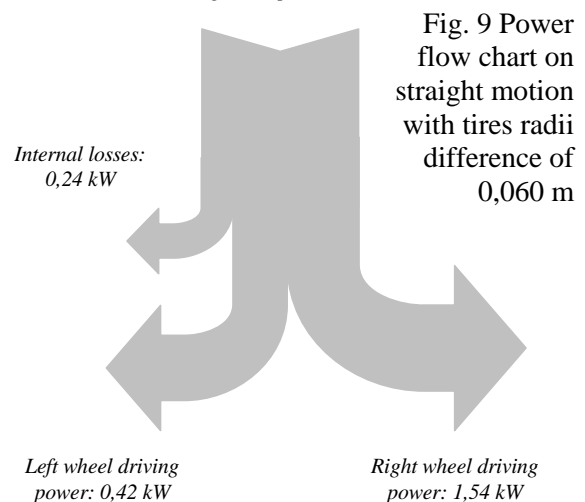


Fig. 9 Power flow chart on straight motion with tires radii difference of 0,060 m

level, and cornering at different steering angles

but having the same tire radii at the axle's level.

First experiments were developed in straight motion with different tire radii. The samples given in fig. 7 and 8 show that even the differential should make its job and avoid the self-generated torque appearance,

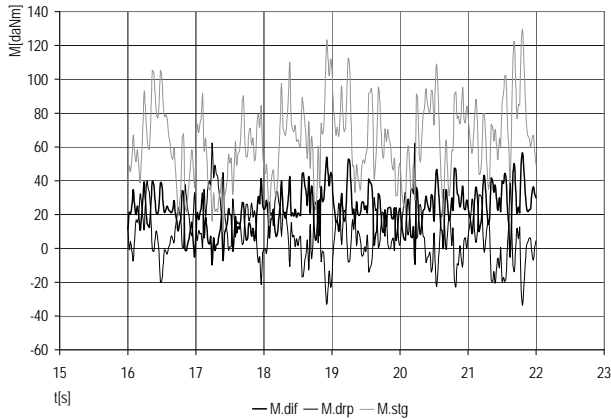


Fig. 10 Torque on the differential

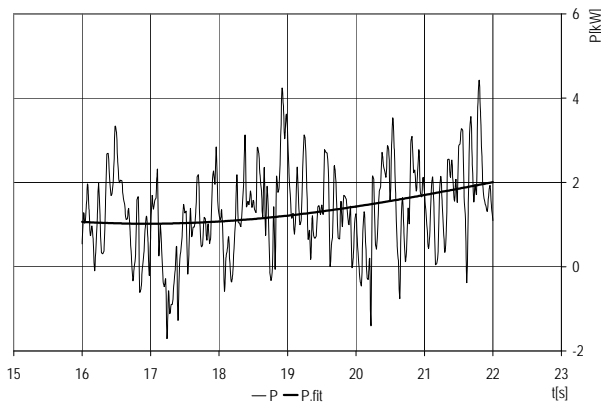
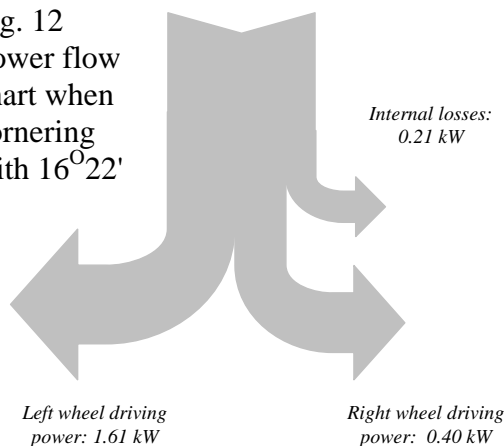


Fig. 11 Supplemental power rear axle

Engine output: 2.22 kW

Fig. 12  
Power flow  
chart when  
cornering  
with 16°22'



supplemental power still occurs due to the increased internal friction of the differential.

Fig. 9 gives the power flowchart at the rear axle's level.

The next tests concerned the cornering procedures. It is obvious that the special differential mounted into the vehicle's axle is doing the same job (e.g. fig. 10, 11 and 12).

## 6. CONCLUSIONS

The main problems within the 4WD drivetrains are the self-generated torque and consequently the looping power that occurs.

This work tried to reveal a universal behavior of the special differentials. Meanwhile, this study can be extended to all the 4WD cars, which have special traction control devices.

The results obtained were processed in order to underline the power loops within the transmission both on transversal and longitudinal drivelines. Thus, important and interesting results could be drawn.

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## SIMPLIFIED MECHANISM FOR NO<sub>x</sub> FORMATION

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**Abstract.** This paper describes the extension of the computer code made by author [1] to simulate nitric oxide formation. Complex kinetic mechanisms are applicable only for simple flame computations (e.g. one dimensional, laminar, etc.). For real turbulent flame calculations, their use is impractical, due to the complexity of the interacting processes (turbulence, radiation, heat transfer, etc.) which must be considered to obtain realistic results. A model derived by systematic reduction of multi-step chemistry is used in for the evaluation of the nitric oxide formation. This reduction is based on the partial equilibrium assumption of the considered elementary reactions using the extended Zeldovich mechanism describing the thermal nitrous oxide formation.

**Key words:** NO<sub>x</sub>, Zeldovich, mechanism, stoichiometric, fuel, flame.

### 1. INTRODUCTION

In general, the nitric oxide formation stems from three principal sources:

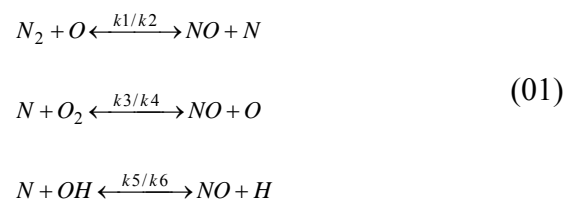
- Thermal NO which is formed due to the dissociation of the molecular air nitrogen (Bowman; Hanson and Salimian; Polifke [2]);
- Prompt NO (Fenimore NO) formed by the “attack” of hydrocarbon fragments on the air nitrogen (Bowman; Görner);
- NO formed from nitrogen containing components in the fuel;

Fuel-NO formation can be neglected during the combustion process in internal combustion engines. Prompt NO formation can also be neglected since this process plays no dominant role in comparison to the thermal NO formation (< 5 [%] of NO is produced via this path) (Görner; Polifke [2]; Zeldovich, et al.). NO is formed in both the flame front and post-flame gases.

### 2. MODEL FORMULATION

In engines, the cylinder pressure rises during the combustion process, so earlier burnt gases are compressed to a higher temperature level as they have immediately after their

combustion. Hence, the thermal NO formation in the burnt gases always dominates in comparison to the NO formed in the flame front and represents the main source of the nitric oxide in engines whose reaction paths are effective at high temperatures (> 1600 [K]). The reaction mechanism can be expressed in terms of the extended Zeldovich mechanism:



The first reaction represents the rate limiting step in comparison to the other reactions. A very high activation energy (or temperature) is necessary to decompose the stable triple bond of the molecular air-nitrogen. Accordingly, this reaction is significantly fast at high temperatures (hence thermal). In principal, it can be seen that the thermal nitric oxide formation is mainly determined by only five chemical species (O, H, OH, N and O<sub>2</sub>) but not by the fuel being used. In order to obtain the required concentrations of the radicals, a complex reaction mechanism must be used in order to

determine NO concentration. In the literature different possibilities are suggested to represent the rate law for NO (Bogensperger; Heywood; Warnatz and Maas).

In the program combustion model, an irreversible single-step reaction mechanism is used for the conversion of fuel, involving only stable molecules such as  $C_nH_m$  (as fuel),  $O_2$ ,  $CO_2$ ,  $H_2O$  and  $N_2$ . Hence, an approach is implemented based on these stable molecules in order to predict thermal NO.

The maximum of NO appears at an equivalence ratio of about  $\sim 0.9$ , i.e. slightly fuel-lean. In most stoichiometric and fuel-lean flames, the occurring OH concentration is very small.

Using this fact, the third reaction of the Zeldovich mechanism can be neglected. In addition, the characteristic times (Heywood) for the formation of thermal NO is several orders of magnitude slower than those characteristic times of the combustion process. Hence, the combustion and the NO formation processes can be assumed to be decoupled and therefore, the concentrations of  $O_2$ ,  $N$ ,  $O$ ,  $OH$  and  $H$  can be approximated by an equilibrium assumption. If the assumption is made that the thermal nitric oxide formation starts at considerably high temperatures (due to the decomposition of the stable triple-bond of  $N_2$ ) a partial equilibrium of the first two reactions can be assumed.

An analysis of experiments and simulations indicates that at high temperatures ( $T > 1600$  [K]) the reaction rates of the forward and reverse reactions are equal (Warnatz and Maas). The state of the considered reaction is said to be in partial equilibrium where the reaction couples are in equilibrium. Using this assumption, the concentrations of radicals can be expressed in terms of the concentrations of stable molecules (since they are easier to measure). These are present in much larger concentrations than the radicals. The assumption of partial equilibrium provides satisfactory results only at considerably high temperatures, since at temperatures less than 1600 [K] a partial equilibrium is not established.

For the formation of thermal NO, the partial equilibrium approach can be used and

so the equilibrium of the first two reactions can be expressed as follows by:

$$\begin{aligned} k_1[N_2][O] &= k_2[NO][N] \\ k_3[N][O_2] &= k_4[NO][O] \end{aligned} \quad (02)$$

Using these expressions, the equation system can be solved and results in a global reaction approach for the thermal nitric oxide formation which can be expressed as:



with  $k_f = k_1 \cdot k_3$  as the forward and  $k_b = k_2 \cdot k_4$  as reverse reaction rate. The chemical species appearing in this global reaction is also used in the given single-step fuel conversion equation. Hence, the source term in the conservation equation for NO is obtained via:

$$\frac{d[NO]}{dt} = 2k_f[N_2][O_2] \quad (04)$$

where only the formation (therefore, only the forward reaction) is considered. The reaction rate of the forward reaction is given as:

$$k_f = \frac{A}{\sqrt{T}} \exp\left(-\frac{E_a}{RT}\right) \quad (05)$$

where  $A$  pre-exponential factor and  $E_a$  activation energy.

### 3. COMPUTATIONAL PROGRAM

The presented simplified mechanism for  $NO_x$  formation is implemented in on computational cod. The developed program is of multi-dimensional type and it solves the specific combined equation systems of:

- Turbulent compressible flow by using:
  - o SGS (Subgrid scale turbulent viscosity) model for turbulence ;
  - o wall logarithm law for the turbulent boundary layer;
  - o altered Reynolds formula for the caloric boundary layer;
  - o approximating the fluid as Newtonian to compute its viscosity
- Chemical reactions of fuel combustion by using :
  - o a kinetic equation of fuel combustion (decan);



- splitting equations of combustion products treated on equilibrium;
- extended Zeldovich mechanism simplified for  $NO_x$  formation.
- The flow and evaporation of liquid jet of particles by using:
  - the general equation of jet simplified in stochastic approach ;
  - the equation of drops' evaporation as deduced by O'Rourke;

The formula is bi-dimensional in space and thus allows a plane and axial symmetrical approach of the geometry of the combustion chamber. The axial symmetrical formula, the most often case met in practice, allows us to take into account the swirl movement as well, enhancing thus the spatial resolution and partially implementing the third geometric dimension.

The temporal differentiate is based on ICE (Implicit Continuous-fluid Eulerian) algorithm which is a partial implicit method. This iterative technique joins the continuity and moment equations and solves them simultaneously by using the state equation; the energy equation is solved explicit apart from the other two. To move forward in time some values several steps in time are needed. For this reason each cycle is achieved in three temporal sub-steps or phases. This approach is in direct connection to the spatial digitization based on ALE (Alternate Lagrangean Eulerian Method) method.

The grid is adjustable and is made up of generalised quadrangle whose corners are specified by co-ordinates dependent on time and are reported to the inferior position of the piston, which allows us to approach the problem Eulerian or Lagrangean as necessity should arise.

#### 4. NUMERICAL SIMULATIONS

The model presented is used for numerical simulation on T684 engine manufactured by „Tractorul” Plant Braşov, for which author have experimental data.

For evaluation, author is use comparisons white measuring data and results obtained whit Wave 5 code produce by Ricardo.

Program calibration is make for indicating diagram uses measuring data, and results of Wave 5 code, for the tow important speed 2400 rpm (speed of max. power) and 1440 rpm (speed of max. torque) the speed of engine emission test cycle Euro 2. The results are present in figures 1 and 2.

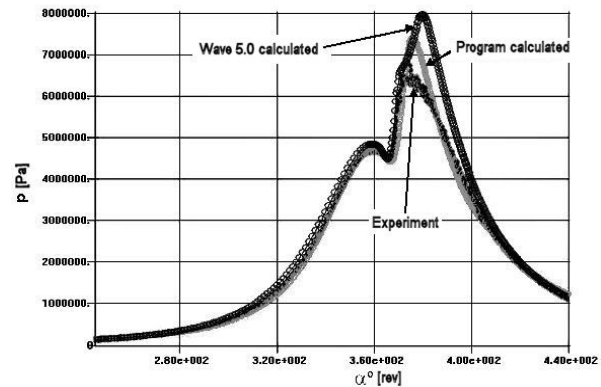


Fig. 1 Indicating pressure at 2400 rpm speed and 100% load

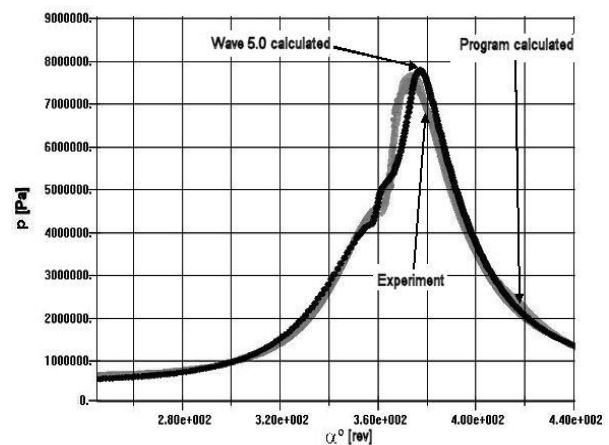


Fig. 2 Indicating pressure at 1440 rpm speed and 100% load

The next step is to compare the measuring data for  $NO_x$  emission (the medium value) whit the calculated data by program and Wave 5.0 for a cycle. Unfortunately the available measuring data is medium for a cycle.

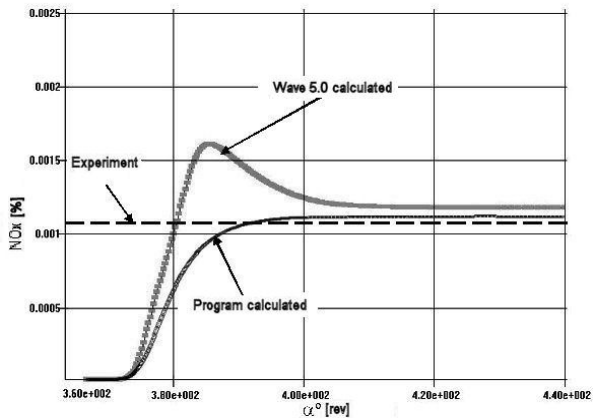


Fig. 3 NOx concentration at 2400 rpm speed and 100% load

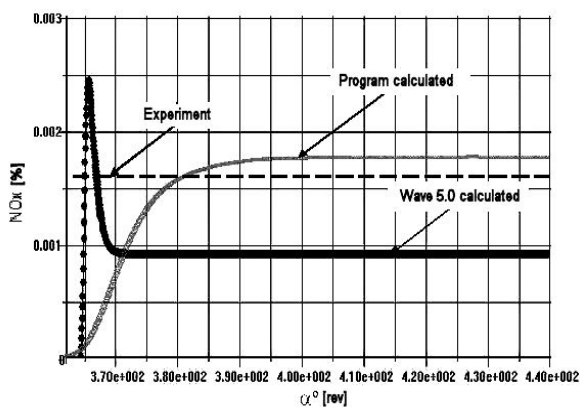


Fig. 4 NOx concentration at 1440 rpm speed and 100% load

Final we test the program for other load different from that of calibration and present the results in figures 5 and 6.

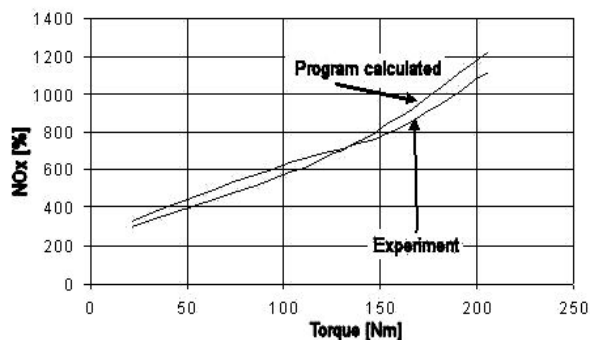


Fig. 5 NOx emission, for load curve at 2400 rpm speed

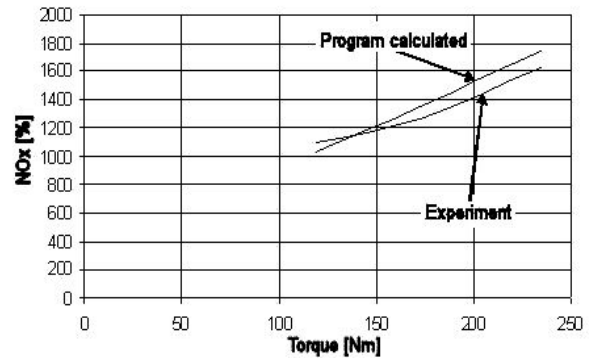


Fig. 6 NOx emission, for load curve at 1440 rpm speed

## 5. CONCLUSIONS

1. The programme is able to estimate  $NOx$  emissions of Diesel engines;
2. Results are in compliance with experimental data, especially for calibration and load regimes;
3. Under given and well defined conditions the programme is predictive enough to be used to analyse particular cases;
4. If well calibrated the programme can be used to analyse the combustion process in order to improve technical and economic performances and cut  $NOx$  emissions of diesel engines; this can be achieved mainly by optimizing:
  - a. the injection lead;
  - b. the shape of the combustion chamber;
  - c. the organized or erratic movements in the cylinder.
5. Results largely depend on the constants of the models and for this reason they have to be closely analysed and carefully interpreted as they may carry a subtle mistake and this would lead to wrong conclusions;
6. The performances of the programme are limited by the models used and for this reason the cases and values studied must be carefully selected so that we do not surpass their applicability range.

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## RELIABILITY OF TECHNICAL SYSTEMS- CONCEPT, CLASSIFICATION AND QUANTIFICATION

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### Abstract

Along with increasing technical complexity of products, and increase economic and social implications of their use, certain qualitative characteristics have acquired a special importance, with priority being pursued throughout the life cycle of products. Thus, features like reliability, maintainability, availability, job security, occupational health and environment protection have imposed themselves as self-standing notions within the broader category of quality.

**Key words:** reliability, the average time of function, maintainability, availability

Reliability is a science now occurred about 45-50 years, having as objectives:

- study of defects (causes ,processes of emergence and development and methods to combat damage);
- quantitative assessment of behavior of products in time, taking into account the influence that carries on these products the internal and external factors;
- determination of models and methods of calculation and forecasting of reliability, based on specific tests and tracking behavior of the operation;
- analyzeing physical defects;
- establish constructive methods, technological and exploitation for insurance, maintenance and increased reliability of systems, devices and elements;
- establish methods for selecting and processing data on the reliability of products [1].

Qualitative, reliability is the ability of a system to operate without failure during a specified period of time in given conditions.

Quantitatively, a system reliability is the probability to meet certain performance functions and without defects, in a certain time and operational conditions data.

Causes that have contributed to a theory of reliability has been increased equipment complexity and character of modern mass

production. In the case of complex systems and equipment, however it would invest to get a reliable ideal, can not get a system that does not degrade over time. It is necessary to know better the real level of reliability, so depending on it to establish the mission duration, periods of review, the safety, etc..

In the case of mass production, due to rapid changes of the technical requirements, we can observe that is not always necessary to obtain a maximum possible level of reliability, but it is essential to know precisely who is the real level of reliability, taking measures to moving it to an optimum value. It is preferable to know that a system will damage after exactly 300 hours than vague to assess the duration of operation between 400 and 600 hours. [2].

Control of reliability level can be done in closed loop:

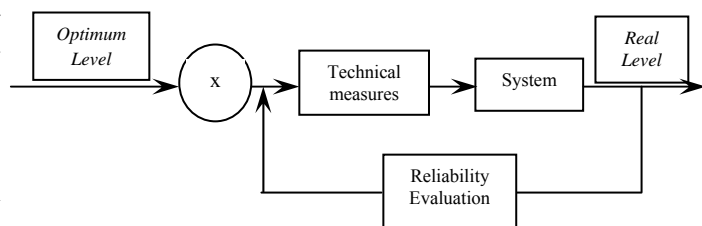


Figure 1. The level of reliability

Realization of such control involves the expression and the possibility of quantitative reliability evaluation.

If the reliability of the study items and repairable systems, and hence the military vehicles, in standards and literature are presented on the concepts and definitions of the terms of use and duration of works to maintain reliability. Since 1992, these concepts (terms, definitions, concepts) are listed and updated norms.

Time function is the distance traveled in km and the number of hours (the time) between two successive failures in which the product works according to specifications required. For some components and subassemblies of products, the time of function is expressed in number of hours (cycles) of operation.

**The average time of function** (average time function) is used in practice whereas the operating time between failures and to production is variable.

The maximum allowable use (resource) is the duration of use until the product reaches a limit for allowable operating parameters. By normative, for each type of products are stable for running (during in km) to the execution of repairs, replacement and disposal, etc..

According to STAS 8174/2-77, maintenance is defined as the ensemble of all technical and organizational measures in order to maintain or restore a system so that it can perform the tasks as specified. There are two ways: preventive (surveillance operation and periodic checks) and corrective maintenance (replacement of defective parts and current repairs, average repairs and capital repairs). Preventive activity provides a low failure rate and a useful lifetime high.

**Maintainability** is the ability (probability) of the system (of the device) to allow maintenance works over a period of time in given conditions, with prescribed procedures and technologies.

Since the extent of maintenance work and time needed to perform is high, in the design will seek to create conditions that facilitate these activities.

Maintainability is determined:

- experimental, by simulation in the laboratory test stand on various types of defects and recording times of intervention to eliminate deficiencies;

- by tracking behavior of systems, structures or products to customers (organization "technical data bank").

**Availability** is the ability of system, under the combined aspects of reliability, maintainability and the maintenance operations, to perform specific functions at a time or during required time. The availability of a product will be greater if his reliability is higher and require less maintenance work.

Availability is affected by two probabilities:

- probability of operation without failures on a certain duration

- likely fall and restore ability to function during a time interval.

Examined quantitatively, availability meanings are:

- availability (time) is the percentage of time that a product is running;

- availability (of product) is the percentage of products available after a while of operation, due to cumulative effect of the system in a time of maximum disruption default;

- availability (of mission) is the percentage of missions (h, km) in a given period of time not having damages that can not remedy in a specified period of interruption.

Availability is achieved through four means: reliability, maintenance, renovation and proper operation.

To this end must be taken into account to ensure that a certain level of reliability, maintenance costs should not exceed, annually, 10-20% of the purchase price of the product and that it is technically and financially limited whereas restoration to its normal is achieved through the maintenance or repair as preventive failures are predictable or unpredictable. In practice, the flow is a compromise between the purchase price, the service requested and accepted risk whereas to achieve availability through reliability there must be used very reliable pieces costing 5 to 10 times more than ordinary, and often do not get return on this way [3].

To characterize the reliability of a system we use the language of probability theory.

May T be the duration of the operation to a system failure and F (t) distribution function of the continuous random variables. In accordance with the definition of a function of distribution of a random variable, F (t) is the probability that the duration T is less than the value t, that is the probability of failure of the system in (0, t).

Complementary probability of failure is the reliability function R (t), which is the probability that (0, t) does not produce damage to the system. The two functions F (t) and R (t) refers to events that occur or not in the time elapsed from the operation of the system at t = 0 until t, and not to events occurring at time t, as would ensue from inscriptions. More correctly would be to use marks F (0, t) and R (0, t).

For certain time, which means task x duration, initialized at time t, the probability of failure is:

$$F(t, t+x) = P(t \leq T < t+x) = F(t+x) - F(t) \quad (1.1)$$

In relation (1.1) a total probability appears, but not entirely reflect reality. The system considered without renewal, can be damaged in the (t, t + x) if not failed in (0, t). It follows that the probability of failure in the F (t, t + x) and the reliability R (t, t + x) are conditional probabilities for the proper functioning of the system (0, t).

One can therefore write:

$$F(t, t+x) = \frac{P(t \leq T < t+x)}{P(T \geq t)} = \frac{F(t+x) - F(t)}{R(t)} \quad (1.2)$$

$$R(t, t+x) = \frac{P(T \geq t+x)}{P(T \geq t)} = \frac{R(t+x)}{R(t)} \quad (1.3)$$

Local behavior of the system around a given time, is described using probability density of random variable T, defined as:

$$f(t) = \lim_{\Delta t \rightarrow 0} \frac{F(t + \Delta t) - F(t)}{\Delta t} = \frac{dF(t)}{dt} \quad (1.4)$$

Probability density f (t) represents the limit of the total probability of failure (t, t + Δt) in this range and size when it tends to zero.

Probability density is called the law of distribution of operating time to failure of

the system and is as a probability of total failure around the time t, regardless of the previous behavior of the system [4].

To describe the risk of failure around the time of the system in good condition up to that point, it defines another indicator that describes the local behavior of the system in terms of reliability. This indicator is called the failure rate and is a conditional probability similar to mortality rates from demographic studies. Is defined as the probability of failure around a given time, subject to the proper functioning of the system until that time.

$$z(t) = \lim_{\Delta t \rightarrow 0} \frac{F(t + \Delta t) - F(t)}{R(t) \cdot \Delta t} = \frac{f(t)}{R(t)} \quad (1.5)$$

From relations (1.4) and (1.5) is obtained:

$$z(t) = -\frac{1}{R(t)} \cdot \frac{dR(t)}{dt} \quad (1.6)$$

and by integrating differential equation (1.6) with initial condition R(0) = 1 is obtained:

$$R(t) = e^{-\int_0^t z(u) du} \quad \text{and} \quad F(t) = 1 - R(t) \quad (1.7)$$

In addition to indicators show, the reliability of a system can be described by the number of random variable which was the basis of characterization: the operation to failure. These characteristics are: mean, mean square deviation, the dispersion time and level of functioning. Average operating time is defined by the relationship:

$$m = \int_0^{\infty} t \cdot f(t) dt, \quad t \in (0, \infty) \quad (1.8)$$

$$\text{or } m = \int_0^{\infty} R(t) dt \quad (1.9)$$

Notatii used:

MTBF - Mean Time Between failures;

MTTF - Mean Time To failures (for systems without renewal);

MTTFF - Mean Time To First failures.

Mean square deviation and dispersion time of operation are defined using the relationship:

$$\Delta = \int_0^{\infty} (t - m)^2 \cdot f(t) dt \quad (1.10)$$

$$\sigma = \sqrt{\Delta} \quad (1.11)$$

Sizes  $\Delta$  and  $\sigma$  are indicating the degree of uniformity of performance of individual systems of the same type in terms of reliability. If the technological process of making systems is well controlled, the indicators  $\Delta$  and  $\sigma$  will be small [5].

Another indicator, independent of time, level of operating time, defined as the root of equation:

$$F(t_\alpha) = \alpha \quad (1.12)$$

Of relationship is easily observed that  $t_\alpha$  can be interpreted as a guarantee time, ie when the proportion of failed items in a given community does not exceed the default value  $\alpha$ .

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## THE QUALITY CHARACTERISTICS AND QUALITY OF PRODUCTS INTENDED FOR MILITARY

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### **Abstract**

*The concept of quality, as stipulated in the European standard SR EN ISO 9000:2001 - Quality management systems. Basic principles and vocabulary, is the extent to which a set of intrinsic characteristics meet the requirements, more exactly the need or expectation that is stated, generally implicitly or compulsory. Defining the concept of quality can not leave aside the ratio between the utility and the level of technical products. A military product with low technical performance, worn-out morally and technically, which is not at least at the level of potential competition can not be considered a quality, competitive product. The resultant is the dynamic aspect of quality materialized in the evolution of its content in step with practical needs, historically determined both extensively (when varying the number of product characteristics) and intensive (when improving the characteristics of the product).*

**Key words:** *quality, quality control, quality assurance, total quality management*

Concerns for the quality of made goods is ancient, from the age in which civilization was at the beginning and the passage of goods between people was rude on free trade. Interest of people for things and "quality" work has been developed with their needs of life. After some authors, the word "quality" has its roots in the Latin "qualitas" deriving from "qualis", which has the meaning of "way of being", "to be". Thus, without using current terminology, but prefiguring some concepts, principles and rules existing, ancient documents from the ancient Greeks, Egyptians, Chinese, transmit such information.

Modern history of the concept of "quality" actually begins with the twentieth century whereas during the last century have been discovered, developed and applied most of the concepts, principles, methods, techniques and tools to obtain, maintain, but especially improving the quality of products and services.

The most important historical events that led to the development of its approach to quality of products and services are:

- development of large scale industrial production of medium and large series (after 1900), with specialized personnel of enterprises and introduction of product quality inspection at the end of construction for the purpose of sorting them;

- development of applications of mathematical statistics (through the years 1942-1943) which led to *the pursuit of priority manufacturing processes* and less on sorting finished products resulting from these processes. Demonstrated that maintaining control of these processes can prevent the manufacture of products of poor quality;

- development of reliability theory (through the years 1945-1950) which took into account the operation of putting in evidence the role and importance of *design quality* in obtaining it.

The time evolution of the concept of "quality" is illustrated in Figure 1.



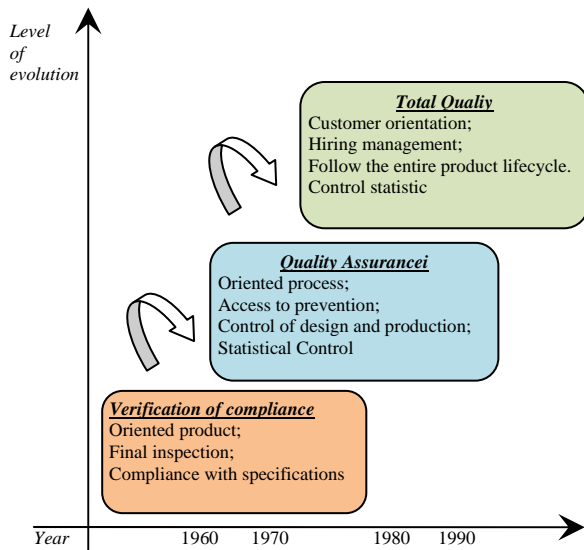


Fig.1. Evolution of the concept

*Quality control* aims to determine whether products meet the quality requirements imposed.

*Quality Assurance* aims to prevent non-quality by adopting appropriate measures to provide confidence that a product or service will satisfy the quality requirements.

*Total quality management* is a modern system of management that aims "domination" by the quality of training the staff in the achievement of quality and extend the concept of quality to the entire activity of an organization.

The notion of "quality" is complex, with uses in many areas where he is assigned different meanings, which is why it is difficult to formulate a single definition and rigorous.

In the multitude of meanings in relation to the concept of quality products and added that, as demand growth and diversification of products and once with them on the development of industrial production, the concept of quality of products has evolved and diversified, speaking more about "potential quality" understanding through that the quality of the product before its assimilation into manufacturing, "partial quality", representing the ratio between the quality produced and required, "as performed" representing the quality resulting from the verification at the end of the manufacturing line, "quality assured"

quality that is resulting from a program unit containing all the activities of quality control (prevention, measurement and corrective action) and "total quality" that integrates the utility, economy, aesthetics and ergonomics aspects of private and social functioning.

In those circumstances it was necessary to adopt a clear and uniform definitions that reflect both the complex concept and its dynamic nature, caused by increasingly high demands of users (customers).

A reference document in the evolution of the concept of quality is ISO 8402:1986, which establishes as definition generally applied the meaning: *all the properties and characteristics of an entity that gives it ability to meet the needs expressed and implied.*

Enriching and clarifying some issues, the standard SR EN ISO 9000:2006 -*The quality management system - Fundamental principles and vocabulary*, shall worldwide expression of the quality *as far as a set of intrinsic characteristics fulfills requirements.* For full understanding of the concept is needed to clarify (under the same standard) at the same time the *requirement terms and quality characteristic.* Requirement by means of need or pending which is declared in default or mandatory general and quality feature is a distinctive feature of physical, sensory, behavioral, temporal and ergonomic working. Quality is a complex concept that has the intrinsic properties of the product to satisfy a need and economic issues related to development and use.

A vital element especially for military, recognized worldwide as one of the vanguard, is the ratio of quality and technical level of products. A military product with a low technical performance can not be considered a quality product, competitive. Moreover, a military purpose should characterize the lack of features and shortcomings. If, for an organization from socio-economic area deficiency has as result dissatisfaction and discontent for the product, the specific of military domain determine that deficiency in operation will lead to casualties. There is therefore no accident that the concept of quality has its origins in the production of goods intended for military.

To better understand what is the quality of equipment used for military, it will be defined in relation to two key dimensions:

- product characteristics;
- lack of weaknesses.

In the following table are examples for this case definition of materials:

Table 1 - Defining quality in terms of features and shortcomings

Characteristics of military equipment	Deficiencies	Result of the occurrence of deficiency	Consequences
Individual reliable arms	Lock mechanisms during the mission	Unable to respond	Injury or death
Means of protection antichemical tight	Breaks or cracks sealed joints	Contamination	Illness and / or death
Warheads of items of ammunition in the safe handling	Failure in safety mechanism	Premature explosion safety during handling	Injury or death
Continuity links radio stations	Quick unloading of batteries	Lack of connections	Lack of command and control

The quality concept of products with military destination is a complex and requires consideration of a number of properties or ownership. For quantitative assessment of quality is necessary to identify all the characteristics of a product and then the formation of groups according to various criteria. Classification of quality characteristics is performed in relation to the following criteria:

- 1) the nature and effect that you have in use;
- 2) the importance in ensuring the usefulness and functionality of products;
- 3) the possibilities for measuring them;
- 4) the expression of these characteristics.

In relation to *nature and the effect they have in the use*, quality characteristics are grouped into the following types: technical, psycho-sensory, availability, economic, with general social.

a) **The technical characteristics** refer to the characteristics of the immanent use of the product, giving them the potential to satisfy user utilities, combatant or non-combatant and is materialized by a series of physical properties, intrinsic chemical structure of the military material and design determined by constructive-functional of it. They are directly or indirectly measurable objective with a sufficient accuracy by technical means.

- constructive solution;
- the nature and structure of materials;
- gauge product;
- ergonomic features (convenience in operation).

b) **The psycho-sensory** concern the effects of aesthetic order, organoleptic, ergonomic, which products have on military by shape, color, taste, smell, etc. degree of comfort. To effectively integrate them into the utility of products it should be borne in mind that these features present a high variability in space and time and that their appreciation is subject to some kind of subjective factors.

- appearance;
- finishing;
- keeping in time of appearance.

c) **The availability** is for military products (equipment) a very important group for assessing the quality because most of them have a duration of use that extends the period of several years even decades. They reflect the ability of products to achieve useful functions throughout the duration of their life, an attitude defined by three fundamental concepts:

- reliability (probability of no decay);
- maintainability (likely to be repaired);
- availability (the probability of being in office at certain times).

d) **The economic and environmental protection** is expressed by a number of indicators such as indicators of intensive, production cost, purchase price, maintenance costs, degree of automation and cybernetic volume of work, efficiency and specific inputs, etc..

e) **Characteristics of general social concern** effects that have the technological achievement of military and their use in the ambient environment, the safety and physical and mental

health of those serving these types of special purpose products.

Another group of characteristics is based on the criterion of importance in ensuring the usefulness and functionality of products. Scale of importance can be detailed in a more or less time depending on the nature and complexity of products, the number of identifiable characteristics and objectives analysis. A typology of maximum synthesis is that features are grouped into:

- *critical features* (or lack of which lay below a certain level is sanctioned by law and not allow access to products on the market: safety in operation, the environmental content in various substances, etc.).

- *basic features* (absolutely necessary and which are missing or lay below a certain level of product failure involves the user);

- *secondary characters* (who may be missing or may be made at the lower levels, thereby reducing unnecessary costs without the use of products to be significantly affected).

Grouping characteristics of quality can be made depending on the *possibilities of measuring them*. Is distinguished as follows:

- *directly measurable characteristics* (length, width, height, weight, strength, range, duration of time, pace and rhythm of firing, autonomy, accuracy, operating cycles, etc.);

- *indirectly measurable characteristics* (quality of coverage in masking spectrum or

infrared through the visible layer thickness, the reliability of the equipment determined by the evidence of resistance to wear, etc.):

- *objective characteristics comparable with standard sample* (number of defects per cm<sup>2</sup> in fabrics, knitwear, table, the degree of resistance to cycles of washing, etc.);

- *subjective characteristics comparable with standard sample* (the painting, the degree of browning, etc.).

Depending on the *mode of expression*, are different:

- *features quantifiable (measurable)* in which the actual amount of the feature can measure and record (odds dimensional, resistance, pressure, etc.);

- *attributive characteristics* that define quality by qualifications (appropriate or inappropriate).

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# THE MECHANISM OF MODIFYING CAST IRON BY MIXING LIQUID STATE OF TWO CAST IRON TO A DIFFERENT DEGREE OF SATURATION IN CARBON

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*Abstract:* the purpose of this paper is to determine whether the mixing in liquid state of two cast iron with different degrees of saturation in carbon, represents or not a process of modifying. It is known (1, 2) in the literature that often this method of mixing in liquid state is considered as a process of modifying.

*Key words:* cast iron, lamellar graphite, mottled iron

## 1. INTRODUCTION

In the case of cast iron with lamellar graphite, the notion of change is not yet sufficiently specified in the literature.

The effect of modifying the cast iron with lamellar graphite can be considered using qualitative and quantitative changes of the structure and the value of cast iron properties . These changes are sudden. Of these the most important changes is a sudden increase of graphite content (Cgr) realized only when the initial cast iron has a degree of grafitization equal to zero (F) or very low (FP). Besides this modification it has been characterized by : obtaining a greater number of eutectic cells ; than in unchanged grey iron and by some separation of lamellar graphite with rounded edges; a sharp increase in resistance to traction; complete elimination of interdendritic graphite (where the original mottled iron) through the achievement of a pearlitic walls in different thicknesses; a sharp decrease degree of bleaching (the hardness) of cast iron in the thin walls and some increase in the value Cleg thick walls of the piece. By maintaining the modified cast iron in liquid state it has been

observed that the structure and the properties of cast iron varies continuously with the trend of reversion to the initial situation.

## 2. RESEARCH METHODS

Within the research theme proposed ,the method of work consisted of mixing in liquidstate of two cast iron with diffrent degrees of saturation in carbon, without adding another external modifier. Melting aggregate used was a furnace heated with silicat bars with two crucibles.

The temperature to ensure the two crucibles is the same:

- a) cast iron with the saturation level in low carbon;
- b) cast iron with high saturation high in carbon.

As a cast iron with a low degree of saturation in carbon it has been used used a mottled iron (FP) with chemical composition: C = 3.3%, Si = 1.08%, obtained from the melting of cast iron with the degree of saturation high carbon (Fe) used a gray cast iron with chemical composition: C = 3.95%, Si = 2.75%, obtained by remelting of a gross smelter iron FK 3.

After separate melting of cast iron in two crucibles, they were mixed in liquid state and then have maintained a mixing time for completion. Casting was done in dry form, achieving the cylindrical samples of diameter  $\varphi = 20$  mm and  $\varphi = 30$  mm. 750/5/10 hardness was carried out at a Brinell.

It was also determined macrostructure and microstructure of samples and investigated the appearance of crack.

In figure 1 the results showing the appearance breakage samples obtained by mixing a liquid state mottled iron with various quantity of grey cast iron.

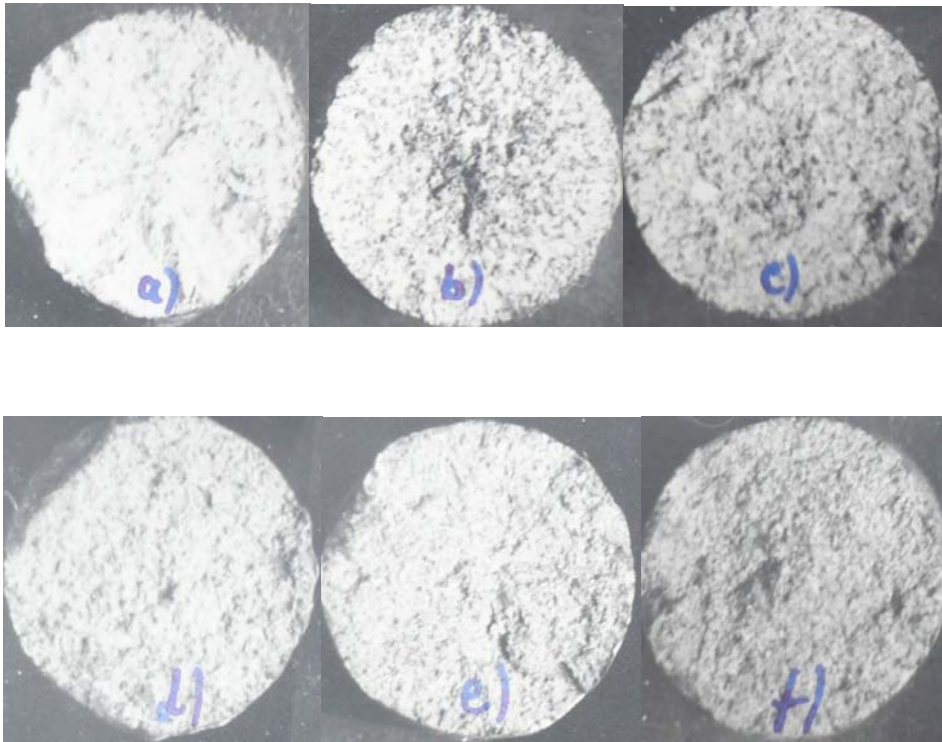


Fig. 1 Changes of breakage appearance samples according to the quantity of grey iron added

a) 0% FC; b) 10% FC; c) 15% FC; d) 20% FC; e) 25% FC; f) 100% FC

### 3. THE RESULT

Table 1 shows the values of hardness and chemical composition obtained according to the quantity of grey cast iron (FC) added in mottled iron (FP).

Nr. Crt.	probă (mm)	Duritatea medie HB	Compoziție chimică a fontei modificate			S <sub>C</sub>	C	Compoziție chimică						
			Fontă		F <sub>P</sub>			F <sub>C</sub>		S <sub>C</sub>				
			F <sub>P</sub>	F <sub>C</sub>	C <sub>tot</sub>			Si	C <sub>tot</sub>		Si			
1	20	438	-	-	-	-	-	100	0	3,3	1,08			0,8
2	20	215,5	-	-	-	-	-	90	10					
3	20	349,5	-	-	-	-	-	80	20					
4	20	298	-	-	-	-	-	70	30					
5	20	217	-	-	-	-	-	60	40					
6	20	206,5	-	-	-	-	-	50	50			3,88	1,5	1

7	20	206,5	-	-	-	-	-	90	10	3,3	1,08			0,8
8	20	189	3,31	1,06	0,41	0,86	4,37	80	20					
9	20	192,5	3,17	1,13	2,15	0,81	4,3	70	30					
10	20	162	3,50	1,46	3,12	0,91	4,96	60	40					
11	20	158,5	3,63	1,73	3,32	0,97	5,36	50	50					
12	20	143	-	-	-	-	-	0	100			3,95	2,75	1,1
13	20	415	2,95	0,74	0,19	0,70	3,69	100	0	3,3	1,08			0,8
14	20	373	2,85	0,81	0,22	0,71	3,66	95	5					
15	20	235	2,98	0,9	0,19	0,75	3,88	90	10					
16	20	265,5	2,95	1,07	0,26	0,75	4,02	85	15					
17	20	201,5	2,93	1,12	0,55	0,75	4,05	80	20					
18	20	215	3,31	1,25	0,87	0,85	4,56	75	15					
19	20	177	3,73	1,53	3,5	0,96	5,26	0	100			3,95	2,75	1,1

It can be seen that the quantity of gray iron added is higher, the more white the initial iron gradually changing to gray. It should be noted that there is a sudden change in appearance samples breakage.

As shown in figure 2, the size of the quantity of gray iron added increase the quantity of C, Si and Cgr in cast iron obtained after mixing, which explains the appearance breakage samples (increase grafitization).

- 1) Variația % C<sub>tot</sub>
- 2) Variația % C<sub>gr</sub>
- 3) Variația % Si

Changes in the degree of grafitization resulting from their microstructure analysis (Figure 3) shows that increasing grafitization and increasing separation from graphite as they enter a larger amount of cast iron gray. It notes the trend of occurrence of interdendritic graphite to the addition of 25% FC. This increase is grafitization guard uniform.

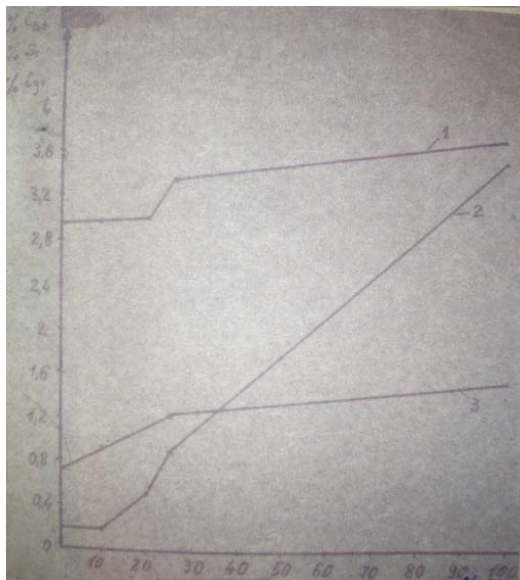


Figure 2. Changes in content of CLEG, Si, and CGR depending on the amount of added gray cast iron

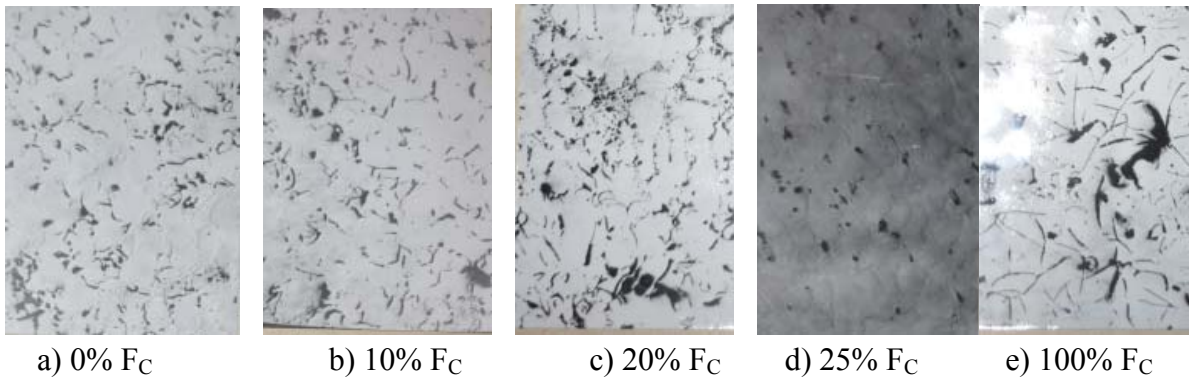


Figure 3. The changes microstructure of cast iron obtained by mixing two liquid state cast iron

From figure 4 results that the initial cast iron has been a cast iron with a low degree of grafitization (close F, Figure 4). By increasing the sullage head of gray cast iron decrease free cementite thus cast iron with 25% FC no longer represents free cementite but has perlito-ferritic structure with lamellar graphite.

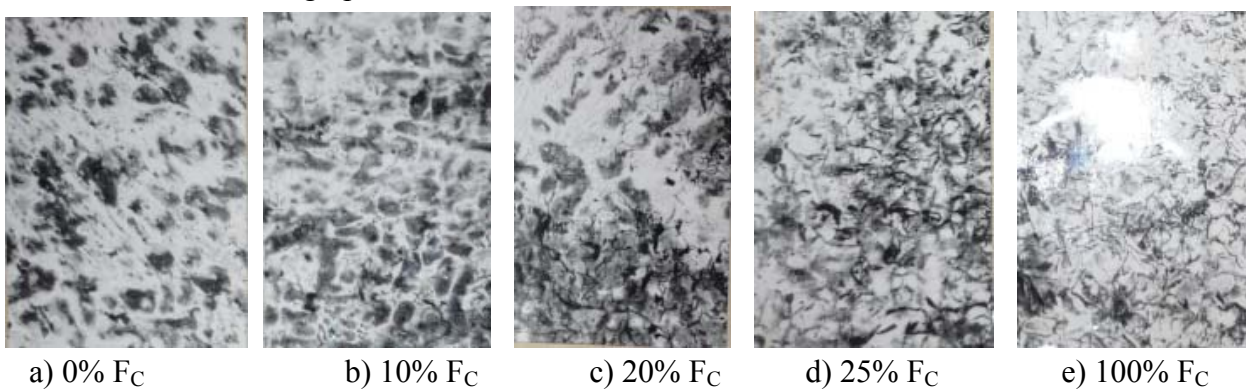


Figure 4. The changes of cast iron microstructure obtained by mixing liquid state

From microstructural analysis results a proportional variation of the final structure of cast iron, depending on the amount of gray cast iron added

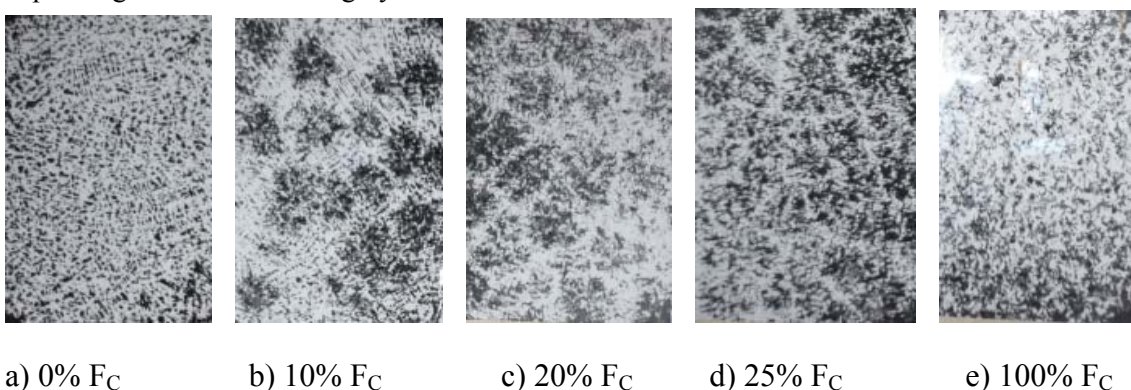
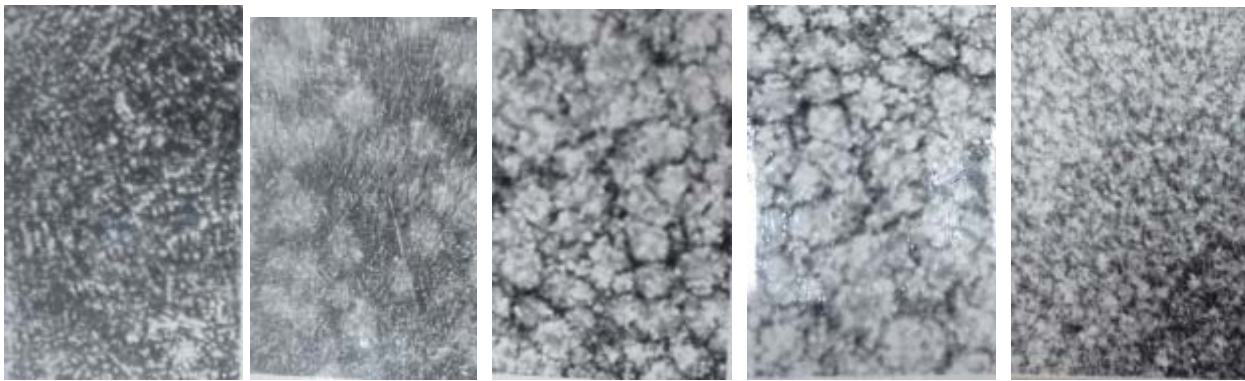


Figure 5 .The microstructure of cast iron obtained by mixing the two liquid state of reagent cast iron stead, metallographic microscope (10:1)



a) 0% F<sub>C</sub>      b) 10% F<sub>C</sub>      c) 20% F<sub>C</sub>      d) 25% F<sub>C</sub>      e) 100% F<sub>C</sub>

Figure 6. The microstructure of cast iron obtained by mixing (10:1) reagent steel and gray cast iron under a stereomicroscope

From figures 5 and 6 results that the initial cast iron (50, 60), the macrostructure indicating the presence of austenite dendrites and the skeleton of free cementite and by adding iron gray cells begin to appear eutectic, initially high (50, 60) and then becomes smaller. At gray cast iron eutectic cell number is up and so that the mixing takes place an increase in eutectic cell but on the contrary a decrease from cast iron ash.

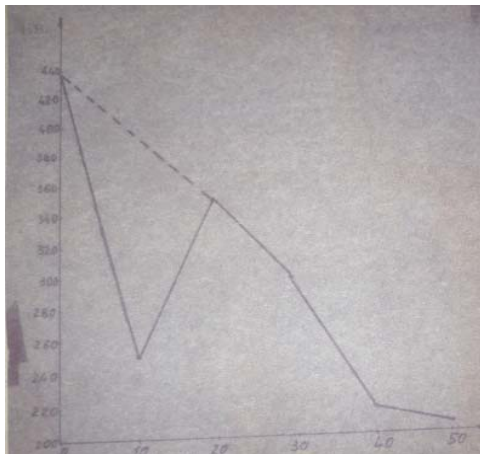


Figure 7. The changes in hardness of cast iron resulting by mixing in the liquid state of two cast iron depending on the amount of gray cast iron introduced.

From figure 7 shows that the hardness decreases gradually with increasing the proportion of gray iron added but must be a jump. Anomaly exists in the introduction to

FC 10% is explained by the occurrence of graphite interdendritic causes a sharp decrease in hardness of cast iron.

#### 4. CONCLUSIONS

Experience shows that the curve made by the mechanical properties change does not jump but there is a linear variation of them. Analyzing the results obtained can be detached appreciation that the phenomenon of mixing liquid state of two cast irons with different degrees of saturation (regardless of scale) does not present sufficient evidence to be treated as a phenomenon that does not change the qualitative changes occur. But could say that mixing the two cast iron liquid state has the effect of improving the properties of cast iron results, with only a process of graphite without causing a change in the cast iron.

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## DEVELOPMENT OF MINIATURIZED SYSTEMS BASED ON COMPLIANT MECHANISMS

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**Abstract:** *The compliant mechanisms are different from the traditional rigid body mechanisms in the sense that last ones are, in fact, rigid links connected by movable joints, used to transfer or transform energy and motions across themselves as desired by the users. In the first part of the paper, the characteristics of compliant mechanisms are presented. In the second part some systems based on compliant mechanisms are described. These mechanisms have in their structure elastic elements and / or flexure hinges materialized by lamellar elastic elements. The results of FEM analysis are given, the developed prototypes are described and the experimental results are discussed.*

**Key words:** *compliant mechanisms, flexure hinges, FEM analysis.*

### 1. INTRODUCTION

The compliant mechanisms have a smaller number of movable joints, such as turning and sliding joints. The result is reduced wear and reduced need for lubrication. They also conduct to reduction of noise and vibration due to reduced number of components and friction movements. Backlash reduction due to a decreased number of joints increases the mechanism precision. They are used to transfer / transform energy and motions across themselves as desired by the users (Fig. 1), [1].

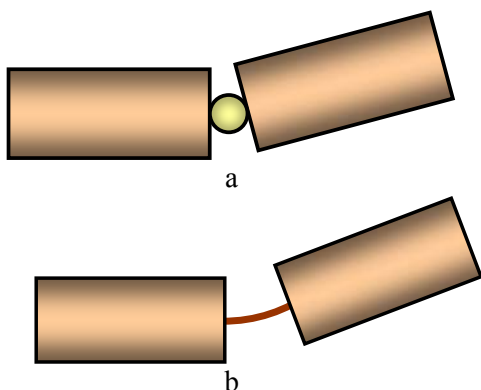


Fig. 1 Classical (a) and flexure (b) joints

Conventional joints cannot be easily miniaturized, but using compliant mechanisms this problem can be resolved.

Functionally and constructively, the flexure hinges that are active through bending may possess a single bending axis, two bending axes or multiple bending axes. The axes about which bending is enabled are also known as sensitive axes [2, 3].

The notch shapes are determined by the available production technologies. So far the notches were mainly produced by conventional rotating machine tools and therefore limited to circular shapes.

Compliant mechanisms can be miniaturized for use in simple mini-systems, micro structures, actuators and sensors. The monolithic construction simplifies production, enabling low-cost fabrication [4, 5].

### 2. THE STUDIED COMPLIANT MECHANISMS

Following there are presented the constructive variants of compliant mechanisms [6]. Solid models for the mechanisms are presented in figures 2 - 4. These mechanisms have in their structure elastic elements and / or

flexure hinges materialized by lamellar elastic elements. Few of these mechanisms are realized of a single piece (monolithic structure). The solid models are developed using Solid Works software.

In figure 2 some compliant mechanisms for linear motion are proposed.

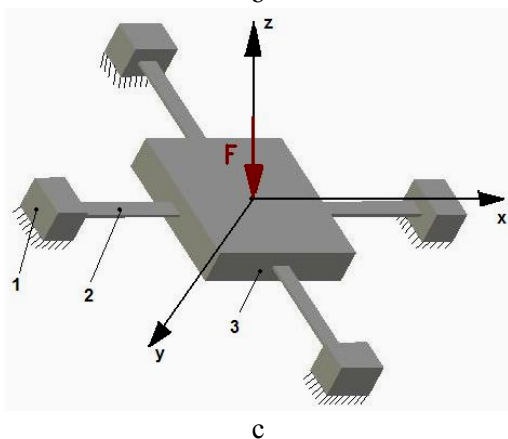
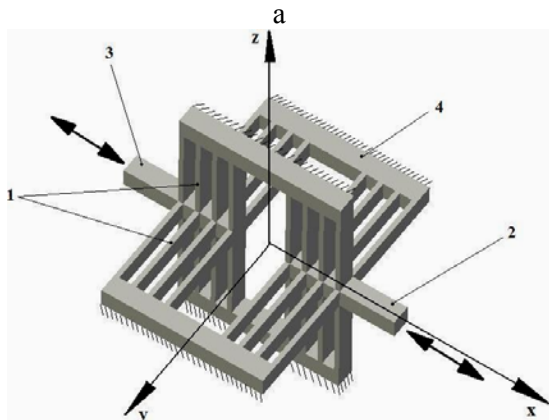
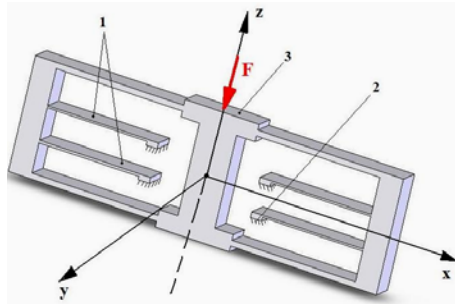
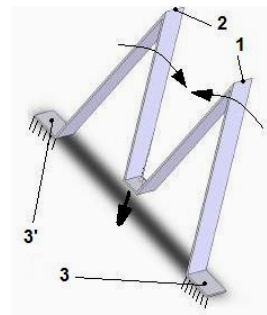


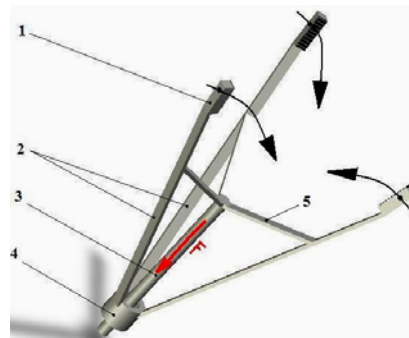
Fig. 2 The compliant mechanisms for linear motion

Figures 2a, b, c shows different variants where the element 3 is the output element, and flexure hinges are realized with lamellar spring.

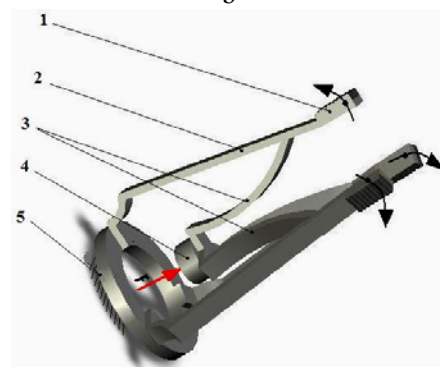
In figure 3 are presented compliant minigraspers with: two fingers (Fig. 3a) and three fingers (Fig. 3b, c).



a



b



c

Fig. 3 Compliant minigraspers

Figure 4 presents a parallel platform based on compliant mechanism.

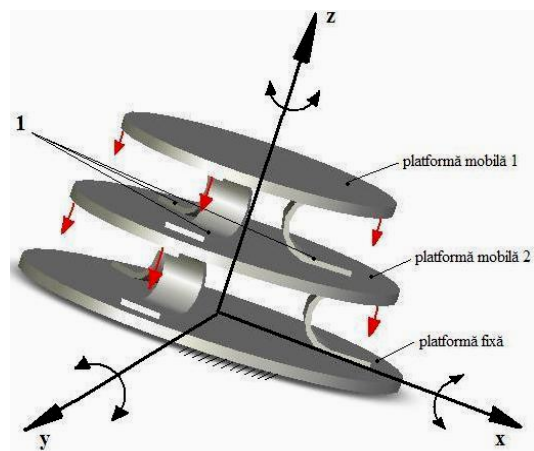


Fig. 4 Parallel platform

### 3. THE FEM ANALYSIS

The finite-element technique, through several commercially available software programs, is a favourite tool for modelling and analyzing the behaviour of compliant mechanisms [7]. A few reasons for the preference given to the finite-element procedure in both industry and research include the speed of analysis, wide choice of analysis types (static, modal, dynamic, thermal, and mixed/coupled-field are the basic modules currently incorporated in professional finite-element software), and direct interaction with related CAD tools.

effectiveness during operation according to the following criteria:

- Capacity of producing the desired limited rotation.
- Precision of rotation.
- Stress distribution in the model.

The results of the displacements are presented in figure 6.

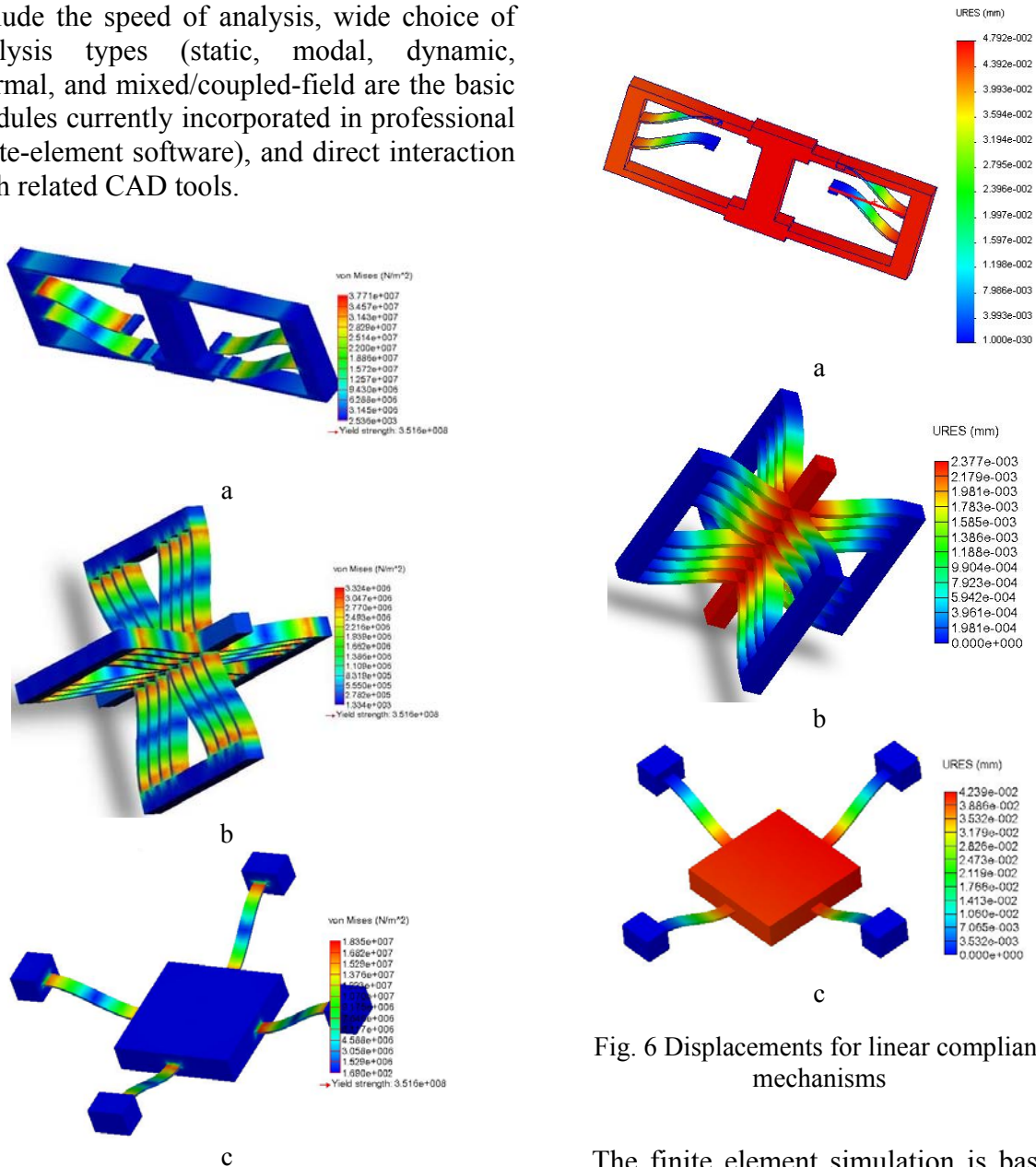


Fig. 5 Von Mises stress for linear compliant

Fig. 6 Displacements for linear compliant mechanisms

The results concerning the von Mises stress for linear compliant mechanisms are given in figure 5.

The compliant mechanisms can be designed and analyzed based on their

The finite element simulation is based on the static model of the compliant mechanisms, the material used for this analysis being steel. The FEM analysis is performed using CosmosWorks software.

Following there are presented the FEM analysis results for studied minigrippers and proposed parallel platform (Fig. 7-10).

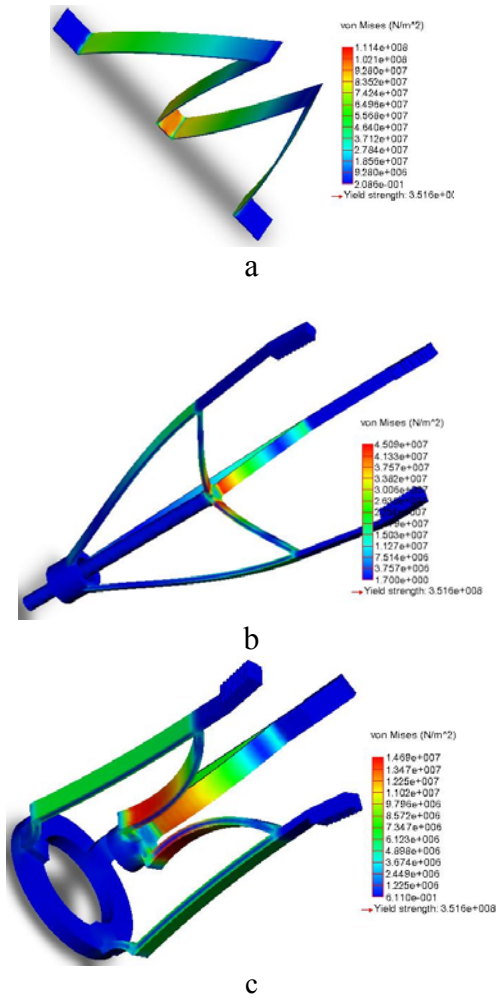


Fig. 7 Von Mises stress for compliant minigrippers

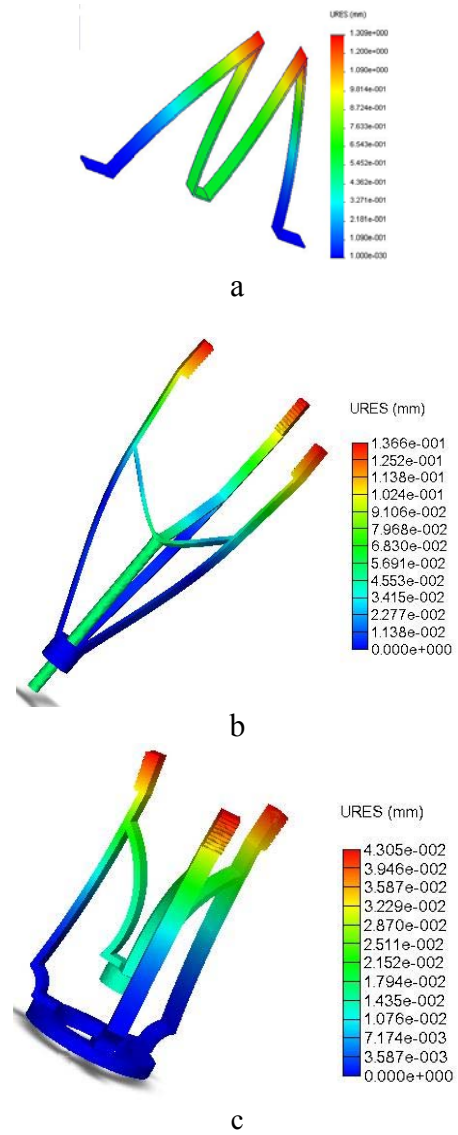


Fig. 9 Displacements for compliant minigrippers

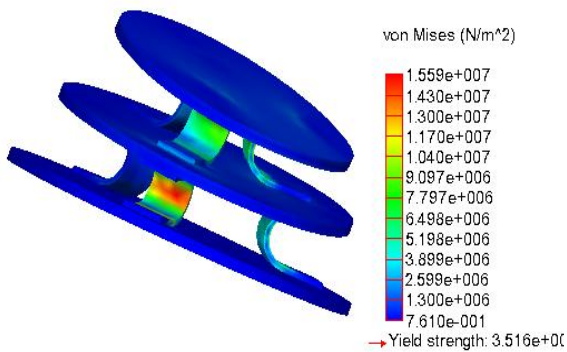


Fig. 8 Von Mises stress for parallel platform

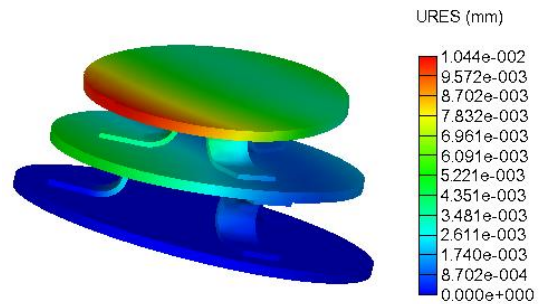


Fig. 10 Displacements for parallel platform

#### 4. DEVELOPMENT OF A COMPLIANT MINIGRIPPER

Following there is presented the developed compliant minigripper which equips an experimental test bench (Fig. 11).



Fig. 11 The compliant minigripper realized

The minigripper is actuated by an actuator based on Shape Memory Alloy (SMA) helical spring. It is called *Electric Piston* (Fig. 12), [8]. Because the linear actuator activates by electric heating, the contraction time varies greatly with the applied current. The higher the current, result the faster the heating, and the faster the contraction. Currents over 10 amps can actuate the piston in less than one second. However, higher currents require extra caution to protect the piston's SMA spring from damage due to overheating.

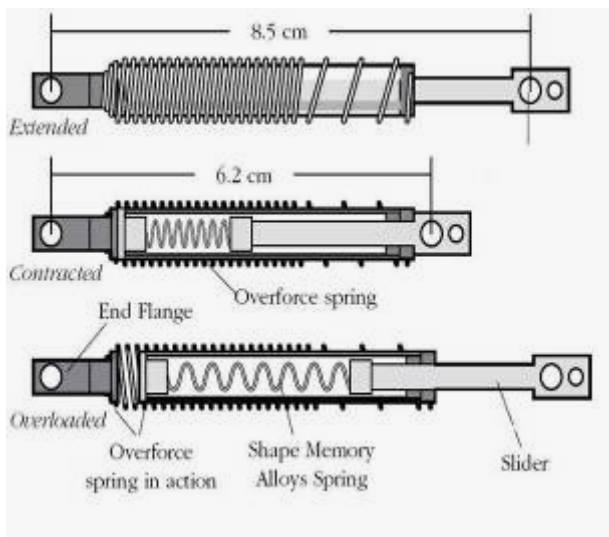


Fig. 12 Electric Piston overview

Temperatures over 300°C can cause permanent damage to the SMA coil spring and cause it to “lose its memory” [9, 10]. Also,

current levels below 2 amps generally will not heat the SMA spring sufficiently for actuation.

Since the SMA spring's heating and cooling rate depends on the surrounding temperature, cold conditions require somewhat higher activation currents and can have faster overall cycle times.

The structure of the test bench for measuring the data referring to the actuated minigripper is presented in figure 13.

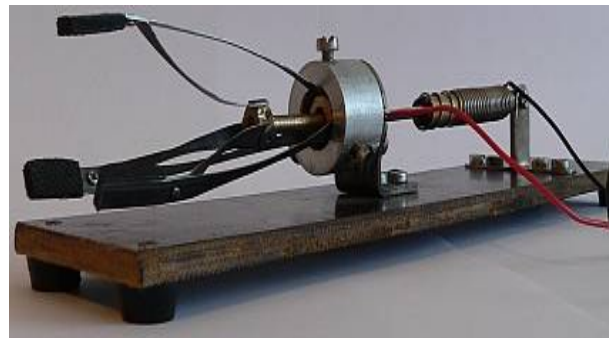


Fig. 13 Example of the developed bench

The bench contains next components: minigripper, nut for fixing minigripper, plate support, Electric Piston with Shape Memory Alloy spring and support for fixing the electric piston. For different input heating currents, different heating durations were obtained. The linear stroke of the actuator is around 20 mm, that is enough for complete closing of the minigripper' fingers. The net force developed by the actuator is 4.5 N

#### 5. CONCLUSION

The compliant mechanisms can be successfully applied to the fields that need high precision positioning in small workspace.

In this paper we present some original compliant mechanisms which are designed and analyzed. The structure and function of an experimental test bench for a compliant minigripper are presented.

Finite element simulations are performed to verify the accuracy of model-predicted compliance factors for several design configurations. The results are in good agreement with those produced by the analytical approach within 10% relative errors.

The measurements validate the FEM analysis for steel material.

The compliant mechanisms have few advantages comparatively with linkages. They are already used in the field of MEMS due to their reduced dimensions and simple structure. For the compliant mechanisms it is very important the material that are made of because under the same loading, for different materials can be obtained different output values.

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## MODERN INSTRUMENTS FOR MEASURING AND VERIFICATION OF SURFACES MADE BY MECHANIC PROCESS

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**Abstract** :This paper is aimed to be a short presentation of modern instruments for measuring and verification of surfaces made by mechanic process in aeronautics and automotive industry, education, medical application, heritage preservation and architecture, etc.

**Keywords**: coordinate measuring machine, 3D scanner, inspection

### INTRODUCTION

#### Coordinate Measuring Machine

The Coordinate Measuring Machine first appeared in the early 60's and the Coordinate-Measuring-Machine industry was immediately born. A "coordinate measuring machine" (CMM) is a device for measuring the physical geometrical characteristics of an object. This machine may be manually controlled by an operator or it may be computer controlled. Measurements are defined by a probe attached to the third moving axis of this machine. Probes may be mechanical, optical, laser, or white light, among others.

The 3D measuring machines are widely used for measurements on parts and calculation of simple geometrical elements as for example points, line, plane, circle, cone, cylinder etc. These measurements allow then to check the conformity of the parts based on general linear and angular dimensions and on form and positional errors as defined in norms like ISO 1101.

The typical CMM is composed of three axes, an X, Y and Z(fig.1). These axes are orthogonal to each other in a typical three dimensional coordinate system. Each axis has a scale system that indicates the location of that axis. The machine will read the input from

the probe, as directed by the operator or programmer. The machine then uses the X,Y,Z coordinates of each of these points to determine size and position.



Fig. 1. Coordinate Measuring Machine

A coordinate measuring machine (CMM) is also a device used in manufacturing and assembly processes to test a part or assembly against the design intent. By precisely recording the X, Y, and Z coordinates of the



target, points are generated which can then be analyzed via regression algorithms for the construction of features. These points are collected by using a probe that is positioned manually by an operator or automatically via Direct Computer Control (DCC).

### Arm Articulated CMM

An articulated arm configuration is used for portable, or tripod mounted style machines. The articulating arm allows the probe to be placed in different directions with respect to the object being measured. These systems contain a series of counterbalanced six-degrees-of-freedom linkage arms as shown in fig. 2. Each of the arms is provided with precision rotary transducers that encode the rotary motion of the linkages and calculate coordinates in 3D space. The measuring envelope of this type of system is spherical, enabling measurement of hard to reach locations within components. Accuracy of measurements is largely affected by operator skill and is lower as compared to bridge style systems. These types of systems are manufactured with light weight alloy for high rigidity and low weight. They are configured to operate at temperature ranges as high as 50°C. Arm type CMMs are versatile systems with a wide range of accessories for on-site measurement tasks.

### The latest improvements and changes

In the last decade or so, several developments have led to improved CMM functionality. These include:

- *Accuracy and affordability.* According to Brown & Sharpe, a machine that was within the 10 micron range of accuracy 10 years ago, may now be in the five to six micron range. Ultra-high-accuracy machines a decade ago were in the one to two micron range and have remained there since. This may be a sign that improvements in accuracy have reached a plateau, allowing a move toward value-oriented high-accuracy machines.

- *Software.*

PC-DMIS offers very good support for CAD models, but does not support well, what is defined as "special geometry".



Fig. 2. Arm Articulated CMM

QUINDOS is a software that offers very big number of complete options for measurements on precisely machined parts with special geometry and is retained to be a very powerful solution.

CHORUS CAD is a powerful and flexible measuring and inspection software, which provides full access to a number of powerful integrated functions, ranging from basic dimensional measurement to surface generation and analysis.

- *The user.* One of the most influential elements in directing new CMM technology is

the ways in which CMM users have changed. Ten years ago, the CMM operator was a quality engineer. Now, however, many more manufacturing engineers are operating CMMs, as the quality responsibility has shifted from the end-user to an engineer working midprocess. There is less need at the end of the line to determine whether things go right or wrong because manufacturers determine that as they make the product. Consequently, new versions of software are being developed with the manufacturing engineer in mind, rather than the quality engineer.

- *Portability.* Because the focus has shifted from quality control to process control, CMMs are starting to be located on the shop floor, whereas they once may have been housed in a more controlled environment. This shift has

led to development of CMMs that are tolerant of less environmentally controlled areas.

### 3D scanners

A **3D scanner** is a device that analyzes a real-world object or environment to collect data on its shape and possibly its appearance (i.e. color). The collected data can then be used to construct digital, three dimensional models useful for a wide variety of applications. These devices are used extensively by the entertainment industry in the production of movies and video games. Other common applications of this technology include industrial design, orthotics and prosthetics, reverse engineering and prototyping, quality control/inspection and documentation of cultural artifacts.



Many different technologies can be used to build these 3D scanning devices; each technology comes with its own limitations, advantages and costs. It should be remembered that many limitations in the kind of objects that can be digitized are still present: for example optical technologies encounter many difficulties with shiny, mirroring or transparent objects.

The two types of 3D scanners are contact and non-contact. Non-contact 3D scanners can be further divided into two main categories, active scanners and passive scanners. There are a variety of technologies that fall under each of these categories.

### Inspection

The laser scanner is the perfect inspection tool for analyzing and reporting geometric dimensioning and tolerancing (GD&T). The

direct .stl files generated can easily be imported into inspection software and quickly processed. The 3D scanner can help you with scanning and measuring of objects of any sizes in various environments, generating inspection and colorimetric reports and:

- Non contact inspection
- First article inspection
- Supplier quality inspection
- Part-to-CAD inspection
- Conformity assessment of 3D models against the original parts / production tooling
- Conformity assessment of manufactured parts against the originals

Fig.3. 3D Scanner

**Reverse Engineering & Styling, design & Analysis:** Facilitates surface reconstruction, class A surfacing, 3D modeling, clay model digitizing, mechanical design, tooling & jigs design, maintenance, repair & overhaul (MRO) and finite element analysis (FEA).

**Other applications** include 3D scanning of existing objects, 3D archiving, medical

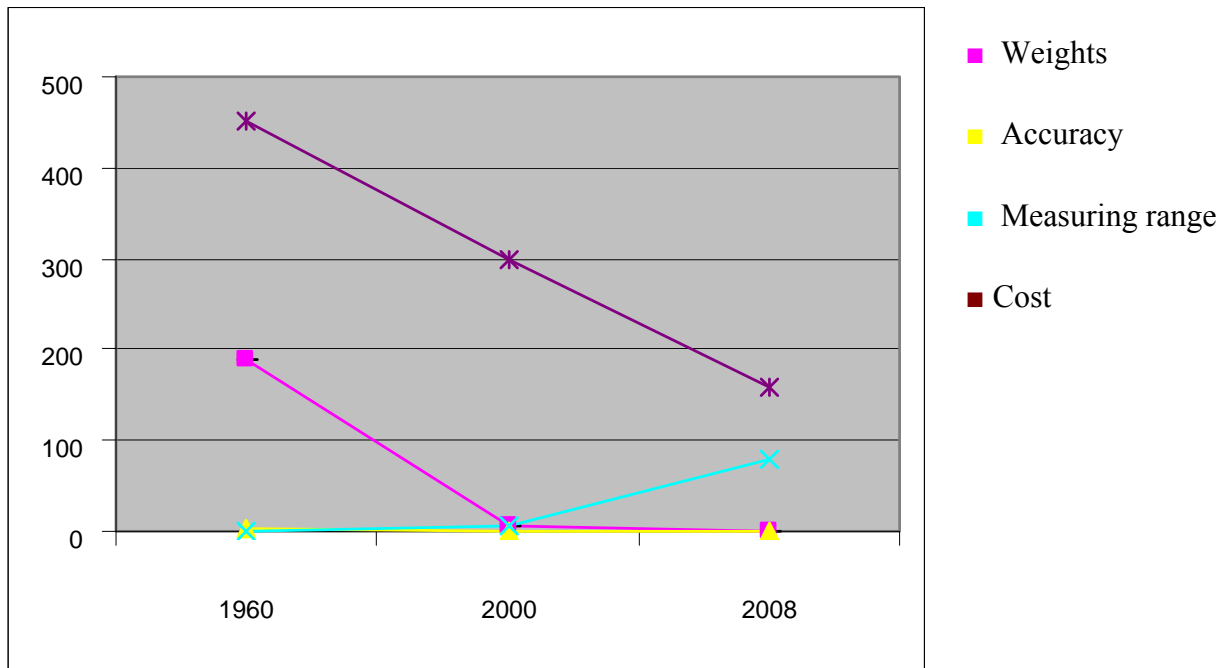
applications, complex shape acquisition, measurements archiving, damage assessment, digital models and mock-ups, packaging design and rapid prototyping.

### CONCLUSIONS

The future of the CMM is difficult to predict many are suggesting that CMM Technology will become obsolete in the coming decade. CMM Products however continue to dominate the manufacturing inspection arena and unless a major technological innovation occurs the CMM will remain the focal point of the Quality Laboratory. The current trend is to move CMM Measurements to the production Floor and many new designs have come to market in recent years specifically aimed at this application. CMM have also gotten faster over the past decade although few customers need speed to be achieved at the expense of CMM Accuracy.

Table 1 express the evolution of coordinate measuring machines from generation to generation.

	<b>CMM</b>	<b>Arm Articulated CMM</b>	<b>3D scanners</b>
<b>Year</b>	1960	2000	2008
<b>Weights(kg.)</b>	from 190 to 227	from 5.9 to 6.8	from 0.980 to 1.250
<b>Accuracy(µm)</b>	from 0.6 + L/600 to 2.8 + L/400	from 0.025 to 0.150	20 ±0.2L/1000-20±0.1L/1000
<b>Measuring range(m)</b>	0.8 to 1.5	1.8 to 5.2	0.5 to 80
<b>Cost (*100)</b>	450	300	159



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## SOLUTIONS OF INCREASING THE PRODUCTIVITY IN MODULAR FIXTURE DESIGN USING AUTODESK INVENTOR

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**Abstract:** *The paper presents some aspects concerning modular clamping systems achieving significant productivity gains in design time. The three main categories of procedures applicable in modular fixtures design are: 1) the modular components (which are in a finite number and also having a finite possibilities of combining) can not cover certain locating schemes and workpiece clamping, thus it is necessary to design specific components that complicate the design; automating the design of special elements increases the productivity and quality of the design process. 2) adjusting the relative position and orientation of the components can be discrete and/or continuous, automatic representation of clamping subassemblies having necessary adjustment dimensions is time saving. 3) creating assemblies of higher rank to those existing in a modular set.*

**Key Words:** *modular fixture, clamping, Computer Aided Design, Computer Aided Assembly, spatial representation, Modular Fixturing Systems*

### 1. INTRODUCTION

The constant tendency in last decades was the orientation of the production towards the diversified needs of consumers and the result is moving the center of gravity to the small and medium series production of batches organized. Consequently, they have developed technologies and flexible equipment, that respond quickly and effectively from economic point of view to the highly dynamic competitive markets, with claims of high quality.

Applying the modular principles in design, construction and operation leads to increase the flexibility of equipment. In these conditions, a relatively complex mechanical system operating for a period much shorter than the sustainability of its components is rational to build a set of modular components, and that after the system is no longer required to be disassembled and reused modules [1, 2].

From the structural point of view, we have two types of flexible fixtures: modular fixtures (most populars) or reconfigurables nonmodular fixtures (rarely applied in industry) and intelligent fixtures.

Modular workholders fills the gap between the general-purpose and special-purpose fixtures. Now, the modular workholders permit tooling to be built with the custom-made accuracy of special-purpose fixturing but at a cost of general-purpose fixtures.

Two forms of modular fixturing systems are available today: modular systems with grid pattern holes (MSH) and modular systems with T slots. The first system offers several advantages over second system: many more positional possibilities, more security, repeated setups are easier, if grid pattern holes are damaged, these are repairable. This is the reason that the present paper focuses on MSH.

The most important MSH of general use for machine tools, commercially available are: Carr Lane, AMF, Halder, Kipp, Norelem, IMAO and Nabeya [3, 4, 5].

Advantages of using modular fixtures need to be pursued in all life stages of a device: design, execution, operation, maintenance:

- a spectacular decrease of time required for design and construction;
- the design is simple as a given modular set that is operating with a limited number of normalized components need to be assembled, using CAD and the modules database designing time is reduced;
- the documentation is much simplified;
- online improvement process can be facilitated by rapid positions changing, modules orientation, their replacement;
- design and assembly can be solved directly by the worker operating the modular set;
- setup times to install the modular fixture on a machine tool are reduced;
- storage cost is low, the device is desassembled after production and the modules require a less storage space.

Limitations:

- a modular set is expensive;
- the stack up of geometric errors of the assembled components result in lower accuracy and decreasing of rigidity;
- modular sets devices can match-up for parallelepiped workpieces (enclosures, plates etc..) rather than the revolution workpieces;
- generally, the extent of a modular fixture is more than a dedicated device.

**2. DESCRIPTION OF MF**

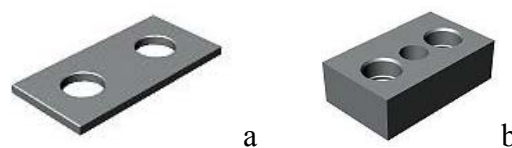
Modular fixture system is designated to hold the work piece against the locators during machining in industrial production, mainly in single piece production or small batch production.

The typical structure of a fixture consists of a base-plate, to which the clamping and locating units are attached. The locator is the part of the locating unit that contacts the workpiece. The clamping units consist of a clamp supporting unit and a clamp that actually contacts the workpiece and exerts a clamping force on it. Fixtures may contain different numbers and different types of clamping and locating units, but units generally always follow the same basic format that consists of a supporting unit upon which sits a particular type of locator or clamp [3].

**3 AUTOMATING DESIGN OF SPECIAL FIXTURE COMPONENTS**

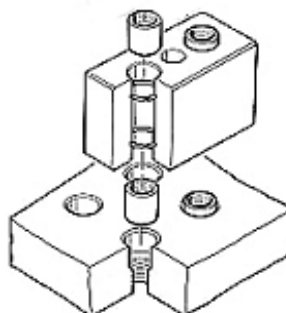
An example of automating design of nonmodular fixture components is the riser block for the V – locator, necessary when a shaft with two different diameters is located.

Suppose that the modular set is AMF-M12, where exist two types of spacer blocks (fig. 1): spacer without accurate locating (type 1, fig. 1a) and with accurate locating (type 2, fig. 1b).



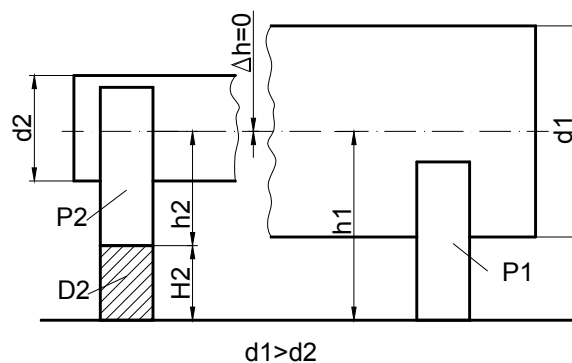
**Fig. 1 Spacer blocks**

The second spacer uses two elastic centering sleeves for positioning without clearance (fig.2).



**Fig. 2 Spacer positioning**

**3.1. Case 1. One riser block**



**Fig. 3 Case 1**

where P1, P2 are V- blocks with 90 ° opening, precisely positioned, allowing pieces with diameters ranging between 8 ... 80 mm, and D2 is a riser block.

$$h_i = 31.37 + d_i / \sqrt{2}, i=1, 2 [5] \quad (1)$$

The condition of correct location is  $\Delta h = 0$ .  
 $h_1 = h_2 + H_2$

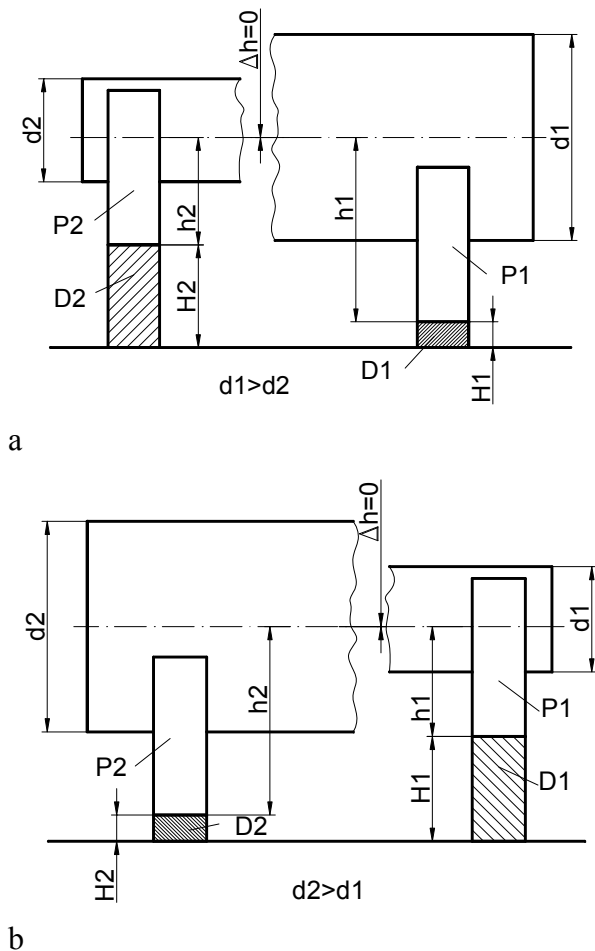
$$H_2 = \frac{d_1 - d_2}{\sqrt{2}}, d_1 > d_2 \quad (2)$$

**3.2. Case 2. Two riser blocks**

If  $\Delta h = 0 \rightarrow h_1 + H_1 = h_2 + H_2$

There are two possibilities  $d_1 > d_2$  or  $d_2 > d_1$ .

$$H_2 - H_1 = \frac{d_1 - d_2}{\sqrt{2}} \quad (3)$$



**Fig. 4 Case 2**

Minimum cost is achieved by using one modular riser block (D1) and one non-modular component (D2) which will be machined (fig

4.b) because we need to machine less material for a thinner special riser block.

The case 1 is more accurate than case 2.

**3.3. Setting up a constructive form of the riser block.**

In case 1, if we use a modular V-block the extreme workpiece diameters are:  $d_{min} = 8$  mm and  $d_{Max} = 80$  mm.

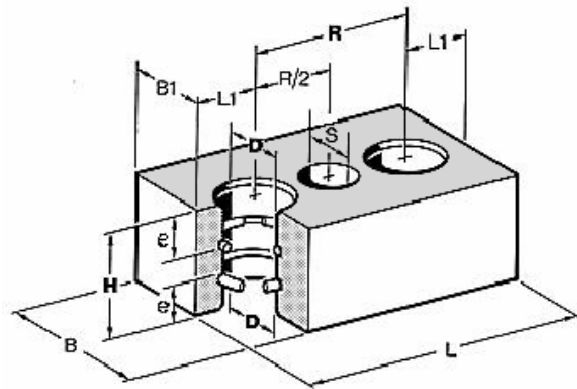
$$d_{Max} - d_{min} = \sqrt{2} H_2 \rightarrow H_{2Max} = 50.9117 \text{ mm.}$$

Note the need for construction restrictions.

a) for  $H_2 < 5$  mm an imprecise positioned spacer can be used (fig. 1a):

$$H_2 \leq 5 \text{ mm} \rightarrow d_{Max} - d_{min} = 5 \cdot \sqrt{2} = 7.071 \text{ mm.}$$

For  $H_2 = 5$  mm is possible to use a shorter centering surface of the alignment bushing  $e = (20.5 - 5) / 2 = 7.75$  mm, instead of normal 10 mm.



**Fig. 5 Support [5]**

b) if  $H_2 \geq 2e = 20$  mm, where  $e = 10$  mm is the half of sleeve height (fig.5), result:

$$d_{Max} - d_{min} = \sqrt{2} \cdot 20 = 28.28 \text{ mm}$$

If we use two identical V-blocks and riser block type 1  $\Delta d = 0 \dots 7.071$  mm, and for type 2  $\Delta d = 28.284 \dots 72$  mm, thus  $\Delta d = 7.071 \dots 28.282$  mm is not covered. Using two riser blocks (fig.4) we can fill the gap: a modular riser block and a special riser block. Because the AMF riser block has  $H_2 = 50$  mm, from (3) results the height of the special spacer:

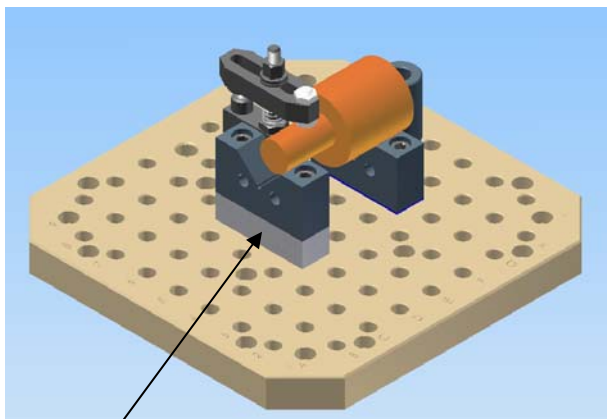
$$H_2 = 50 - \frac{\Delta d}{\sqrt{2}}$$

If  $\Delta d = 7.071$  mm  $H_2 = 45$  mm, if  $\Delta d = 28.284$  mm  $H_2 = 30$  mm. In this case, because  $H_2 = 30 \dots 45$  mm we will machine a riser block type 2.

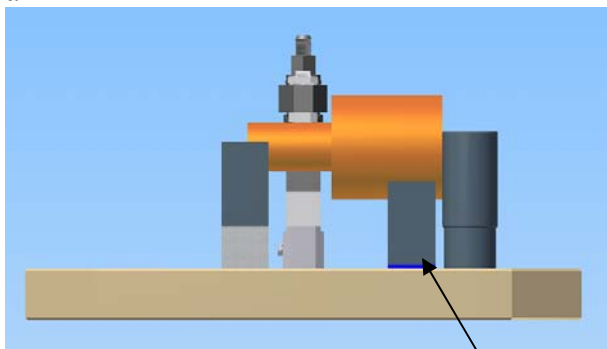
#### 4. DIMENSIONAL ADJUSTING OF MODULAR COMPONENTS.

With Autodesk Inventor the usual sequence of design is to put the workpiece on the screen. The next step in assembling the fixture is selecting the appropriate tooling plate of sufficient size and positioning under the workpiece. Next, the locating components are selected to properly locate and support the workpiece in the fixture.

The supports are then mounted to the tooling plate with locating screws. The V blocks locate cylindrical workpiece. The adjustable stops locate the workpiece in areas where fixed type locators cannot. The mounting elements (locating screws, riser blocks etc.) perform a variety of different mounting functions for the other accessories and components used in fixturing workpieces (fig.6).



a



b

**Fig. 6** Fixturing of the workpiece

Performance in the assembly design assumes the proper use of subassemblies and the role that adaptivity plays in performance. The assembly presented in fig. 6 was created by placing 3D constraints between parts in order to position and hold them together, using multiple levels of

assemblies for sake of organization and performance. For the assembly the two riser blocks (fig. 6.a, 6.b) are adaptive parts created in the Create In-Place Component dialog box that ensure a flush constraint added between the constraint sketch plane and the selected face. The Project Geometry command projects the entire face, the sketch become adaptive automatically and than is extruded to the next face of the tooling plate. Than an iAssembly factory was created, a table-driven assembly file that allows the use of component part configuration to build variations of the original design.

#### 5. CONCLUSIONS

The process for a modular fixture design consists of selecting the suitable modular components and assemble them in the application. Automating the design of nonmodular components we obtain an increase of productivity and quality of the design process.

Fixing clamps combine discrete adjustment by height spacer with continuous adjustment mechanism based on screw-nut. Determination and representation of automatic clamping subassembly at necessary adjustment dimension, spare designer calculations and repetitive assembly operations.

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## THE INFLUENCE OF CHEMICAL COMPOSITION, STRUCTURE AND THERMAL TREATMENT ON THE CASTING REFRACTORY ALUMINUM ALLOYS

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**Abstract:** There is a analyze of Al alloys pistons used in the construction of thermal engines pistons. Are studying the influence of heat treatments, tempering and return, of mechanical properties of aluminum alloys. The question of maintaining these properties at the operating temperatures of engines piston, heat stability and structure of alloys based on the repeated cycles of heating involved in the operation of engines is discussed.

**Key words:** aluminum alloy ,mechanical proprieties, alloying elements, pistons , thermal treatments

### 1. INTRODUCTION

The usage of alloys with base Al in the casting pistons of the thermal engine heat is widely spread because they offer advantages, since the beginning of XX century. In these alloys there is two types types: I alloy containing as alloying elements mainly Cu, and II alloy containing elements that mainly aliere Si.

In the first type of cast alloys there is a structure in which the predominant  $\alpha$  solid solution as the base metal matrix, and the second type predominates binary eutectic  $\alpha_E + Si_E$  or more complex eutectic structure  $\alpha_E + Si_E + Ea_E$ .

The most used chemical compositions of these two types of alloys is presentated in Table 1 and represent mean values , because in diferent countries the chemical composition of these alloys differ greatly.

In Table 2 there are examples of aluminum alloys used in countries which product small power cars.

Table 1 Average chemical composition [%] of the two types of Al alloys

Alloy	Cu	Si	Mg	Ni	Mn	Ti	Others
I	6.9-7.1	4.4-4.8	0.3-0.4	-	0.3-0.5	-	Fe<0.8
II	0.7-3.5	11-13	0.8-1.3	0.8-1.5	0.2-0.7	0.15-0.2	Fe<0.7

Table 2 Average chemical composition [%] of Al alloys cast in pistons

Contry	Si	Cu	Mg	Ni	Mn	Ti
STUA	8.5-13	0.5-4	0.5-1.5	0.9-1.5	0.2-0.9	-
United Kindom	11-13	0.5-1.3	0.8-1.3	2-3	-	-
Ceh Republic	11.5-13	0.8-1.3	0.8-1.3	1-2	0.3-0.5	-
Italy	12.4-15	0.5-4.7	0.7-1.4	2-2.7	0.6-0.8	0.1-0.2
Japon	8.5-13	0.8-4	0.7-1.5	0.5-2.5	-	-
German	8.5-13	0.8-2.8	0.8-1.5	0.2-1.3	0.3-1.3	-
Russian Federation	11-13	0.75-3.4	0.75-1.4	0.75-1.4	0.25-0.7	0.14-0.22

The quality request for cast alloy in pistons for thermal engines is : specific weight and

coefficient of thermal expansion temic reduce (at least in the temperature field in which pistons works 200 -400 ° C) , high fluidity casting, low tendency the formation of cracks at hot. , opportunity to used pressure casting machines (MTP), dimensional stability over time, etc..

Most use alloys is type II for the small power engines at cars and motorcycles. [11] [1] [3] [4] [5] Specifically speaking for Dacia car, pistons the recommended chemical composition given in Table 3.

Table 3 Chemical composition of alloy type II

Al Alloy	Cu	Si	Ni	Mn	Ti	Zn	Fe
II	1.5-1.3	11-13	0.8-1.3	0.3-0.6	0.05-0.2	<0.5	<0.8

This alloy has been used in experiments made in [6] [7]

## 2.EXPERIMENTAL STUDY OF MECHANICAL PROPRIETIS

Experiments were performed on alloy ATSi12CuMnNi STAS 2001/2-80. Chemical prescribed of alloy is given in table 4.

Table 4 Chemical composition of Al alloy ATSi12CuMnNi on the STAS 2001/2-80

Al Alloy	Cu	Si	Mg	Ni	Mn	Ti	Zn	Fe
ATSi12CuMnNi	0.8-1.5	11-13	1.0-1.5	0.8-1.3	0.2-0.5	0.2	<0.5	<0.8

This alloy is casted under pressure and after that is subject to thermal treatment stabilization (TTS) which consists of heating to 230 °C for 11 hours followed by cooling in air. This type of heat treatment that attempts to merge solid solutions for stabilize the alloy [11] [9] [10]. After casting in pistons of engine the alloy will not suffer structural changes due to heating and cooling cycle that happens during operation.

These variations starts on the ambient temperature 20 °C and reach. 400 °C reach. [2] [9] [10] [11]. These prescriptions technological default by parent company Renault have not taken account of research which shows that necessity to stabilize the structure of ATSi12CuMnNi alloys (meaning phase

transformation of these alloys). It is necessary to perform a heat treatment capable of providing structural stability for alloy. It is important that the material of thermal engine piston do not suffer sensitive phase transformation after mounting sensitive in cars and during their operation. Results can be seen in the following two types of tests on cylindrical samples 12.5 mm of alloy type ATSi12CuMnNi cast in shell.

Table 5 Chemical composition of alloy used in experiment

Alloy	Si	Cu	Mg	Ni	Mn	Ti	Fe	Zn	Sn	Pb	Al
ATSi12CuMnNi	11.8	0.75	0.95	0.80	0.20	0.21	0.7	0.16	0.03	0.07	upto 100

## 3.EXPERIMENTAL RESULTS AND DISCUSIONS

There is mechanical tests for Rm (mechanical resistance) HB (hardness) and A (percent) to continues to heat up to 325 °C. The aim is to determine the required time for stability of the mechanical properties at different temperatures of heating.

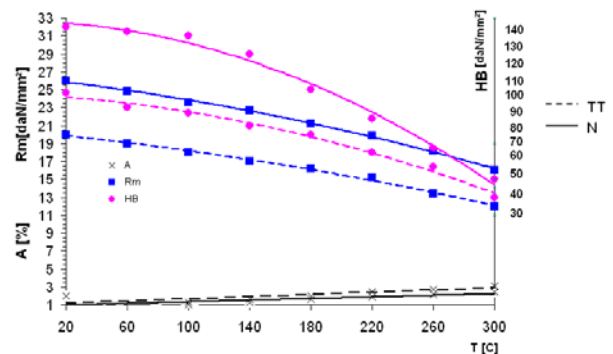


Figure 1 Variation of the mechanical properties alloy ATSi12CuMnNi, up to continuous heating up to 1 – state thermal treated TT (hardening and aging) 2 - state thermal untreated N

### 3.1 CHANGES IN MECHANICAL PROPERTIES OF DIFFERENT STATE OF ALLOY IN FUNCTION OF TEMPERATURE TO CONTINUES HEATING UNTIL 325 OC

Tended to obtain maximum of mechanical proprieties (mechanical resistance  $R_m$  and the hardness HB and A) in the working conditions is necessary in machinery construction . On the other side the values of mechanical proprieties is necessary to be corelate with exact working condition of engines.

values are almost equal. From this results that alloy should not be treated because at operating temperature of thermal engine the mechanical proprieties were be mutual compensate.

So therefore the first conclusion that refer to the favorbile states favorbile use of aluminum alloys seems to be a tendency to use aluminum alloys untreated thermal (at least by tempering and return)

### 3.2 DETERMINATION OF TIME REQUIRED TO STABILIZE THE MECHANICAL PROPERTIES DEPENDING ON THE TEMPERATURE OF HEATING

The aim is to determine the time needed to stabilize the mechanical properties depending on the temperature of heating.

The main issue is to determine the minimum values for times at different temperatures ensuring the structural stability of alloys in time. Figure 2 shows the influence of temperature and duration of heat on  $R_m$  (breaking resistance) in hot state and cold state after different periods of maintenance until mechanical proprieties become „constant”. By cold state we understand ambient temperature. Figure 3 shows the influence of temperature and time to the hardness (of course, until the hardness is stabilize.)

From values of mechanical properties obtained and the variation of these values is the following the conclusions:

- Regardless of the initial values of the mechanical properties decrease with increasing test temperature;
- Values decrease is higher for untreated thermal alloys ;
- Getting constant values of mechanical properties takes place at different times to maintain function of temperature;
- If the heating tempertura designed to stabilize the alloy increase so the time maintenance is decrease ;

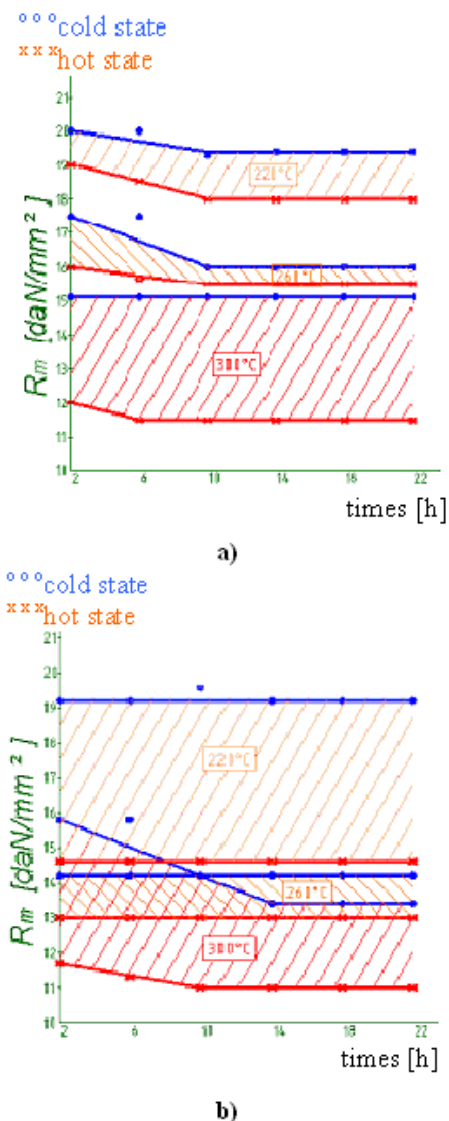


Figure 2 Changes in mechanical property  $R_m$  depending on temperature and time in states: a - thermal treated, b- untreated

Thus Figure 1 shows that mechanical resistance starts with initial values of very different. At operating temperature of thermal engine these

-Temperature and time for thermal treatment an used / prescribed by the company producing it is not properly because assure less than 1/3 of the depth of penetration request operating conditions of engine [ 2], [5], [13], [14]

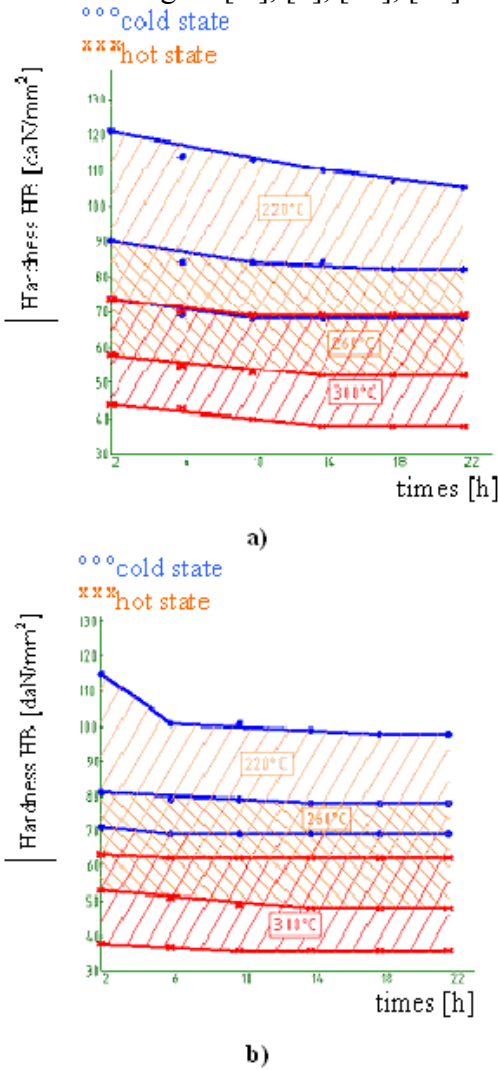


Figure 3 Influence of temperature and time on maintenance of HB alloy ATSi12CuMnNi until to stabilize the HB values in cold state to and hot state a - thermal treated, b- untreated

The studies of another alloys very similar in terms of chemical composition used in casting pistons Dacia cars have shown that alloy is not used at full capacity and technological possibilities of operating.

### 3.3 STUDY THE INFLUENCE OF ELEMENTS OF ALLOYING ELEMENTS EA FROM TRANSITION GROUPS ON MECHANICAL PROPERTIES OF ALLOYS ATSi12CuMnNi.

The anterior researches showed unquestionably beneficial influence of from alloying elements from groups transition on the mechanical properties [1] [2] [11] [7] [8] [14] and therefore on the operating behavior of cast alloy type siluminium in pistons. Tests on the mechanical properties versus chemical concentration of alloying elements is presented in figure 4

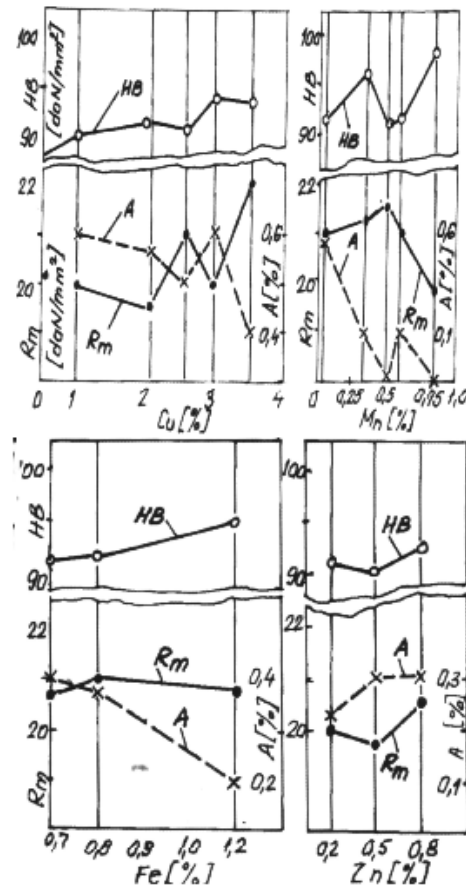


Figure 4 Influence of alloying elements Ea on alloys used in casting pistons thermal engine

Figure 4 shows the influence on the mechanical properties for alloying elements Ea often used to made alloys for pistons.

Alloying elements of the groups of transition leading to the formation in alloy structure intermetallic compounds intermetallici very stable [2], [6], [14], [15], which distributes on the limits of separation of granular solid solution  $\alpha$  and in interior of solid solution  $\alpha$ , this grains promoting growth the refractory (see mechanical properties at high temperatures).

To illustrate the structure of alloy ATSi12 + Ea figure 5 show the microstructure in cast state at scale 100:1

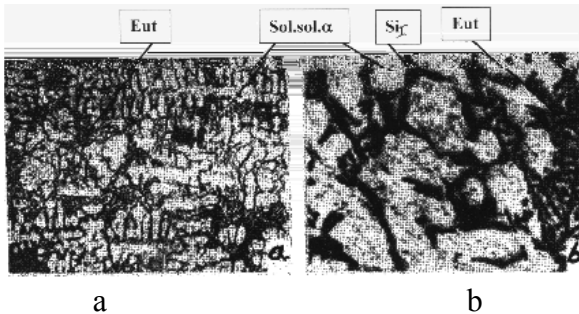


Figure 5 Microstructure alloy ATSi12 +Ea cast state state 100: 1, b-200: 1 attack with 10% NaOH

In the structure is observed formations of allied  $\alpha$  solid solution (alloying elements dissolved in Al) and eutectic (Eut) composed of  $\alpha$  solid solution and  $Si_E$  (element state silicon)(solid solution  $Eut = \alpha$  solid solution +  $Si_E$ ) and even patches of primary silicon  $Si_I$ .

From the tests on alloys ATSi12CuNi which aimed to determine optimal chemical composition and procedure of thermal show values presented maximum mechanical properties, particularly, at higher heating temperatures that characterized refractory casting aluminum alloy. Revealed that:

1. Mechanical properties of alloys especially refractory of alloys are due to a cumulation of factors.
2. Increase alloying degree of  $\alpha$  solid solution with alloying elements which has a low coefficient of diffusion in solid aluminum.
3. Increase the hardness of grain limits of  $\alpha$  solid solution with the presence of secondary phases particles ( $AlMg_5Cu_4Si_4$ ,  $Al_6Cu_3Ni$  and

others), which up to 300°C interact weakly with  $\alpha$  solid solution

4 There is smaller quantities of fine particles of  $Si_I$ , (elemental silicon) with tendency to clotting

5. Alloying with elements of transition groups which lead to increased refractory of aluminum alloys due to appearance in structure of intermetallic compounds bands like bands very stable at the operating temperature of the pistons, regardless if the intermetallic compounds are on a separation limit of intercrystalline grains or they are formed dispersed in solid solution  $\alpha$

6 Alloys type ATSi12CuMnNi type usually used in casted pistons for engine with ignition sparks, show that most effective chemical composition alloy is : Si=11-13%, Cu 1.5-3 %, Mg=0.8-1.3%, Ni =0.8-1.3, Mn=0.3-0.6% ,Ti=0.05-0.2%, others Fe=0.8, Zn=0.5, Pb=0.1 %  
Si Zn=0.02 %

#### 4. CONCLUSIONS

Analyzing the variation of average values of mechanical properties for casting alloys used in the pistons, in untreated and treated states both with continuous heating up to 300 °C, and at high temperatures like in cycles which reproduce operation of the engine, to stabilize mechanical properties, can be drawn some conclusions of great importance for industrial practice.

1. Aluminum alloys for casting pieces for which working at high temperatures like the pistons for internal combustion engines, regardless of their chemical composition, treatment applied after casting on the continuous increase of temperature to 300 °C or maintaining the temperature of 220 °C a, 260 °C and 300 °C to achieve constant values for mechanical properties, lost substantially in value for HB and Rm and earn an A.

2. The loss of mechanical properties is even higher (intense) as these properties have higher values before heating (continuous or maintain to 220 °C -300 °C)

3 The heat treatment applied to aluminum alloys that work at temperatures above 250 °C, which aims to obtain maximum mechanical properties of aluminum alloys, tempering and return becomes useless whereas after heating at a temperature above the temperature solvus line, because the phenomena that happens in solid solution  $\alpha$  these properties are reduced dramatically. Is actually a treatment of tempering and return which is determined by the initial state of alloy.

4 Cast aluminum alloys regardless of chemical composition and condition (cast, heat treated), when used in aggregates that working at temperatures that exceed the limit for conversion of  $\alpha$  solid solution, solvus line, should be heat-treated at least temperature of working in order to stabilize the structure by tempering or return

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## ANTHROPOMORPHIC GRIPPERS FOR ROBOTS - CURRENT STAGE AND PERSPECTIVES

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**Abstract:** *The paper, first, presents anthropomorphic grippers considered representative, selected from the popular ones, indicating some structural and functional characteristics. Then it describes a family of anthropomorphic prehensors with four fingers, made with articulated bar mechanisms and a version of gripper with fingers operated through wheels and wires proposed by the author. At the end of the paper, several structural and functional specifications are made in connection with Barrett gripper.*

**Key words:** *robotics, anthropomorphic gripper, design, functional simulation,*

### 1. INTRODUCTION

Grippers are complex mechatronic structures used by robots, especially by industrial robots, for prehension and gripping operations in the case of pieces in order to handle transfer from an initial position to a final position required within an action, respectively, a robotized technological process. Depending on the nature of the prehension force, the main categories of prehension systems are mechanical systems, vacuum systems and magnetic systems. Mechanical prehension systems are known as bilateral systems because the condition of achieving prehension is the application of at least two forces with opposite directions, in contact with the piece that is gripped. Vacuum and magnetic prehension systems are also known as unilateral prehension systems because they perform prehension with a single active area that encounters the piece that is gripped. Mechanical prehension systems have as main part a mechanical structure, a mechanism that ensures the position of contacting elements of the piece towards it, and the contact force development - the necessary grasp.

According to the constructive peculiarities of the mechanical structure, there are three main types of mechanical grippers: with jaws, with fingers (anthropomorphic) and tentacle like.

Currently, in the case of the industrial robots, mechanical grippers with jaws are frequently used, but there is a tendency to implement more and more frequently anthropomorphic grippers (fig. 1), as there is a transition from gripping activities of simple shaped pieces, to prehension and micro-handling of complex shaped pieces.

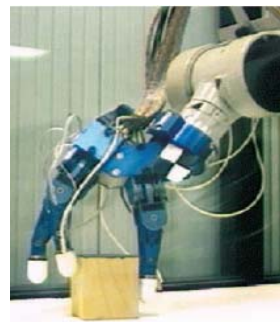


Fig. 1 Industrial robot equipped with anthropomorphic gripper

Anthropomorphic grippers with fingers may have two, three, four, five, or even six

articulated fingers with two or three phalanxes.

## 2. MAIN TYPES OF ANTHROPOMORPHIC GRIPPERS

Out of the popular versions of anthropomorphic grippers made so far in various laboratories abroad, some are presented in fig. 2 .

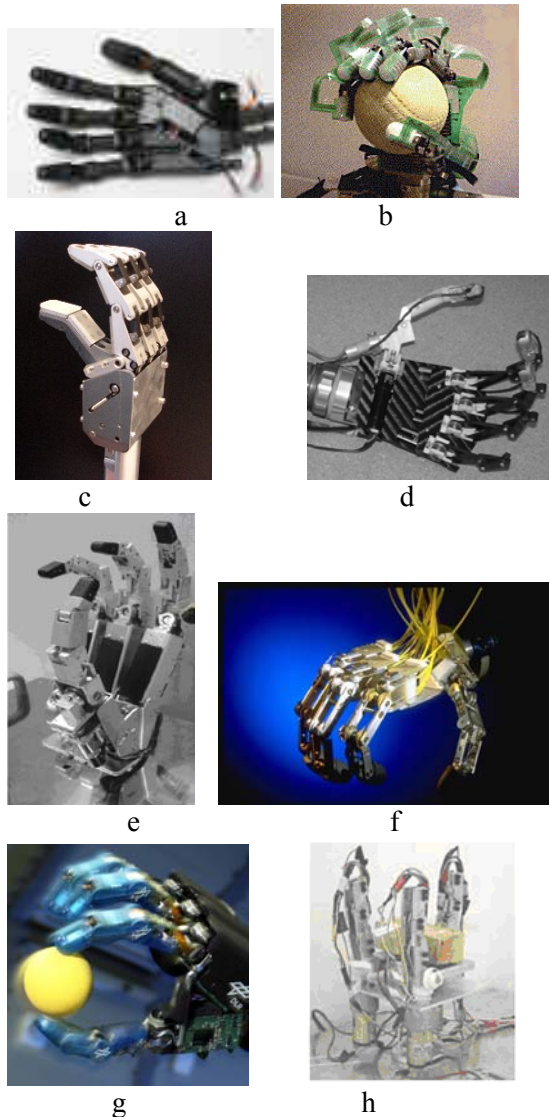


Fig. 2. Representative anthropomorphic grippers

In fig. 2,a it is shown an anthropomorphic structure ( Shadow project – England ) with 21 degrees of mobility (each finger has 4 degrees of mobility, and the thumb has 5 degrees of mobility). The version in fig. 2, b made by Dainichi Company, Ltd. Kani,

Japan, has 20 couples and 16 degrees of mobility (3 on the fingers and 4 on the thumb) and a weight of 1.4 kilograms. In fig. 2, c it is shown a version offered by the French firm Techno Concept (in versions with 3, 4 or 5 fingers). The next version (fig. 2, d) has 6 degrees of mobility (one on each finger and 2 on the thumb), is also designed for prostheses and it was conducted at the University of Southampton. NAIST Hand (fig. 2, e) has four fingers and 12 degrees of mobility with actuating engines located in the palm. Dist Hand (fig. 2, f) has four fingers, each operated by 6 polyester tendons, actuated by 5 DC motors, and the fingers are equipped with position sensors and touch sensors. DRL Hand (fig. 2, g) has four fingers with 3 degrees of mobility and one additional degree of freedom in the palm. Cassino LARM Hand (fig. 2, h) has three fingers made of articulated mechanisms with bars, 3 degrees of mobility (each finger is actuated by an electric motor via a conical gear).

Following the critical and comparative analysis of the versions above, as well as the analysis of others versions which are not presented here, there have been highlighted several drawbacks. Among these, we may highlight the following: relatively high constructive complexity, lack of improvement in the case of the mobility degree, lack of modular conception, which partly have been removed by the versions proposed by the author.

## 3. ANTHROPOMORPHIC GRIPPERS PROPOSED BY THE AUTHOR

### 3.1.Family of modular anthropomorphic grippers with articulated bars

This family made of the prehensor versions with two, three or four fingers has been obtained using as structural constructive modules a finger and a platform (palm), fig. 3, a, b.



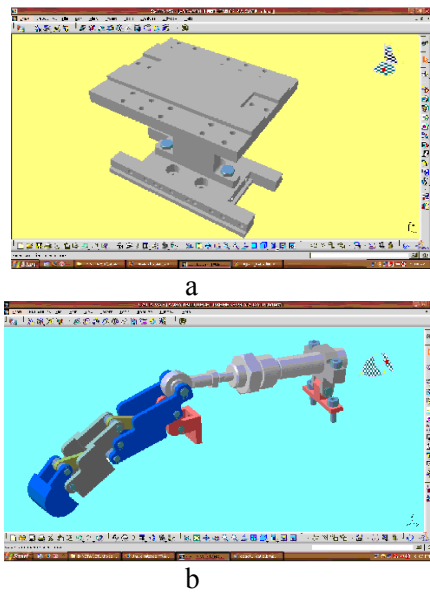


Fig. 3 Constructive modules of the prehensors family

According to versions of the relative disposition of fingers in fig. 4, a, for a prehensor with four fingers, using the two constructive modules the constructive versions in fig. 4, b<sub>1</sub>, b<sub>2</sub> and b<sub>3</sub> have been obtained.

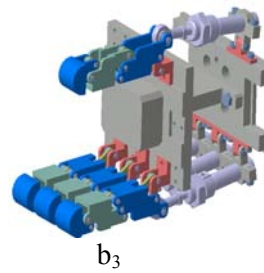
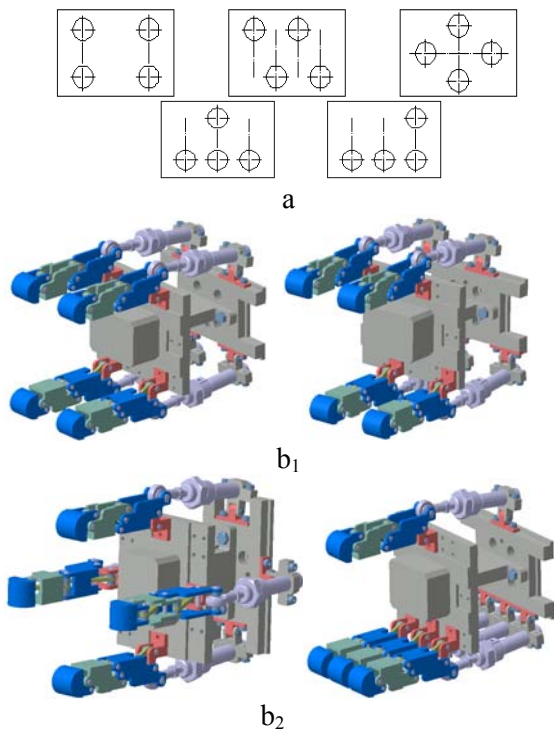


Fig. 4 Versions of four fingers prehensor

An example of montage on a robot ABB of a prehensor in the family that has been designed is given in fig. 5.



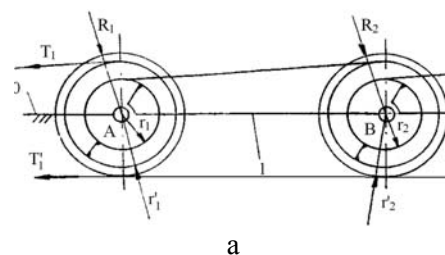
Fig. 5 Example of montage on a robot of the prehensor

Using the same modules, with minimal modifications of the platform module, anthropomorphic prehensors variations with two fingers, three fingers, five fingers and even with six fingers, can be obtained.

### 3.2. Anthropomorphic grippers actuated by wheels and wires

Since the 1980 s several types of anthropomorphic prehensors with wires with 2 or 3 phalanxes have been developed [2,3].

A finger driven through wired mechanisms is based on a structural model like those in fig. 6 (mono-mobile, fig. 6, a; bi-mobile, fig.6, b).



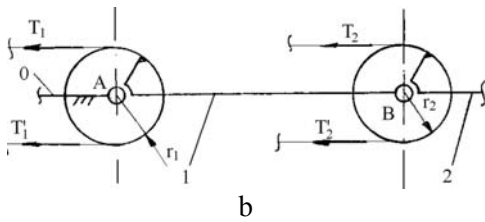


Fig. 6 Modules of the finger driven through wheels and wires

In the case of the mono-mobile structural module, in order to close the finger, the extension force  $T_1$ , is used, and in order to open the finger the force  $T'_1$ , is applied onto the wire wrapped on the wheels whose radii are  $R_1$  and  $R_2$ . For the bi-mobile structural module, each wheel that corresponds to an inter-phalanx joint is driven by a wire, which operates via an engine, in the direction of the forces  $T_1, T_2 \dots$  to close the finger and in the direction of the forces  $T'_1, T'_2 \dots$  to open the finger. Cinematically, in the case of the mono-mobile module (fig. 7, a) the spinning angle of the wheel 1 is  $\varphi_1$ , and of the wheel 2 is  $\varphi_2$ , leading to a total angle  $\varphi_{2t} = \varphi_1 + \varphi_2$ . According to the equality  $ab=cd$ , written under the form  $\varphi_1 r_1 = \varphi_2 r_2$ , the angle  $\varphi_2$  is  $\varphi_2 = \varphi_1 r_1 / r_2$ , and the total angle is  $\varphi_{2t} = \varphi_1 + \varphi_1 r_1 / r_2$ .

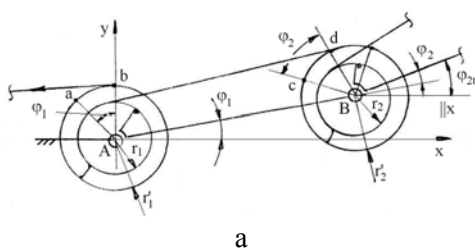


Fig. 7 Cinematic schemes of the modules driven through wires

For the case of the bi-mobile module (fig.7, b) each wheel gyrates at a certain angle, so that the total spinning angle of the element 2 (the phalanx 2) will be  $\varphi_{2t} = \varphi_1 + \varphi_2$ .

As a constructive version for such a prehension system, using the bi-mobile module, the version in fig. 8 has been designed (represented in lateral view in fig. 8, a, and in view from above in fig. 8, b).

This version has four fingers of two phalanxes, and each inter-phalanx joint is driven independently. These movements are associated with one spinning movement at the base of the fingers, only for the lateral fingers and the opposable finger. Consequently, the total mobility degree is  $M = 11$ .

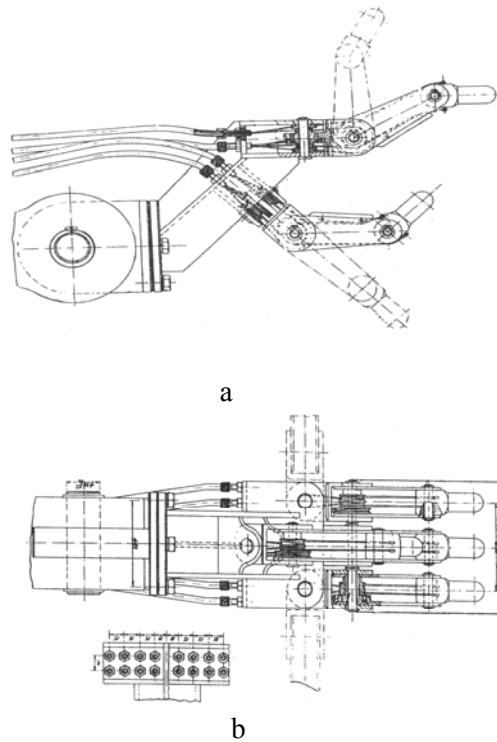


Fig. 8 Constructive version of a prehension system driven through wires

#### 4. BARRETT PREHENSOR

Difficulties to make the prehensor in fig. 8, have imposed as solution the purchase of a gripping system based on wired mechanisms developed by the Barrett Technology Inc. Company from the USA (fig. 9, a, b) [7].

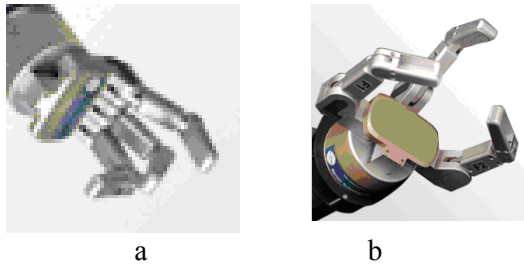
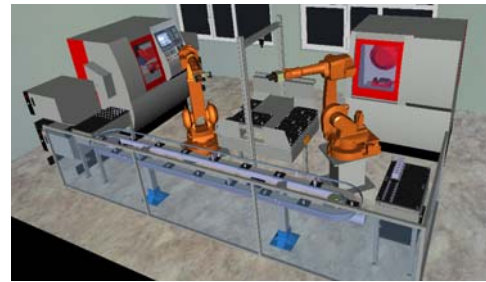


Fig. 9 Barrett Prehensor

This type of prehensor has three fingers with two phalanxes and the lateral fingers can rotate with 180 degrees. The total degree of mobility is  $M = 4$  (one mobility for each finger and a mobility corresponding to the rotation of lateral fingers). The movement of the phalanxes is interdependent, so if the first phalanx contacts the piece and it is stuck, the movement is continued by the final phalanx until contacting the piece (contacting various surfaces of the piece is conditioned by the maximum angles that can be achieved by the phalanxes). Two prehensors of this type are to be mounted on the robots ABB of the manufacturing cell (fig. 10, a) within the Robotics Laboratory of the Department of Product Design and Robotics from the Transylvania University of Brasov. With these prehensors, complex prehension operations of pieces assembling and / or disassembling operations for products will be performed, in a first stage, of small and medium complexity. In the following period for the effectiveness of these operations, it is intended to simulate operations in the virtual environment. A first step in this direction has been made by shaping in virtual environment of the manufacturing cell (fig. 10, b) [6].



a



b

Fig. 10 Manufacturing and assembly cell

## 5. CONCLUSIONS

Based on facts presented in this paper the following main conclusions can be drawn:

1. It is noted an obvious tendency of diversification of the anthropomorphic prehensors (with fingers) and an extension of their use, including the case of the industrial robots.
2. Two main types of anthropomorphic prehensors (with fingers) can be identified, depending on the constructive elements: with articulated bars or with wheels and wires.
3. In the case of these prehensors, the structural and kinematic synthesis and the analysis can be done with classical methods known in the theory of mechanisms, adapted accordingly.
4. The constructive and functional optimization of anthropomorphic prehensors can be obtained by functional simulation in CAD software or in virtual environment.

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## THE INFLUENCE OF CONDITIONS OF THE HEAT TREATMENT OF ALUMINUM ALLOYS

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**Abstract :** Work was followed in determining the optimum parameters of heat treatment of deformable aluminum alloys, regarding both the hardening and aging. The tests were performed on two brands of deformable alloys, both after the usual process and electromagnetic field. Abstract

**Key words:** aluminium alloys, heat treatment

### Introduction

The variant or the optimum variants can be obtained by correct joining of the chemical composition with the values parameters of thermic treatments and supplementary by utilization some factors of stimulation the processes at the crystalline net level. The experimentations were accomplished on two apt alloys hardenings through thermic treatment, presented in the table 1.

### Attempts and experimental results.

In the sight of hardening were selected temperatures of 500, 510, 520 and 530° C, and the ultimate hardness, expressed in units

Brinell are presented in the table 2 and the diagrams from the figures 1 and 2.

Table 1

Nr. alloy	Brand alloy	Chemical composition, în %							
		Cu	Mn	Mg	Cr	Ti	Si	Fe	Al
1	AlCu <sub>4</sub> Mg <sub>1,5</sub> Mn	4,02	0,541	1,28	0,027	0,0025	0,267	0,481	rest
2	AlCuMgMn	3,97	0,628	0,572	0,037	0,0072	0,333	0,476	rest

The proofs from these alloys were submissive the thermic treatment of hardening and the ageing, after different variants. For all these variants, from the temperature of heating in the sight of hardening the proofs were cooled in water, after a period of maintaining of one hour. Ageing was accomplished in the oil-drowned heated and maintained to 170 C, the maintaining at artificial ageing were of 1, 5 hours, and to the natural one of 7 days.

Table 2

Nr. crt.	Type of the heat treatment	Type of the alloy	Hardening temperature, °C			
			500	510	520	530
1	Hardening + natural ageing	1	117	119	98	106
2		2	116	118	92	102
3	Hardening + normal artificial ageing (170°C, 1,5h)	1	112	120	113	102
4		2	102	108	103	102

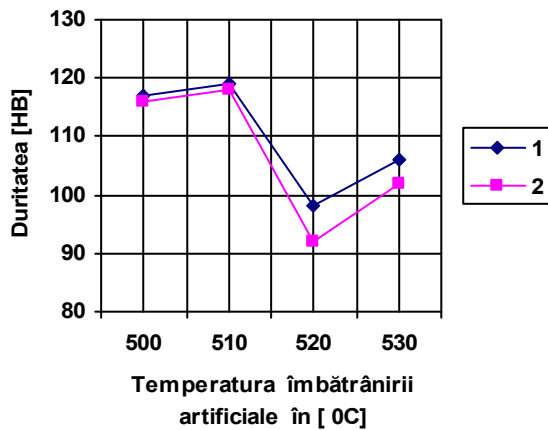


Fig.1. The hardness Brinell obtained after hardening from different temperatures and the natural ageing to 500°C, 510°C, 520°C, 530°C.

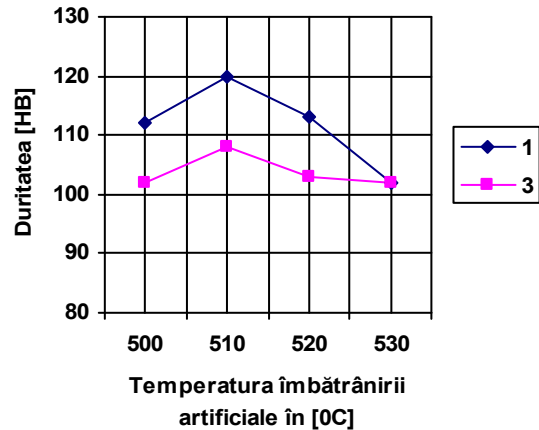


Fig.2. The hardness obtained after hardening in water and the artificial ageing at 170°C, for the alloys 1 and 2 .

Besides the testing the influence of temperature from which is done hardening there have been studied also the effects of a external field energy in the time of artificial

ageing at 170° C and the duration of 1, 5 hours. The results of experimentations are presented below in the form of the table (3) and charts (fig.3, 4).

Table 3

Nr. crt	Type of the heat treatment	Type of the alloy	Hardening temperature, °C			
			500	510	520	530
1	Hardening + artificial ageing in alternating electromagnetic field	1	126	128	110	106
2		2	124	122	113	109

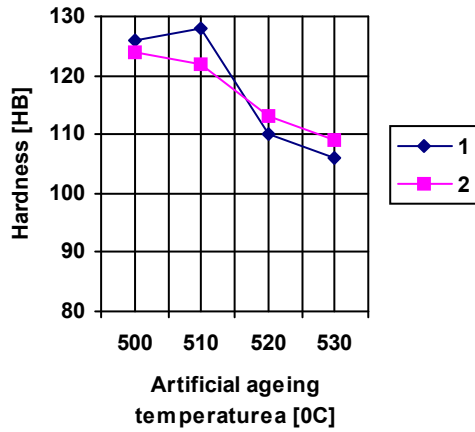


Fig.3. The obtained results after hardening from different temperatures and the artificial ageing in alternatively electromagnetic field;

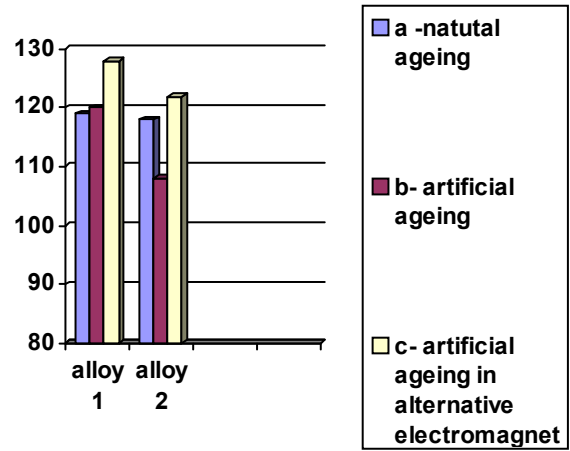


Fig. 4. The comparative results of thermic treatment after the many variants of ageing: a- obtained ageing; b- artificial ageings obtained c- artificial ageings in alternatively electromagnetic fields

In figures 5 and 8 are shown structures after various state of treatment.

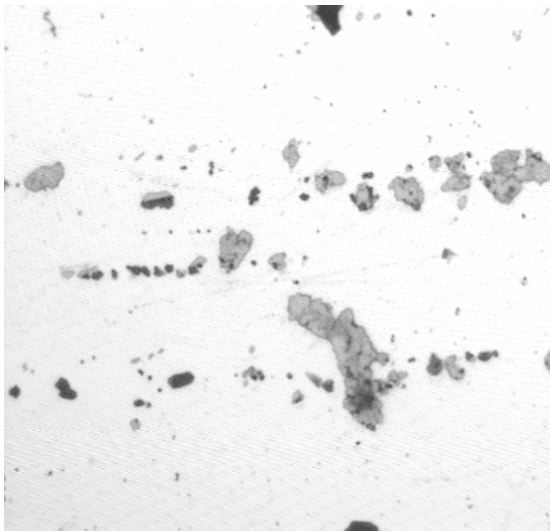


Fig.5. Alloy AlCuMg1, 5Mn after hardening and usual artificial ageing.  
Attack: 10% H<sub>3</sub>PO<sub>4</sub>. 1000:1

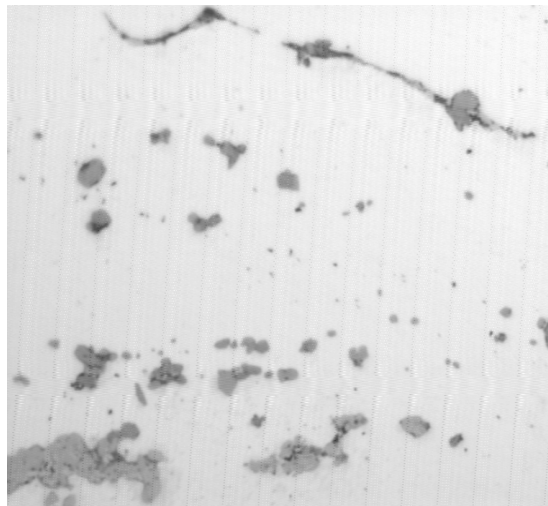


Fig.6. Alloy AlCuMg1, 5Mn after hardening and natural ageing.  
Attack: 10% H<sub>3</sub>PO<sub>4</sub>. 1000:1

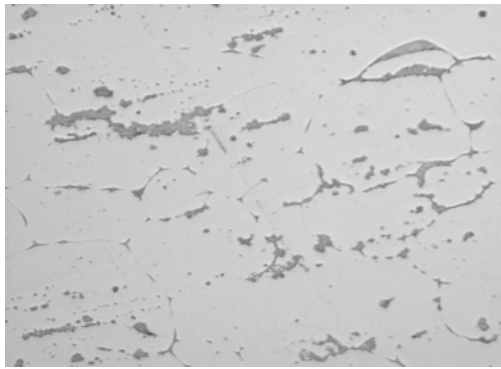


Fig. 7. Alloy AlCu4Mg1, 5Mn after hardening at 510C and artificial ageing in electromagnetic field.  
Attack: 10% H<sub>3</sub>PO<sub>4</sub>. 1000:1

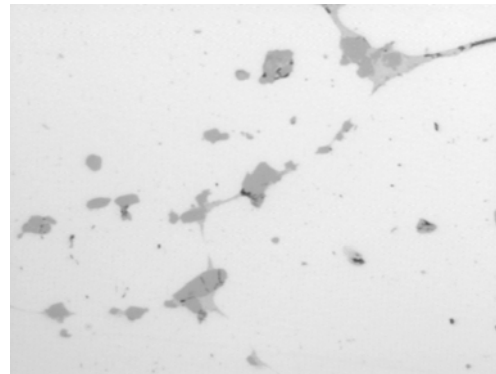


Fig. 8. Alloy AlCu4Mg1, 5Mn after hardening at 510C and artificial ageing in electromagnetic field.  
Attack: 10% H<sub>3</sub>PO<sub>4</sub>. 1000:1

It is found that after hardening the quantity of phase precipitated is decreasing. These soluble compounds (Al<sub>2</sub>Cu, Al<sub>2</sub>CuMg, Al<sub>3</sub>Mg<sub>2</sub>, Al<sub>6</sub>Mn, Al<sub>6</sub>Mg<sub>4</sub>.etc) and contributing to hardening in the ageing process.

After artificial ageing are formed coherent phase type  $\theta^I$  and  $\theta^{II}$  which by tensioning the crystalline network allows cold hardening and therefore increase its hardness.

The field magnetic had to next the parameters:

- frequency: 50 Hz;
- the magnetic flux :  $9,6 \cdot 10^{-4}$  Wb.

As in the previous cases the duration of maintaining the artificial ageing were of 1, 5 hours. It is consisted that in the case of utilization the electro-magnetic field the best results had the proofs hardening in water from 510°C; in the same time, for all the cases, external field energy has conducted to improve hardness. Compared to the normal procedure, the overlap of the electromagnetic field. In order to emphasize the efficiencies of the variants of thermic treatments, in the figure 4 is presented comparative the results of the thermic treatment applied after the studious variants. Therefore it has been chosen the temperature of hardening with the best results , namely of 510° C.

### Conclusions.

From the experimental studies effectuated in present work be can emphasized the following:

- for the alloys taken under consideration, the optimum temperature of heating in the sight of hardening is of 510°C;

- concluded the usual thermic treatment, with natural or artificial ageing, the best results of hardness were obtained to the alloy 1; this has and the eldest content in copper and magnesium, carry call forth soluble phases, which provide the hardness;

- overlap the electro-magnetic field across one thermic from artificial ageing,

has profitable effects about the process of hardening; we consider that the supplementary contribution of energy from the crystalline net level conduces to the stimulation of the diffusion process, the one which challenges the cold hardening of the crystalline net through the formation of zones Guinier Preston and /or the phases  $\theta^I$  and  $\theta^{II}$  ;

- passing over the optimum temperature of heating in the sight of hardening compromises the results of thermic treatment in all the variants.

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## A NEW MATHEMATICAL MODEL OF BALLISTIC CYCLE FOR ARTILLERY SYSTEM

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**Abstract:** *In this paper a mathematical model of ballistic cycle from an artillery system using the gas dynamics equations is presented. In order to solve this mathematical model the method of characteristics, was used and elaborating an interior ballistic software. It is possible to study the variation of powder gases pressure and projectile velocity versus time and displacement using this software, the former represents the content of fundamental problem of interior ballistics.*

*For an extant artillery system, the theoretical results obtained with the aid of the mentioned above software this mathematical model and experimental data are compared.*

**Keywords:** *artillery system, cycle ballistic, interior ballistics, gas dynamic, equation with partial derivatives equation, method of characteristics.*

### 1. INTRODUCTION

By definition, the ballistic cycle is composed of all physical and chemical processes which occur during the displacement of the projectile under the gas powder pressure force.

Depending on the hypothesis given for the engagement of the projectile rotating band in the rifling of the barrel, until the gases pressure is below the value of start pressure, the powder is burned in close volume. After that, as the projectile in tube moves ahead, it issues rarefaction waves which will travel toward breech.

Accordingly, the mixture of the gases and unburned powder elements will be set in from the rest. The reflected waves from the breech may interact with the projectile, depending on the weights of powder and projectile rate.

In the classical interior ballistics one cannot include the waves system which occurs during the cycle, and the fundamental problem is evaluated as follows:

-the uniform density of gases is assumed to be in the flow field between the breech and the bullet at any particular time during the weapon firing process;

-the space-mean values are assumed for the thermodynamic variables;

- the dynamic effects are included through the inclusion of various correction factors only determined more or less empirically.

Therefore a new mathematical model involving unsteady, one-dimensional motion of gases would permit a study of the fundamental problem of interior ballistics and provide more accurate results than the data obtained by classical methods.

### 2. THE MATHEMATICAL MODEL

Due to the complexity of the firing process, in order to solve the fundamental problem, will be assumed some hypotheses as follows:

a. The overall powder elements, which compose powder charge are similar in dimensions and begin to burn in the same time;

b. The powder gases are in equilibrium until the beginning of projectile motion under the gas pressure, similar in all the sections, equating the pressure  $p_{ct}$ ;

c. The powder gases and unburned powder elements form an homogeneous mixture, which moves with the same velocity;

d. The powder burning law is expressed using the relation  $\psi = \chi z(1 + \lambda z + \mu z^2)$ ;

e. The friction between projectile and barrel is neglected, so the equation of projectile motion becomes  $\varphi_1 q \frac{dv}{dt} = sp_{pr}$ ;

f. The charged chamber has constant section, which is equal with the cross section of the barrel  $s$ ;

g. The recoil of the barrel is not taken into account;

h. The losses by transfer of heat are neglected;

i. Only the gases motion in the direction of barrel's axes is taken into account.

The signification of used parameters is that established in specialty literature [1]-[3].

According to the accepted assumptions, the fundamental problem of the interior ballistics becomes a matter of unsteady state and one-dimensional motion of varied gases amount.

The motion, continuity, and energy equations [5,6] become (1), (2) and (3), wherein:

$$a = \sqrt{\frac{\gamma p}{\rho^2 \left[ \frac{1}{\rho} - \frac{1-\psi}{\delta} - \alpha \psi \right]}}$$

$$a' = \sqrt{\gamma p \left( \frac{1}{\rho} - \frac{1-\psi}{\delta} - \alpha \psi \right)}$$

$$\Phi = p \left( \frac{1}{\rho} - \frac{1-\psi}{\delta} - \alpha \psi \right)^\gamma$$

The equation of gases forming velocity for a given amount, in Eulers's variables, it is written, such:

$$\frac{\partial \psi}{\partial t} + u \frac{\partial \psi}{\partial x} = \frac{\chi}{e_1} \sigma(\psi) u_1 p. \quad (4)$$

In order to reduce the parameters number, the following relative variables are introduced:

$$\bar{a} = \frac{a}{a'_0}; \quad \bar{x} = \frac{x}{\ell_0}; \quad \bar{t} = \frac{t a'_0}{\ell_0}; \quad \bar{u} = \frac{u}{a'_0};$$

$$\bar{p} = \frac{p}{p_{\max}}; \quad \bar{a}' = \frac{a'}{a'_0}; \quad \bar{\Phi} = \frac{\Phi}{\Phi_0} \quad \text{wherein:}$$

$$\ell_0 = \frac{W_0}{s}; \quad p_{\max} = \frac{f \Delta}{1 - \alpha \Delta} = \frac{f p_0}{1 - \alpha p_0};$$

$$\Phi_0 = f \left( \frac{1}{p_0} - \alpha \right)^{\gamma-1}; \quad a'_0 = (\gamma f)^{\frac{1}{2}}.$$

Taking into account the relative variables, the equations (1), (2), (3) and (4) become (5), (6), (7) and, (8) respectively.

$$\frac{\partial \psi}{\partial \bar{t}} + \bar{u} \frac{\partial \psi}{\partial \bar{x}} = \Gamma' \sigma(\psi) \bar{p}, \quad (8)$$

in which:

$$D = \left( \alpha - \frac{1}{\delta} \right) \rho_0; \quad \Gamma' = \frac{\chi}{e_1 a'_0} u_1 \ell_0 p_{\max}.$$

$$\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} + \frac{2a}{\gamma-1} \frac{\partial a'}{\partial x} = \frac{a a'}{\gamma(\gamma-1)} \frac{\partial(\ln \Phi)}{\partial x}; \quad (1)$$

$$\frac{2}{\gamma-1} \left( \frac{\partial a'}{\partial t} + u \frac{\partial a'}{\partial x} \right) + a \frac{\partial u}{\partial x} = \frac{\gamma p}{a'} \left( \frac{\partial \psi}{\partial t} + u \frac{\partial \psi}{\partial x} \right) \left( \alpha - \frac{1}{\rho} \right) + \frac{a'}{\gamma-1} \left( \frac{\partial(\ln \Phi)}{\partial t} + u \frac{\partial(\ln \Phi)}{\partial x} \right); \quad (2)$$

$$\frac{\partial(\ln \Phi)}{\partial t} + u \frac{\partial(\ln \Phi)}{\partial x} = (\gamma-1) \left[ \frac{f}{\gamma-1} - \left( \alpha - \frac{1}{\delta} \right) p \right] \frac{1}{p w_1} \left( \frac{\partial \psi}{\partial t} + u \frac{\partial \psi}{\partial x} \right). \quad (3)$$

$$\frac{\partial \bar{u}}{\partial \bar{t}} + \bar{u} \frac{\partial \bar{u}}{\partial \bar{x}} + \frac{2}{\gamma-1} \bar{a} \frac{\partial \bar{a}'}{\partial \bar{x}} = \frac{\bar{a} \bar{a}'}{\gamma(\gamma-1)} \frac{\partial(\ln \bar{\Phi})}{\partial \bar{x}}; \quad (5)$$

$$\frac{2}{\gamma-1} \left( \frac{\partial \bar{a}'}{\partial \bar{t}} + \bar{u} \frac{\partial \bar{a}'}{\partial \bar{x}} \right) + \bar{a} \frac{\partial \bar{u}}{\partial \bar{x}} = \frac{\bar{a}'}{\gamma-1} \left( \frac{\partial(\ln \bar{\Phi})}{\partial \bar{t}} + \bar{u} \frac{\partial(\ln \bar{\Phi})}{\partial \bar{x}} \right) + \Gamma' D \sigma(\psi) \frac{\bar{p}^2}{\bar{a}'}; \quad (6)$$

$$\frac{\partial(\ln \bar{\Phi})}{\partial \bar{t}} + \bar{u} \frac{\partial(\ln \bar{\Phi})}{\partial \bar{x}} = [1 - (\gamma-1) D \bar{p}] \Gamma' \sigma(\psi) \frac{\bar{p}}{\bar{a}'^2}. \quad (7)$$

$\ln \bar{\Phi}$  is eliminated from the continuity equation (6) using the energy equation (7), and finally, it is obtained:

$$\frac{2}{\gamma-1} \left( \frac{\partial \bar{a}'}{\partial t} + \bar{u} \frac{\partial \bar{a}'}{\partial \bar{x}} \right) + \bar{a} \frac{\partial \bar{u}}{\partial \bar{x}} = \frac{\Gamma' \sigma(\psi) \bar{p}}{\gamma-1} \frac{1}{\bar{a}'} \quad (9)$$

Formed of equations (5) and (9), the following system is a system with partial derivatives, first in order:

$$(10) \quad \begin{cases} \frac{\partial \bar{u}}{\partial t} + \bar{u} \frac{\partial \bar{u}}{\partial \bar{x}} + \frac{2}{\gamma-1} \bar{a} \frac{\partial \bar{a}'}{\partial \bar{x}} = \frac{\bar{a} \bar{a}'}{\gamma(\gamma-1)} \frac{\partial (\ln \bar{\Phi})}{\partial \bar{x}} \\ \frac{2}{\gamma-1} \left( \frac{\partial \bar{a}'}{\partial t} + \bar{u} \frac{\partial \bar{a}'}{\partial \bar{x}} \right) + \bar{a} \frac{\partial \bar{u}}{\partial \bar{x}} = \frac{\Gamma' \sigma(\psi) \bar{p}}{\gamma-1} \frac{1}{\bar{a}'} \end{cases}$$

### 3. INTEGRATION OF THE DIFFERENTIAL SYSTEM

#### 3.1 Type of the System

One can write the system (10) in the matricidal form, as follows:

$$\frac{\partial U}{\partial t} + A_x \frac{\partial U}{\partial \bar{x}} = Q, \quad (11)$$

where:

$$U = \begin{bmatrix} \bar{u} \\ \bar{a}' \end{bmatrix}; A_x = \begin{bmatrix} \bar{u} & \frac{2\bar{a}}{\gamma-1} \\ \frac{(\gamma-1)\bar{a}}{2} & \bar{u} \end{bmatrix};$$

$$Q = \begin{bmatrix} \frac{\bar{a} \bar{a}'}{\gamma(\gamma-1)} \frac{\partial (\ln \bar{\Phi}^*)}{\partial \bar{x}} \\ \frac{2}{\gamma} \frac{\Gamma' \sigma(\psi) \bar{p}}{\bar{a}'} \end{bmatrix}.$$

Applying the Fourier analysis method, one assumes that the system solution form is

$$U = \hat{U} e^{i(d_x x - \omega t)}, \quad (12)$$

Wherein :  $\hat{U}$  represents the amplitude of wave,  $d_x x - \omega t$  wave phase,  $d_x$  and  $\omega$  wave

number associated with  $x$  direction, respectively, wave pulsation.

Substituting this solution in system (10), one can obtain:

$$(d_x A_x - \omega I_2) \hat{U} = 0. \quad (13)$$

The following equation can provide the eigenvalues of the system (10):

$$K \hat{U} = \lambda \hat{U}, \quad (14)$$

Where  $\lambda$  are eigenvalues,  $K = d_x A_x$ .

The characteristic equation of the system (10) is as follows:

$$\det(K - \lambda I_2) = 0, \quad (15)$$

Or, if performing operations,

$$(\bar{u}^2 d_x - \lambda^2) - \bar{a}^2 d_x^2 = 0. \quad (16)$$

In equation (16), the eigenvalues  $\lambda$  are unknown, while  $d_x$  is a parameter.

Since the determinant of the second order equation (16) is positive

$$\Delta = 4\bar{a}^2 d_x^2 > 0, \quad (17)$$

We can conclude that system (10) is a hyperbolic type system.

#### 3.2 The Characteristics Equations

One can solve the hyperbolic system of differential equation using the characteristics method. That method transforms the equations with partial derivatives into the ordinary differential equations. The characteristic direction are defined as the curves along which the derivatives of the gases properties such as

$\frac{\partial \bar{u}}{\partial t}$ ,  $\frac{\partial \bar{u}}{\partial \bar{x}}$ ,  $\frac{\partial \bar{a}'}{\partial t}$  and  $\frac{\partial \bar{a}'}{\partial \bar{x}}$  are discontinuous. The equations for these curves can be determined by considering the system (18).

$$\left\{ \begin{aligned} \frac{\partial \bar{u}}{\partial \bar{t}} + \bar{u} \frac{\partial \bar{u}}{\partial \bar{x}} + \frac{2\bar{a}}{\gamma-1} \frac{\partial \bar{a}'}{\partial \bar{x}} &= \frac{\bar{a}\bar{a}'}{\gamma(\gamma-1)} \frac{\partial(\ln \bar{\Phi}^*)}{\partial \bar{x}} \\ \frac{2}{\gamma-1} \left( \frac{\partial \bar{a}'}{\partial \bar{t}} + \bar{u} \frac{\partial \bar{a}'}{\partial \bar{x}} \right) + \bar{a} \frac{\partial \bar{u}}{\partial \bar{x}} &= \frac{\bar{a}'}{\gamma-1} \left( \frac{\partial \bar{\Phi}^*}{\partial \bar{t}} + \bar{u} \frac{\partial \bar{\Phi}^*}{\partial \bar{x}} \right) + \Gamma' D\sigma(\psi) \frac{\bar{p}}{\bar{a}^2} \\ \frac{\partial \bar{u}}{\partial \bar{t}} d\bar{t} + \frac{\partial \bar{u}}{\partial \bar{x}} d\bar{x} &= d\bar{u} \\ \frac{\partial \bar{a}'}{\partial \bar{t}} d\bar{t} + \frac{\partial \bar{a}'}{\partial \bar{x}} d\bar{x} &= d\bar{a}' \end{aligned} \right. \quad (18)$$

Equation (19) for  $\frac{\partial \bar{u}}{\partial \bar{t}}$  by solving the system

(18) is

$$\frac{\partial \bar{u}}{\partial \bar{t}} = \begin{vmatrix} \frac{\bar{a}\bar{a}'}{\gamma(\gamma-1)} \frac{\partial(\ln \bar{\Phi}^*)}{\partial \bar{x}} & \bar{u} & 0 & \frac{2\bar{a}}{\gamma-1} \\ \frac{\Gamma' \sigma(\psi) \bar{p}^2}{\gamma-1} \frac{1}{\bar{a}'} & \bar{a} & \frac{2}{\gamma-1} & \frac{2\bar{u}}{\gamma-1} \\ d\bar{u} & d\bar{x} & 0 & 0 \\ d\bar{a}' & 0 & d\bar{t} & d\bar{x} \end{vmatrix} \quad (19)$$

$$= \begin{vmatrix} 1 & \bar{u} & 0 & \frac{2\bar{a}}{\gamma-1} \\ 0 & \bar{a} & \frac{2}{\gamma-1} & \frac{2\bar{u}}{\gamma-1} \\ d\bar{t} & d\bar{x} & 0 & 0 \\ 0 & 0 & d\bar{t} & d\bar{x} \end{vmatrix}$$

Setting up the denominator to zero and performing algebraic manipulations yield the following equations for characteristics' directions:

$$\frac{d\bar{x}}{d\bar{t}} = \bar{u} + \bar{a} \quad (20)$$

$$\frac{d\bar{x}}{d\bar{t}} = \bar{u} - \bar{a} \quad (21)$$

The governing partial differential equations namely (10) can be reduced to simple ordinary differential equations along the characteristics' directions. The reduction can be done setting the numerator of the equation (19) to zero and performing required algebraic manipulations. This procedure explicitly uses definitions of characteristics' directions. Thus, the simplified equations along the characteristics directions (20) and (21) will become equations (22) and (23).

$$\frac{2}{\gamma-1} d\bar{a}' + d\bar{u} = \frac{\bar{a}\bar{a}'}{\gamma(\gamma-1)} \frac{\partial(\ln \bar{\Phi}^*)}{\partial \bar{x}} d\bar{t} + \frac{\Gamma' \sigma(\psi) \bar{p}}{\gamma-1} \frac{1}{\bar{a}'} d\bar{t} \quad (22)$$

$$\frac{2}{\gamma-1} d\bar{a}' - d\bar{u} = -\frac{\bar{a}\bar{a}'}{\gamma(\gamma-1)} \frac{\partial(\ln \bar{\Phi}^*)}{\partial \bar{x}} d\bar{t} + \frac{\Gamma' \sigma(\psi) \bar{p}}{\gamma-1} \frac{1}{\bar{a}'} d\bar{t} \quad (23)$$

The equations of characteristics in both plane of independent variables  $(\bar{x}, \bar{t})$  and plane of searched functions  $(\bar{u}, \bar{a}')$  are as follows:

- for the first family:
  - in the plane of independent variables: equation 20;
  - in the plane of the searched functions: equation 22;
- for the second family:
  - in the plane of independent variables: equation 21;
  - in the plane of the searched functions: equation 23;

The equations of characteristics in plane of the searched functions can be written in another form if is taken into account the relation:

$$\left[ \frac{d(\ln \bar{\Phi})}{d\bar{t}} \right]_{II} = \left[ \frac{d(\ln \bar{\Phi})}{d\bar{t}} \right]_{I} - \bar{a} \frac{\partial(\ln \bar{\Phi})}{\partial \bar{x}} \quad (24)$$

Using the relation (6), the equations of characteristics in plane of searched functions become:

- for the first family:
    - in the plane of the searched functions: (25)
- $$\frac{2}{\gamma-1} d\bar{a}' + d\bar{u} = \frac{\bar{a}'}{\gamma(\gamma-1)} d(\ln \bar{\Phi}) + \frac{1}{\gamma} (1 + D\bar{p}) \Gamma' \sigma(\psi) \frac{\bar{p}}{\bar{a}'} d\bar{t}$$

- for the second family:
    - in the plane of the searched functions: (26)
- $$\frac{2}{\gamma-1} d\bar{a}' - d\bar{u} = \frac{\bar{a}'}{\gamma(\gamma-1)} d(\ln \bar{\Phi}) + \frac{1}{\gamma} (1 + D\bar{p}) \Gamma' \sigma(\psi) \frac{\bar{p}}{\bar{a}'} d\bar{t}$$

The equations of characteristics and the equation of energy (7) allow determining the values of  $\bar{u}, \bar{a}, \bar{x}, \bar{t}$  and  $\bar{\Phi}$  in the intersection points of opposite family of characteristics. In order to further use this points at the construction of characteristics' network, it is necessary that in every point to calculate the values of magnitudes  $\bar{p}, \psi$  and  $\bar{a}$ . For that the relations are used:

$$\bar{p} = \bar{\Phi}^{\frac{1}{1-\gamma}} \bar{a}^{-\frac{2\gamma}{1-\gamma}}; \quad (27)$$

$$\psi = \chi z(1 + \lambda z + \mu z^2); \quad (28)$$

$$\bar{a} = \bar{a}' + \frac{\bar{p}}{\bar{a}}(D_2 + D\psi); \quad (29)$$

$$dz = \left(1 \mp \frac{\gamma \bar{u}}{\bar{a}}\right) \frac{\Gamma'}{\chi} \bar{p} d\bar{t}; \quad (30)$$

Where  $D_2 = \frac{1}{\delta} \frac{\rho_0}{1 - \alpha \rho_0}$ .

The used initial conditions for the integration of differential equations correspond to the beginning of projectile motion, when:

$$\bar{t} = 0; \bar{x} \in [0, 1]; \bar{u} = 0;$$

$$\psi_{ct} = \frac{\frac{1}{\rho_0} - \frac{1}{\delta}}{\frac{f}{p_{ct}} + \alpha - \frac{1}{\delta}}$$

$$z = z_{ct} = \frac{\psi_{ct}}{\chi}; \bar{p} = \bar{p}_{ct} = \frac{\psi_{ct}}{D_1 - D\psi_{ct}}$$

$$\bar{a}' = \bar{a}'_{ct} = \sqrt{\psi_{ct}}; \quad \bar{\Phi} = \bar{\Phi}_{ct} = \psi_{ct} (D_1 - D\psi_{ct})^{\gamma-1};$$

$$\bar{a}_{ct} = \frac{\sqrt{\psi_{ct}}(D_1 + D_2)}{D_1 - D\psi_{ct}}.$$

The boundary conditions for the integration of differential equations are the following:

- at the rear part of the barrel:  $\bar{x} = 0; \bar{u} = 0;$

- at the rear part of the projectile:

$$\bar{x} = 1 + \bar{\ell} = 1 + \frac{\ell}{\ell_0};$$

$$d\bar{u} = \frac{1}{\rho_1} \frac{\omega}{q} \frac{1}{\gamma(1 - \alpha\rho_0)} \bar{p} d\bar{t}.$$

### 3.3 Characteristics' Network

At the beginning, it is divided the characteristic of second family which leaves from origin of projectile motion (point N) and crosses the axe of ordinates (point A), by numerical integration of equations (8) and (21), taking into account b assumption, Figure 1.

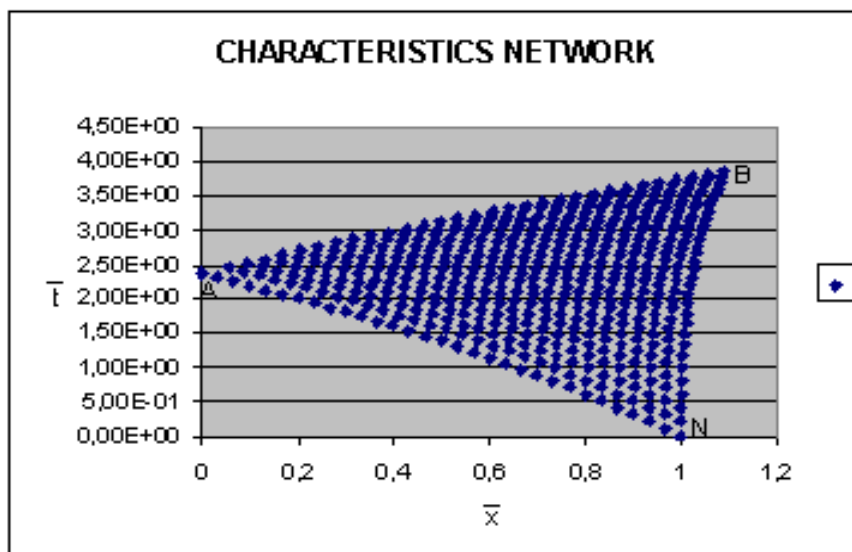


Figure 1: The characteristics' network

Then, in order to divide the characteristic of the first family, which leaves from point A and crosses the curve, which represents the projectile motion law (point B), it is necessary to realize the construction of characteristics' network in curvilinear triangle ABN.

The values of magnitudes upper of curve AB can be obtained only the construction of characteristics network.

The construction of characteristics network using the obtained relations, it is possible only during of powder burning, when  $\psi \leq 1$ . After finishing of powder burning, when  $\psi \geq 1$ , the entropy of every elementary layer will be

constant, but different in different layers and right parts of characteristics in plane of searched functions will be simplified.

#### 4. RESULTS AND CONCLUSIONS

For the numerical integration of differential equations with the bellow shown initial and limit conditions, the interior ballistics soft is elaborated which allows to obtain the values of status magnitudes of powder gases an the values of motion magnitudes of projectile, inside of the barrel.

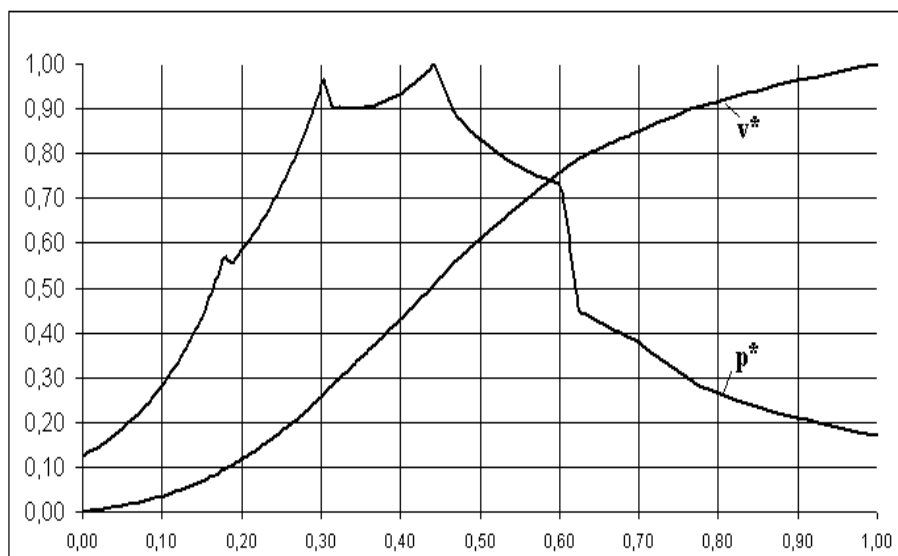


Figure 2 The variation of pressure and velocity versus time

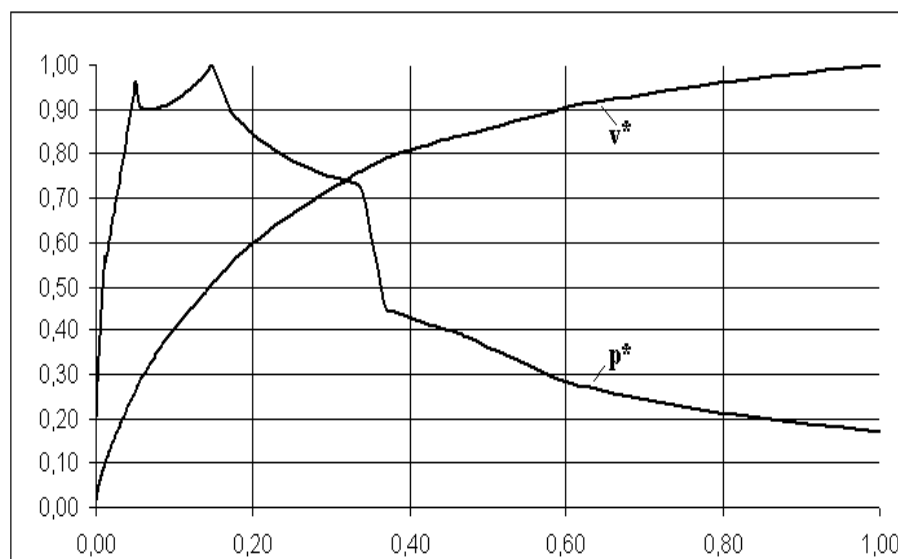


Figure 3: The variation of pressure and velocity versus displacement

In Figures 2 and 3 the variation of gas pressure is presented,  $p^*$  and projectile velocity,  $v^*$  versus its displacement,  $\ell^*$  and time,  $t^*$ , obtained with the aid of the interior ballistics software, for an extant ballistic system. The magnitudes with index are relative variables that were obtained as a ratio between the value of current variable and its maximum value.

The calculi were effectuated for an extant gun, for which there are given the following data:

$$D=2,28; \quad D_1=3,28; \quad D_2=2,72; \quad \omega/q = 0,17; \\ \psi_{ct} = 0,025; \quad z_{ct} = 0,034; \quad \bar{p}_{ct} = 0.0078;$$

$$\bar{a}_{ct} = 0,295; \quad \bar{a}'_{ct} = 0,159; \quad \bar{\Phi}_{ct} = 0,032; \\ \ell_0 = 0,313 \text{ m}; \quad a'_0 = 1027,62 \left( \frac{\text{J}}{\text{kg}} \right)^{0,5}; \\ \Phi_0 = 164697,9 \text{ Pa} \left( \frac{\text{m}^3}{\text{kg}} \right)^{1,2}; \quad p_{\text{max}} = 3832,9 \text{ MPa}.$$

The theoretical results, obtained with the aid of this interior ballistics soft, are in a good correspondence with the experimental data, for the same extant ballistic system.

Table 1 Experimental and theoretical data

Parameters	Type of data	
	Experimental data	Theoretical results
Maximum pressure [MPa]	2400	2344,6
Muzzle velocity [m/s]	840	847,1

Viewing data from the above -given Table 1 it is observed that the difference between the initial velocities values is of approximately 0,5% and between the maximum pressures values is of approximately 5%.

The mathematical model is validated and there is a good correspondence between the data obtained by empirical calculi and the data abstracted from the field.

As a first consequence, such calculi system may be used as a model for any other artillery system or for experimentation.

Since the mathematical model confers values of the powder gas density, and implicitly the value of the temperature in the current barrel section at any time of the exposure, it could be deemed as a technical support for any mathematical model assigned to the study of the heat transfer from hot gases to the barrel material through the boundary layer.

Keeping in mind the method and available means, I may recommend to any science –interested person to go deeper into this very exciting matter and I am available for any questions that may help to this purpose/

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## ON THE TRAVEL SAFETY OF RAILWAY VEHICLES USED FOR FREIGHT TRANSPORT

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**Abstract:** Travel safety is an area that pertains to railway vehicle dynamics and constitutes, together with bearing structure resistance and travel dynamics, lines of research that define a vehicle's capacity to travel on the railway.

A vehicle's chance to derail is in a strict connection with the torsional capacity of the vehicle as a whole, wheel load, railway geometry and irregularities.

The paper presents experimental studies on the determination of the torsional rigidity of the bearing structures (carbody, bogies). The methods and the experimental technology of determining the torsional rigidity are revealed for the bearing structures of the chassis and bogies of the freight cars, as determining elements of travel safety.

Finally, a defining computational methodology is presented for establishing the derailment conditions (Nadal's formula) with the consequent conclusions.

**Keywords:** torsional rigidity, force as a function of displacement variation, Y/Q ratio

### 1. INTRODUCTION

Travel safety is an area that belongs to the dynamics of railway vehicles and constitutes, together with bearing structure resistance and travel dynamics, preoccupations and lines of research that define the capacity of a vehicle to travel on the railway.

The possibility and chance of a vehicle to derail is in strict connection with the torsional capacity of the vehicle as a whole, wheel load, railway geometry and irregularities [3].

### 2. VERIFICATION OF WHEEL LOAD REPARTITION

The purpose of the test is determining the repartition and deviations of wheel loads. The trials were conducted in accordance with the recommendations of the testing program and the methodology of ERRI B55 Rp8 [4].

The car was tested by positioning it successively with the two bogies on the stand with the tensometric transducers, rail type.

The car was tested for torsion by superimposing the effects of torsion on the basis of the car axle base and the bogie axle base. One of the points was put in a lifting-lowering motion, during which time at that point the displacement  $\Delta h$  and the sustainment force  $\Delta F$  were measured. An analog process was used for the bogie frames.

With the values of the wheel loads determined during the torsion testing, hysteresis diagrams of the unloading were drawn. From these diagrams the decreases of the wheel loads  $\Delta Q_{ij}$  were determined, which were compared to the admissible limits  $\lim \Delta Q_i$ , according to the norms of ERRI B55 Rp8 [4].

With the measured values of  $\Delta F$  and  $\Delta h$ , hysteresis diagrams were drawn. The values from the diagrams and the specific technical and constructive characteristics of the car were used in the computation of safety against derailment.

The torsion corresponding to the car ( $g^*$ ), and the bogie ( $g^+$ ) is computed using (1):

$$g^* = \frac{15}{2a^*} + 2 [\%]; \quad g^+ = 7 - \frac{5}{2a^+} [\%] \quad (1)$$

where:

- 2a\* is the car axle base;
- 2a+ is the bogie axle base.

The values of the maximum admissible unloadings  $\lim \Delta Q_j$  are computed for each axle, according to the following equations:

$$\lim \Delta q_j = \frac{\lim \left( \frac{Y}{Q} \right)_a - \frac{Y_{a0j}}{Q_{0j}}}{\lim \left( \frac{Y}{Q} \right)_a}, \quad \lim \Delta Q_j = \lim \Delta q_j \cdot Q_{0j} \quad (2)$$

where:

$\lim \Delta Q_j$  – the maximum admissible unloading of the wheel in order to ensure against derailment;

$\lim \Delta q_j$  – relative limit value of the unloading;

$Q_{0j}$  – average wheel load at axle j;

$\lim(Y/Q)_a = 1,2$ ;

$Y_{a0j}$  – transverse guidance effort at axle j on the exterior wheel of the curvature.

The condition that the car must satisfy in order to traverse the rail torsions without any risk of derailment is that the wheel unloadings observed during testing do not exceed the admissible limit values, computed with equation (2).

The unloadings  $\Delta Q_j$  of the wheels are determined by measuring with the above mentioned installation. The measurement is done progressively, starting from the situation of the car resting on a straight railway, the carbody is torsioned, then the bogies, at the values  $g^*$  and  $g^+$  computed with equations (1) imposed by ERRI B55 Rp8.

Finally, the following inequality is checked:

$$\Delta Q_{jk} < \lim \Delta Q_j. \quad (3)$$

In case the inequality is respected, the safety against derailment of the car is certified from the point of view of the torsional rigidity of the tested car.

### 3.DETERMINING THE TORSIONAL RIGIDITY

The torsional rigidity  $C_t^*$  of a carbody with own weight and the characteristics of the elastic elements of the suspension, are criteria of appreciating the travel safety of the car.

The torsional rigidity  $C_t^*$  is a characteristic of the carbody related to the axle base, expressed by a torsional moment ( $\Delta F \times 2b_z^*$ ) applied to the carbody at an angular displacement  $\left( \frac{\varphi}{2a^*} \right)$  resulting in:

$$C_t^* = \frac{2a^* \cdot \Delta F \cdot 2b_z^*}{\varphi} \left[ \frac{\text{KN} \cdot \text{mm}^2}{\text{rad}} \right] \quad (4)$$

where:

$2b_z^*$  - distance between the suspension supports on the axle [mm];

$2a^*$  - car axle base [mm];

$\varphi$  – angular displacement [rad];

$\Delta F$  – variation of the vertical force [KN].

The angular displacement  $\varphi$  [rad] can be expressed as:

$$\varphi = \frac{h}{2b_z^*} \quad (5)$$

and the expression for the torsional rigidity becomes:

$$C_t^* = 2a^* \cdot (2b_z^*)^2 \cdot \frac{\Delta F}{h} \left[ \frac{\text{KN} \cdot \text{mm}^2}{\text{rad}} \right] \quad (6)$$

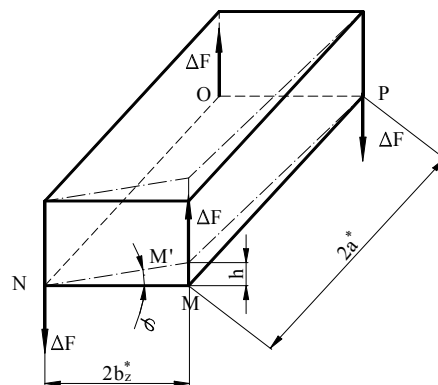


Figure 1. Geometric characteristics of the railway car

It is sufficient for the  $\frac{\Delta F}{h}$  ratio to be determined experimentally in order to determine the torsional rigidity  $C_t^*$ .

The experimental measurements in order to determine the  $\frac{\Delta F}{h}$  or  $\frac{\Delta F'}{h'}$  ratios can be conducted both for the carbody and the bogie frame. For the carbody, the measurements can be conducted both in the presence of the bogies or in their absence, and in the case of cars on two axles, both in the presence of the axles and in their absence.

Figure 2 shows the arrangements necessary in order to conduct the tests to experimentally determine the  $\frac{\Delta F'}{h'}$  in the case of the vehicle without the bogies.

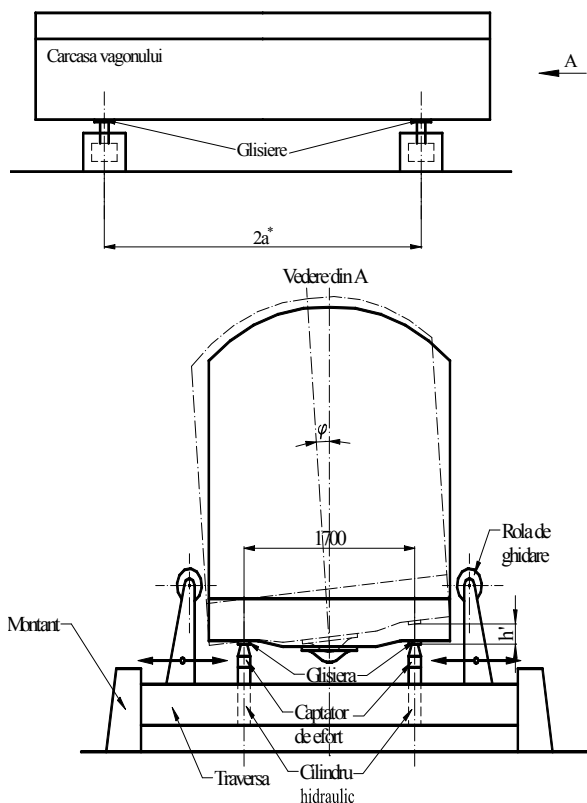


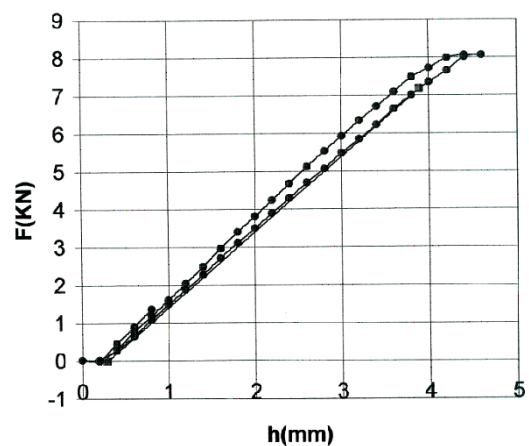
Figure 2. The arrangements necessary in order to conduct the tests to experimentally determine the  $\frac{\Delta F'}{h'}$  in the case of the vehicle without the bogies

### OF WHEEL LOAD AND TORSIONAL RIGIDITY

Further on, experimental determinations of the wheel load and the torsional rigidity will be presented for the cistern car with a capacity of 72m<sup>3</sup> [1,2].

Table 1

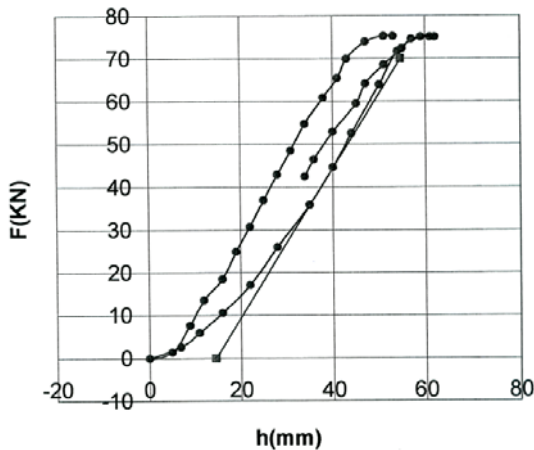
Test	Imposed values by the testing program and procedures [kN]	Values obtained from the testing [kN]
<b>Verifying wheel load repartitions with Y 25 Cs bogies</b>	$\lim \Delta Q_{fz1} = 6,2564$	$Q_{11} = 30,9160$ $Q_{12} = 31,6480$ $\Delta Q_1 = 0,3660$ $\Delta Q_{\mu I} = 0,9170$ $\Delta Q_{fz1} = \Delta Q_1 + \Delta Q_{\mu I}$ $\Delta Q_{fz1} = 1,2830$
	$\lim \Delta Q_{fz2} = 6,1224$	$Q_{21} = 31,3750$ $Q_{22} = 29,8490$ $\Delta Q_2 = 0,7630$ $\Delta Q_{\mu I} = 0,9170$ $\Delta Q_{fz2} = 1,6800$
	$\lim \Delta Q_{fz3} = 5,9826$	$Q_{31} = 29,4520$ $Q_{32} = 30,3740$ $\Delta Q_3 = 0,4610$ $\Delta Q_{\mu II} = 0,8548$ $\Delta Q_{fz3} = 1,3158$
	$\lim \Delta Q_{fz1} = 6,2564$	$Q_{11} = 30,9160$ $Q_{12} = 31,6480$ $\Delta Q_1 = 0,3660$ $\Delta Q_{\mu I} = 0,9170$ $\Delta Q_{fz1} = \Delta Q_1 + \Delta Q_{\mu I}$ $\Delta Q_{fz1} = 1,2830$



$$C_t^+ = 1,43600 \cdot 10^{10} \text{ KN} \cdot \text{mm}^2 / \text{rad}$$

Figure 3. Force-displacement diagram for the bogie frame torsioning

#### 4. EXPERIMENTAL DETERMINATIONS



$$C_t^* = 13,86450 \cdot 10^{10} \text{ KN} \cdot \text{mm}^2 / \text{rad}$$

**Figure 4. Force-displacement diagram for the chassis torsioning**

The computation for the  $(Y/Q)_a$  ratio is conducted according to the methodology of ERRI B 12 Rp 49 [5].

a) Car technical data:

- weight  $T = 26,1 \text{ t}$ ;
- Average wheel load  $Q_0 = 32,0 \text{ kN}$ ;
- Load corresponding to the two stage primary suspension inflexion point (ERRI B 12 Rp 49)  $F_{cz} = 26,2 \text{ kN}$ ;
- Mounted axle weight (ERRI B 12 Rp 49)  $Gr = 12,9 \text{ kN}$ ;
- Car axle base  $2a^* = 10660 \text{ mm}$ ;
- Bogie axle base  $2a^+ = 1800 \text{ mm}$ ;
- Wheel base  $2e = 1435 \text{ mm}$ ;
- Distance between rolling circles  $2b_A = 1500 \text{ mm}$ ;
- Distance between suspension springs  $2b_Z = 2000 \text{ mm}$ ;
- Distance between gliders  $2b_G = 1700 \text{ mm}$ ;
- Rigidity – measured value  $C_t^* = 13,864 \cdot 10^{10} \text{ KN} \cdot \text{mm}^2 / \text{rad}$ ;
- Bogie frame rigidity – measured value  $C_t^+ = 1,436 \cdot 10^{10} \text{ KN} \cdot \text{mm}^2 / \text{rad}$ ;
- Primary suspension rigidity (ERRI B 12 Rp 49)  $C_{z^+ 1(2)} = 1,004 \text{ KN/mm}$ ;
- Glider springs rigidity (ERRI B 12 Rp 49)  $c_G = 0,57 \text{ KN/mm}$ ;
- Maximum relative deviation of wheel load  $\Delta q_0 = 0,2$ ;
- Wheel radius  $r = 460 \text{ mm}$ ;
- Radius of the railway used in computation  $R = 150 \text{ m}$ ;
- Gravitational acceleration  $g = 9,81 \text{ m/s}^2$ ;

- Derailment safety criterion  $\lim(Y/Q)_a = 1,2$ .

In order to complete the theoretical computation regarding safety against derailment ( $Y/Q$  ratio), for the tested car, the following assumptions were used:

- For the empty car, the first stage of the suspension comes into action;
- In quasistatic conditions, it is acceptable to use, for computation, the following values for the travel velocity, transverse acceleration and rail over-heightening in curves:  $v = 0, a = 0, u = 0$ .

b) Computation of the  $(Y/Q)_a$  ratio

1. Torsioning of the car during testing (ERRI B 12 Rp 49 rel. 42)

$$g^* = 15 / 2a^* + 2 = 3,407 \%$$

2. Torsioning of the bogie during testing (ERRI B 12 Rp 49 rel. 43)

$$g^+ = 7.5 / 2a^+ = 4,22 \%$$

3. Exterior leading force (ERRI B 12 Rp 49 rel. 48)

$$Y_a = 0,5319 \cdot Q_0 + 1,9062 = 18,927 \text{ KN}$$

4. Interior leading force (ERRI B 12 Rp 49 rel. 49)

$$Y_i = -0,4923 \cdot Q_0 - 0,1512 = -15,905 \text{ KN}$$

5. Transverse force in the axle box (ERRI B 12 Rp 49 rel. 50)

$$H_y = -(Y_a + Y_i) = -3,022 \text{ KN}$$

6. Absolute decrease of the wheel load due to the  $H_y$  force (ERRI B 12 Rp 49 rel. 76)

$$\Delta Q_{H_y} = H_y \cdot (r / 2b_A) = -0,927 \text{ KN}$$

7. Absolute maximum deviation of the wheel load (ERRI B 12 Rp 49 rel. 75)

$$\Delta Q_{F_{z0}} = \Delta q_0 \cdot Q_0 = 6,4 \text{ KN}$$

8. Absolute total decrease of the wheel load due to rail twisting on the basis of the axle base of the bogie (ERRI B 12 Rp 49 rel. 61)

$$\frac{1}{C_{tA(2a^+)}} = \frac{10^3 \cdot (2b_A)^2}{C_t^*} + \frac{10^3 \cdot b_A^2 \cdot 4}{2a^+ \cdot b_z^2 \cdot c_{z1}^+} = 1,402 \text{ \% / KN}$$

$$C_{tA(2a^+)} = 0,7134 \text{ KN/\%o}$$

$$\Delta Q_t^+ = g^+ \cdot C_{tA(2a^+)} = 3,0106 \text{ KN}$$

9. Absolute total decrease of the wheel load due to rail twisting on the basis of the car's axle base (ERRI B 12 Rp 49 rel. 73)

$$\frac{1}{C_{tA(2a^+)}} = \frac{10^3 \cdot (2b_A)^2 \cdot 2}{C_t^*} + \frac{10^3 \cdot b_A^2 \cdot 2 \cdot 4}{2a^* \cdot b_z^{+2} \cdot 2 \cdot c_{z1}^+} +$$

$$+ \frac{10^3 \cdot b_A^2 \cdot 2 \cdot 4}{2a^* \cdot b_G^{+2} \cdot c_G} = 1,2674$$

$$C_{tA(2a^*)} = 0,789 \text{ KN/\%o}$$

$$\Delta Q_t^* = g^* \cdot C_{tA(2a^*)} = 2,688 \text{ KN/\%o}$$

10. (Y/Q)<sub>a</sub> ratio (ERRI B 12 Rp 49 rel. 47)

$$\left(\frac{Y}{Q}\right)_a = \frac{Y_a}{Q_0 - (\Delta Q_t + \max \Delta Q_{fz0} + \Delta Q_{Hy})} = 0,908$$

## 5. CONCLUSIONS

In conclusion, it can be considered that the value of the Y/Q ratio of 0,908 is situated under the UIC admissible limit of 1,2 and thus there is a certitude of the elimination of derailment.

Torsional rigidities  $C_t^*$  and  $C_t^+$  of the car and bogie respectively, significantly influence travel safety since they can cause large values of the unloading  $\Delta Q_t^*$  and  $\Delta Q_t^+$  when the bearing structures of the car and the bogie have large torsional rigidities and a low elasticity.

The existence of an adequate elasticity of the car and bogie structure thus leads to an

improvement of the vehicle behaviour in regards to the derailment risk.

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## STUDY ON THE ENERGETIC CHARACTERISTICS OF THE SHOCK INSULATORS OF RAILWAY VEHICLES

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### Abstract

*The paper presents the results of experimental studies on the behaviour of bearing structures and shock insulators of railway vehicles during the shock caused by collisions.*

*The evolutions of energy parameters depending on the collision velocity are highlighted as well as the experimental values of certain kinematic and force parameters as response functions of the considered mechanical system to the action of excitations caused by the shocks that appear in use.*

*The paper contains notions related to the theory of shocks caused by collisions of railway vehicles as well as an experimental chapter which, together with the first part, highlight the importance of using shock insulators with a higher capacity for storing potential deformation energy, in order to reduce the maximum values of the response parameters of the considered mechanical system and also to protect the vehicles against the shocks that appear in use.*

*Keywords: testing, collision, buffers, stored potential energy.*

### 1. GENERAL INFORMATION

The shock caused by the collision of railway vehicles leads to the transmission of considerable forces and accelerations that determine:

- loads of the resistance structure of the railway cars (chassis, carbody) and the bogies (frame, beams) ;
- loads on the interior amenities of the passenger cars;
- loads on the different equipment, mechanisms and functional apparatus of freight cars;
- accelerations transmitted to transported freight, which can endanger their integrity and that of the affixing or packaging devices;
- accelerations transmitted to passenger cars, with consequences that must be considered in regards to passenger comfort.

In order to insulate against the shocks that appear on the longitudinal direction, and to protect against them, railway vehicles are equipped with shock insulators (buffers, central coupling dampeners or long displacement dampeners).

### 2. THE COLLISION PROCESS

During the collision of two vehicles , between the times  $t = t_1 = 0$ , which marks the start of the collision, and  $t = t_2$ , which marks the end of the collision process, there is a moment  $t = t_{12}$  at which the velocities of the two vehicles are equal  $v_1(t) = v_2(t) = v_{12}$  . At that moment, the vehicles travel at the same velocity  $v_{12}$ , the kinetic energy of the vehicles is minimal, part of the initial kinetic energy being transformed, on the interval  $(0 - t_{12})$  into potential energy stored by the vehicles.

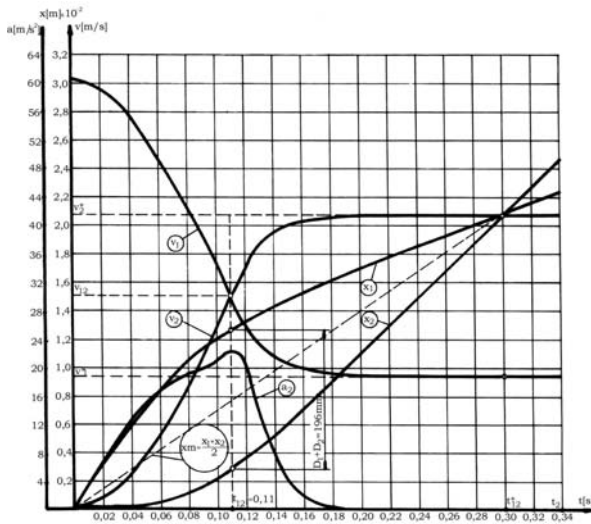


Figure 1

The stored potential energy "E<sub>p</sub>" at the moment "t<sub>12</sub>" is maximal. The deformations and displacements caused by the shock are maximal, implicitly the contraction of the shock insulators (buffers, central coupling dampeners) "D" is maximal [1].

Between the times t = 0 and t = t<sub>12</sub>, by considering the laws of conservation of momentum and energy, we have that:

$$m_1 v_1 + m_2 v_2 = (m_1 + m_2) v_{12} \quad (1)$$

$$\frac{m_1 v_1^2}{2} + \frac{m_2 v_2^2}{2} = \frac{(m_1 + m_2) v_{12}^2}{2} + E_p \quad (2)$$

Introducing v<sub>12</sub> from equation (1) into equation (2), the stored potential energy of the vehicle becomes:

$$E_p = \frac{m_1 m_2}{m_1 + m_2} \frac{(v_1 - v_2)^2}{2} = \frac{m_1 m_2}{m_1 + m_2} \frac{v^2}{2} \quad (3)$$

where: m<sub>1</sub> – mass of the colliding car  
 m<sub>2</sub> – mass of the collided car  
 v – relative velocity between vehicles (collision velocity)

The time variation of the motion parameters of the vehicles, as response functions to the shock caused by collision (figure 1) shows:

1. At each moment "t" of the collision process that occurs on the time interval (0-t<sub>2</sub>), the contraction "D" of the shock insulators which equip the vehicles is:

$$D(t) = x_1(t) - x_2(t) = \int_0^t v_{1(t)} dt - \int_0^t v_{2(t)} dt \quad (4)$$

2. At time t<sub>12</sub>, when the vehicles have the common v<sub>12</sub> and the potential energy stored by the vehicle is maximal, the difference between the distances traveled by the vehicles represents the maximum contraction of the shock insulators "D<sub>max</sub>" and, obviously, the marked surface "S", shown in figure 1 [2]:

$$D_{max} = x_{1(t_{12})} - x_{2(t_{12})} = \int_0^{t_{12}} v_{1(t)} dt - \int_0^{t_{12}} v_{2(t)} dt = S \quad (5)$$

3. Experimentally it is observed that, at the time t = t\*<sub>12</sub>, the accelerations transmitted to the vehicles cancel out. Consequently, the vehicle travel on the time interval (t\*<sub>12</sub>- t<sub>2</sub>), with constant velocities "v\*<sub>1</sub>", and "v\*<sub>2</sub>", remaining in contact on this interval, under the condition of the increase of the space between the vehicles "D(t)" = x<sub>1</sub>(t) - x<sub>2</sub>(t).

4. The process of transformation of stored potential energy into kinetic energy, started at time t = t<sub>12</sub>, ends at time t = t\*<sub>12</sub>, when the vehicles reach the velocities v\*<sub>1</sub>, and v\*<sub>2</sub>.

Consequently, the value of the maximum contraction "D<sub>max</sub>" and the surface "S", which represents the value of the maximum contraction are:

$$D_{max} = \int_{t_{12}}^{t^*_{12}} v_{1(t)} dt - \int_{t_{12}}^{t^*_{12}} v_{2(t)} dt = -S \quad (6)$$

### 3. THE ENERGY CHARACTERISTICS OF THE COLLISION PROCESS, THE 2β COEFFICIENT

The accelerations a<sub>2</sub>(t), the forces transmitted through the buffers F(t), the contractions of the buffers D(t), the potential energy stored by the buffers W<sub>e</sub> and dissipated W<sub>a</sub> were determined experimentally [3].

Against the shocks that strain, during use of the vehicle, longitudinally, railway cars are equipped with shock insulators (buffers, central coupling dampeners, long displacement dampeners). The use of shock insulators having high dynamic characteristics has the following consequences:

- the spectacular decrease of the maximum forces transmitted to the vehicles, with direct consequences on the protection of the resistance structures by decreasing specific deformation

and the stresses caused by the shock of collision;

- decrease of the level of acceleration transmitted to the vehicles, down to values that ensure a necessary protection of the freight, vehicle equipment as well as increased passenger comfort. Further on, the following specific energy coefficients are defined, whose variation as a function of collision velocity  $v = v_1 - v_2$  represents the energy characteristics of the shock caused by the collision of railway vehicles, during the collision process ( $0 - t_2$ ):

1. The  $2\beta = f(v)$  coefficient, which characterizes the shock of railway vehicles, represents the ratio between the potential deformation energy stored by the shock insulators  $W_e$  and the potential energy stored by the system formed by the two vehicles  $E_p$ :

$$2\beta = W_e / E_p \quad (7)$$

2. The  $2\lambda = f(v)$  coefficient is the ratio between the potential deformation energy stored by the resistance structures of the vehicles  $W_{es}$  and  $E_p$ :

$$2\lambda = W_{es} / E_p \quad (8)$$

If the vehicles are identical from this point of view, then  $\lambda_1 = \lambda_2 = \lambda$ .

3. The  $2\delta = f(v)$  coefficient represents the ratio between the potential deformation energy stored by the elastic elements that form the suspension of the vehicles  $W_{eB}$  and  $E_p$ :

$$2\delta = W_{eB} / E_p \quad (9)$$

If the vehicles are identical from this point of view, then  $\delta_1 = \delta_2 = \delta$ .

4. The  $2\chi = f(v)$  coefficient represents the ratio between the potential energy stored by the equipment, apparatus and the freight of the vehicles  $W_{ei}$  and  $E_p$ :

$$2\chi = W_{ei} / E_p \quad (10)$$

If the vehicles are identical from this point of view, then  $\chi_1 = \chi_2 = \chi$ .

It is obvious that:

$$2\beta + 2\lambda + 2\delta + 2\chi = 1 \quad (11)$$

It is extremely important to note that the resistance structures, the elastic elements that form the suspension, the functional equipment, as well as the nature and quantity of the freight are established by other defining criteria than that of the response to the longitudinal shock caused by collision. Thus,

the only way to decrease the effects of the shock is to increase the potential deformation energy stored by the shock insulators. Hence it can be explained why the  $2\beta = f(v)$  coefficient represents the specific energy factor that characterizes the shock phenomenon in railway vehicles. This specific energy characteristic directly influences the unwanted consequences of the shock.

#### 4. COLLISION TESTING

The 95 m<sup>3</sup> tank car on 4 axles, with 22,5 t/axle, designed for the Austrian railways, was subjected to collision testing, under the testing conditions imposed by the UIC UIC in report RP17 of the ORE B12 committee. The loaded car collision tests are presented, during which the tested car with mass  $m_2 = 90t$  was loaded with water and equipped with category C buffers (according to UIC 526-1); the colliding car was a gondola type car with mass  $m_1 = 80t$  loaded with sand, equipped with category A buffers (according to UIC 526-1) [4].

The placement of the transducer in order to experimentally determine the relative deformations is shown in figure 3, and the results of the measurements are presented in tables 1 – 3 (table 1 shows the results of the preliminary measurements, tables 2 and 3 present the results of the measurements for the 40 collisions series).

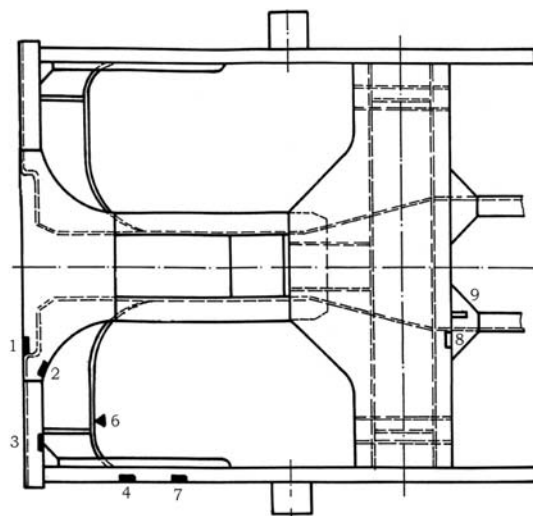


Figure 3.a.



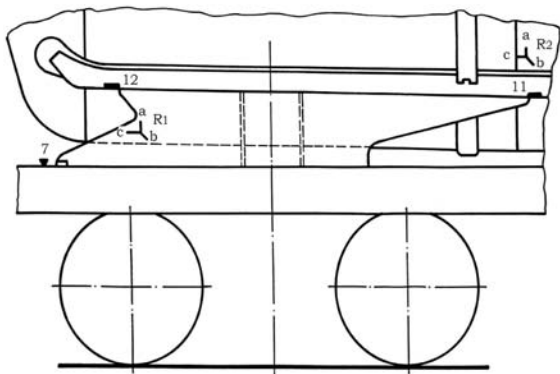


Figure 3. b.

Table 1.

Coll. No.	V (km/h)	F <sub>1</sub> (MN)	F <sub>2</sub> (MN)	F (MN)	a (g)
1	8,9	0,48	0,57	1,05	3,04
2	11,2	0,70	0,79	1,49	4,19
3	13,5	0,92	1,05	1,97	5,33
4	15,0	0,98	1,14	2,12	6,09

Table 2.

Coll. No.	10	20	30	40	
V [km/h]	15,0	15,0	15,0	15,0	
TERσ [N/mm <sup>2</sup> ]	1	243,1	247,2	239,0	243,1
	2	-123,6	-119,5	-119,5	-119,5
	8	-173,0	-173,0	-181,3	-173,0
	11	-352,8	-342,0	-349,2	-352,8
	4	-164,8	-160,7	-160,7	-164,8
	6	214,8	214,2	226,6	222,5
	9	-140,1	-144,2	-148,3	1401,1

Table 3a.

Coll. No.	V (km/h)	TER σ [N/mm <sup>2</sup> ]		
		3	7	12
10	15,0	292,5	- 243,1	214,2
20	15,0	271,9	- 247,2	210,1
30	15,0	284,3	- 243,1	214,4
40	15,0	271,9	- 243,1	197,8

Table 3b.

Coll. No.	V (km/h)	ROSE TYPE TRANSDUCER R <sub>2</sub> [N/mm <sup>2</sup> ]			
		σ <sub>1</sub>	σ <sub>2</sub>	σ <sub>E</sub>	α (rad)
10	15,0	- 77,9	- 162,1	140,4	1,61
20	15,0	- 77,9	- 162,1	140,4	1,61
30	15,0	- 80,2	- 162,8	140,1	1,60
40	15,0	- 76,6	- 157,4	136,3	1,59

## 5. CONCLUSIONS

The study of the experimental results leads to the following conclusions:

- At a collision velocity  $v = 15$  km/h, the force transmitted to the buffers falls within the interval (2,09 - 2,22) MN. The force  $F = 3$  MN can be reached at velocities higher than the collision velocity of  $v = 15$  km/h. Consequently, the repeated shock test (series of 40 collisions) was conducted at the maximum collision velocity accepted by RP17 ORE B12, meaning  $v = 15$  km/h.

- The acceleration transmitted to the collided car at the collision velocity  $v = 15$  km/h has a value between (5,9 - 6,28) g, values that are inferior to those recorded in the case of the use of category A buffers.

- It is observed that the relative deformations and the stresses determined experimentally, in the measurement points considered are below the flow limit  $\sigma_c = 360$  N/mm<sup>2</sup>, increased by 30% in accordance to the shock behaviour of the steel used in the car construction.

- The resistance structure of the chassis, the elements affixing the tank to the chassis and the tank showed an elastic behaviour. Residual deformations were not recorded at any point. Consequently, no permanent deformations were observed. Investigations were conducted on the state of the resistance structure of the car, both visually and using the penetrating liquid method, in the areas of the tank affixing (transducers 11 and 12), as well around the support beam in the heavily loaded areas (transducers 1 and 6). The collision testing shows that the technical solutions adopted correspond to the requirements imposed by use.

The use of shock insulators with a high capacity for storing and dissipating potential deformation energy, leads to the decrease of the unwanted consequences of the shock caused by the collision of railway vehicles, in use.:

- permanent deformations of the elements of the resistance structures of railway vehicles; deteriorarea amenajărilor și dotărilor funcționale;

- ensures the integrity of transported freight and the affixing and packaging devices;

- eliminates the consequences that must be considered when appreciating passenger comfort.

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## BLAST WAVE SCALING LAWS (Hopkinson-Cranz Scaling Method)

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**Abstract:** *This paper provides an overview of blast wave scaling laws. Scaling laws are used to predict the properties of blast waves from large explosive devices based on test data with much smaller charges.*

*The most common form of blast scaling is the Hopkinson-Cranz, or cube-root scaling (Hopkinson 1915, Cranz 1926). Hopkinson-Cranz scaling is commonly described as “cube-root” scaling, a formal statement of which is: Self-similar blast waves are produced at identical scaled distances when two explosive charges of similar geometry and of the same explosive but of different sizes are detonated in the same atmosphere. The meaning and the notations of the parameters used in the paper is that established in the specialty literature [1,2,3,4,5].*

**Key words:** *blast wave, Hopkinson-Cranz scaling law, idealized blast wave, Sachs scaling, spherical TNT explosive charges.*

### 1. INTRODUCTION

A blast wave in fluid dynamics is the pressure and flow resulting from the deposition of a large amount of energy in a small very localised volume. The flow field can be approximated as a lead shock wave, followed by a 'self-similar' subsonic flow field.

Blast effects are associated with either nuclear or conventional explosive devices. Although small nuclear devices (e.g., tactical size) could be used by terrorists, the associated technical problems include many serious issues that could be far more complicated to address than blast effects on buildings. Therefore, nuclear weapon effects are not addressed in this paper.

Scaling laws are used to predict the properties of blast waves from large explosive devices based on test data with much smaller charges [2,4,5,6]. The most common form of blast scaling is the Hopkinson-Cranz, or cube-root scaling (Hopkinson 1915, Cranz 1926) [1].

At its simplest, airblast is made up of two events which occur in extremely quick succession. Firstly, a shockwave creates an overpressure (pressure above ambient) on the surroundings. This is followed almost instantly by a

blast wind creating a dynamic pressure on the surroundings.

When an explosive charge is detonated in air, the detonation wave passes through the charge at several thousand meters per second, forming a compact volume of high pressure gasses. As the detonation wave passes into the surrounding air, its energy is rapidly dissipated by heating the air and the wave slows down.

The rapidly expanding high pressure gasses overtake the detonation front within a few charge diameters (usually 2 to 3). After a short travel distance, the compressed gasses acquire a very steep pressure front (“shocking up”) with a supersonic velocity. As the shockwave progresses, its energy is dissipated due to heat losses to the surrounding air and its velocity falls.

Thus, as the shock or blast wave expands, it decays in strength, lengthens in duration, and slows down, approaching the local sonic velocity. Beyond about 50 charge diameters, the velocity of the shock wave has fallen to near the local sonic velocity and has become an ordinary impulsive sound wave. Hence, airblast and noise are closely related manifestations of the

same progressive airblast wave generated by an explosion in the atmosphere.

The gas behind the shock front moves at lower, flow velocities termed particle velocities.

These flow velocities are associated with the dynamic pressure formed by the blast wind produced by the passage of the shock front.

If an explosion of a spherical charge occurs in still, homogeneous air, well away from any reflecting surface, the characteristics of the blast wave are functions only of the distance from the center of the charge and time [1,2,3]. A pressure transducer, located at some distance from the charge, would record a signal similar to that shown in Figure 1.

For some time after the explosion, the transducer sees only ambient atmospheric pressure ( $P_0$ ). At the blast wave arrival time,  $t_a$ , the pressure rises abruptly to a value  $P_s$  (N.B., the overpressure is defined as  $P_s - P_0$ ). The pressure then decays with time, eventually falling below the preexplosion ambient pressure; this time is called the positive duration or positive phase duration and spans the positive phase of the blast wave. It is often given the symbol,  $t_d$ .

This is followed by a negative phase, with the pressure eventually returning to and oscillating about the local ambient pressure. The negative phase duration is often as much as three times the duration of the positive phase.

Many forms of equations have been proposed to describe the temporal variation of the pressure curve. The shape of this curve is generally exponential.

The following equation, sometimes called a "Modified Friedlander Equation" seems to work well for most situations:

$$P(t) = P_0 + \left(1 + \frac{t}{t_d}\right) * e^{-\left(\frac{\alpha t}{t_d}\right)} \quad (1)$$

where  $P_0$  is the ambient pressure,  $t_d$  is the positive duration, and  $\alpha$  represents a decay constant.

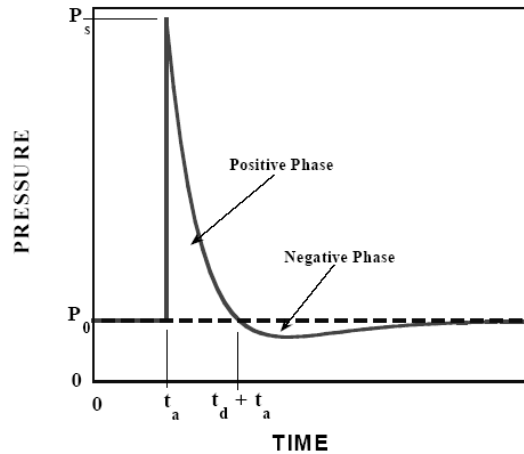


Figure 1. Idealized Blast Wave

At a given location, the overpressure and the dynamic pressure associated with a blast wave shock front vary with time in a similar manner, but the rate of decrease of pressure behind the shock front is different. During the negative or suction phase, the flow direction reverses and the dynamic pressure acts in the opposite direction.

## 2. BLAST WAVE SCALING LAWS (HOPKINSON-CRANZ SCALING)

The most widely used approach to blast wave scaling is that formulated independently by Hopkinson and Cranz. Hopkinson-Cranz scaling is commonly described as "cube-root" scaling, a formal statement of which is:

*Self-similar blast waves are produced at identical scaled distances when two explosive charges of similar geometry and of the same explosive but of different sizes are detonated in the same atmosphere.* [1].

Thus, if the two charge masses are  $W_1$  and  $W_2$  of diameters  $d_1$  and  $d_2$ , respectively, then for the same explosive material, it is clear that:

$$W_1 \alpha d_1^3 = W_2 \alpha d_2^3 \quad (2)$$

$$\frac{W_1}{W_2} = \left(\frac{d_1}{d_2}\right)^3 \quad (3)$$

$$\frac{d_1}{d_2} = \left(\frac{W_1}{W_2}\right)^{1/3} \quad (4)$$

Therefore, if the two charge diameters are in the ratio  $d_1/d_2 = \lambda$ , then, as Figure 2 indicates, if the same overpressure  $P_s$  is to be produced from the two charges, the ratio of the ranges at which the particular overpressure is developed will also be  $\lambda$ , as will the positive phase duration ratio and the impulse ratio.

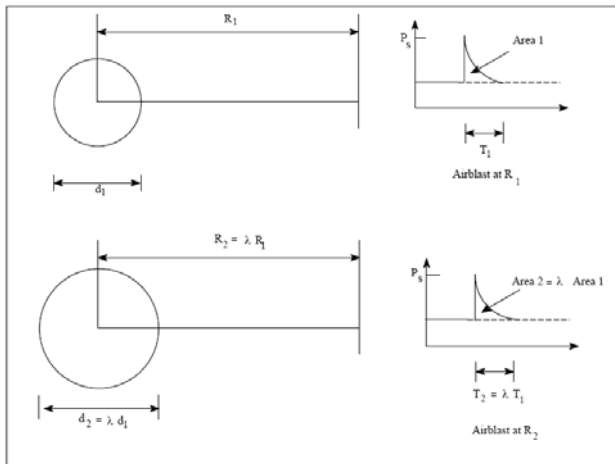


Figure 2. Basis of Hopkinson-Cranz scaling law

Ranges at which a given overpressure is produced can thus be calculated using the equations shown above. For example:

$$\frac{R_1}{R_2} = \left( \frac{W_1}{W_2} \right)^{1/3} \quad (5)$$

where  $R_1$  is the range at which a given overpressure is produced by a charge whose mass is  $W_1$  and  $R_2$  is the range at which the same overpressure is generated by a charge of mass  $W_2$ .

The Hopkinson-Cranz approach leads readily to the specification of a scaled distance,  $Z$ , given by the relationship:

$$Z = \frac{R}{W^{1/3}} \quad (6)$$

It is clear that  $Z$  is, in effect, the constant of proportionality in the relationships of equation 2.

A convenient way of representing significant blast wave parameters is to plot them against scaled distance. The use of  $Z$  in these situations allows a compact and efficient pres-

entation of blast wave data for a wide range of situations.

Blast data at a distance  $R$  from the center of an explosive source of characteristic dimension  $d$  will be subjected to a blast wave with amplitude of  $P$ , duration  $td$ , and a characteristic time history. The integral of the pressure-time history is defined as the impulse  $I$ . ( figure 1)

The Hopkinson-Cranz scaling law then states that such data at a distance  $ZR$  from the center of a similar explosive source of characteristic dimension  $Zd$  detonated in the same atmosphere will define a blast wave of similar form with amplitude  $P$ , duration  $Zt_d$  and impulse  $ZI$ . All characteristic times are scaled by the same factor as the length scale factor  $Z$ . In Hopkinson-Cranz scaling, pressures, temperatures, densities, and velocities are unchanged at homologous times. The Hopkinson-Cranz scaling law has been thoroughly verified by many experiments conducted over a large range of explosive charge energies.

Limited reflected impulse measurements by Huffington and Ewing in 1985 showed that Hopkinson-Cranz scaling may become inapplicable for close-in detonations, e.g.,  $Z < 0.4$  ft/lb<sup>1/3</sup> (0.16 m/kg<sup>1/3</sup>). [5].

### 3. SACHS SCALING

In the case of blast waves from explosions produced at altitude, where ambient conditions can be very different from those at sea level, the most commonly used scaling law is that due to Sachs.

The application of Sachs scaling law leads to the formulation of altitude scaling factors. These are shown in Table 1. In this table, the subscript 0 refers to sea level conditions, while the subscript  $z$  refers to conditions at the altitude of interest;  $P$  is pressure and  $T$  is absolute temperature.

Table 1. Sachs Scaling Factors

PARAMETER	FACTOR		
Distances at sea level	Distances at altitude/ $S_d$	$S_d =$	$(P_0/P_z)^{1/3}$
Pressures at sea level	Pressures at altitude/ $S_p$	$S_p =$	$(P_z/P_0)$
Impulses at sea level	Impulses at altitude/ $S_i$	$S_i =$	$(P_z/P_0)^{2/3} * (T_0/T_z)^{1/2}$
Times at sea level	Times at altitude/ $S_t$	$S_t =$	$(P_0/P_z)^{1/3} * (T_0/T_z)^{1/2}$
	$P_0 =$	101.33 kPa	
	$T_0 =$	288.16° K	

#### 4. CONCLUSIONS

In Hopkinson-Cranz scaling, pressures, temperatures, densities, and velocities are unchanged at homologous times. All characteristic times are scaled by the same factor as the length scale factor  $Z$ . The Hopkinson-Cranz scaling law has been thoroughly verified by many experiments conducted over a large range of explosive charge energies.

Several works have been conducted on the properties of spherical blast waves into free air and reflected blasts on surfaces. The charge can be defined by a TNT charge [1,3,5], or by a gaseous mixture [5]. The TNT equivalency method of explosive sources makes it possible to express the energy release resulting from the detonation of a gas mixture in terms of TNT equivalent energy [5].

Application of the Hopkinson scaling law allows one to translate the adimensional laws at large scale: the amplitude of the pressure is the same for a large-scale structure; the times, impulses and distances are multiplied by a factor  $k$  and the energy by  $k^3$  [4].

The character of the blast waves from condensed high explosives is remarkably similar to those of TNT, and these curves can be used for other explosives by calculating an equivalent charge weight of the explosive required to produce the same effect as a spherical TNT explosive.

Generally, the equivalent weight factors found by comparing airblast data from different high explosives vary little with scaled distance, and also vary little dependent on whether peak overpressure or side-on impulse is used for the comparisons. When actual comparative blast data exist, its average value can be used to determine a single number for TNT equivalence. When no such data exist, comparative values of heats of detonation,  $H$ , for TNT and the explo-

sive in question can be used to predict TNT equivalence [7].

The theoretical heats of detonation for many of the more commonly used explosives are listed in various sources [3], along with TNT equivalency factors [7]. This method of computing TNT equivalency is related primarily to the shock wave effects of open-air detonations, either free-air or ground bursts.

Limitations of this approach have been discussed in various publications [5,6]. Typical sources of compiled data for airblast waves from high explosives are for spherical TNT explosive charges detonated at standard sea level. The data are scaled according to the Hopkinson-Cranz (or cube-root) scaling law.

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## SIMPLIFIED CALCULATION METHOD FOR EXPLOSIVE SAFETY QUANTITY DISTANCE (QD)

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**Abstract:** This paper provides an overview of calculation of quantity distance. The quantity distance (QD) is the distance to which explosion hazards extend from the detonation location, expressed as a function of the quantity of explosive material involved. The current explosive safety quantity distance (ESQD) calculation is too inconvenient to carry out in the field condition. In this paper the reduced formula of ESQD for field ammunition was discussed which based on some hypothesis including mass detonation, no barricade and so on. It can shorten the period of deciding the distribution of field ammunition in the war which is very important to improve our support capability effectively. A quantity-Distance criterion represents physical limits which can not be breached without incurring unacceptable risks. The meaning and the notations of the parameters used in the paper is that established in the specialty literature [1,4,5].

**Key words:** quantity distance (QD), ammunition, hazard classification system, safety, explosive, field ammunition

### 1. INTRODUCTION

Explosive material, an inseparable component in ammunition and ordnance, is essential to military weapon system production and use. Explosive also have an inherent hazardous nature. The explosive properties of ammunition make it necessary for restriction in logistic function like handling and storage that are unlike all other commodities used by the military. Thus the commodity that is most crucial to combat readiness is also governed by the most stringent safety standards for its storage, transportation, and distribution.

In the past years, a number of significant explosive incidents have occurred which resulted in the evolution of Explosive safety quantity distance (ESQD) arcs. These ESQD arcs are at the core of current explosive safety standards and focus on minimizing exposure of personnel and facilities to ordnance storage and handling. The distances of these safety arcs are expressed as a function of the quantity of explosive material at any location and the area that would be affected in the event of detonation [1].

It is impracticable to prescribe distances which would be safe distances in the true sense, i.e. which would guarantee absolute immunity from propagation, damage or injury. An attempt has therefore been made in the recommendations in AASTP-3 to allow for the probability of an accident and how serious the resulting damage or injury would be.

The separation distances (quantity distances) between a potential explosion site and an exposed site recommended in AASTP-3 therefore represent a compromise deemed tolerable by AC/258 between absolute safety and practical considerations including costs and operational requirements [2,8].

The risk deemed tolerable depends upon many factors, some of which are objective, such as the quantity of explosives involved, the nature of the explosives, the packaging of dangerous items, their distribution within premises or in the open air, distance, the nature of the terrain and its contours, etc.

Other factors are subjective to what extent are damage and injuries resulting from an explosive accident tolerable? For example, how many deaths, how many serious injuries, how many buildings destroyed or damaged and

other costs are tolerable? It is therefore clearly essential to have a good knowledge of the nature of the main hazard, namely blast or projections or fire, as well as the foreseeable development of the accident: instantaneous, progressive, sporadic etc.

Consideration of these factors will yield the concept of hazard divisions, the net explosives quantity and the mutual influence of potential explosion site and exposed site. Quantity-distances are proposed in each case in the form of tables. These quantity distances imply a degree of harm or damage which is difficult to quantify but which most NATO nations regard as tolerable.

There is no question that establishment of explosive safety standards and quantity distance criteria has reduced the risk and enhanced personnel safety. Calculating ESQD arcs is not a problem if you have sufficient time. However, there was not enough time to calculate by rule and line in the battlefield that has made it more difficult to carry out strictly. Maintaining strict calculation is costly and at times inefficient.

For example one of complicated problem not easy to solve is the calculation of NEW (net explosive weight) because there are all kinds of ammunition. So the QD calculation is complicated and often inhibits effective ammunition logistics and can actually slow the flow of munitions to the war. In this paper we seek redress for maintaining explosive safety while enhancing ordnance logistics and combat readiness by establishing a “reduced” formula of calculating ESQD for *field ammunition* (Ammunition and explosives deployed in the field for training or operational purposes).

In order to promote the safe storage and transport of dangerous goods, an International System for Classification has been devised (table 1).

The system consists of 9 classes (1-9) of which Class 1 comprises ammunition and explosives. Class 1 is divided into divisions. The hazard division indicates the type of hazard to be expected primarily in the event of an accident: mass explosion (Division 1.1), projection effects (Division 1.2), fire and radiant heat (Division 1.3), no significant hazard (Division 1.4), mass detonation with very low probability

of initiation (Division 1.5) and detonation of a single article, with low probability of initiation (Division 1.6) [7,8]. Ammunition and explosives must be classified in accordance with STANAG 4123. National authorities competent for the classification of ammunition and explosives are given in AASTP-3 [8].

## 2. EXPLOSIVE SAFETY QUANTITY-DISTANCE (ESQD) REQUIREMENTS

Explosive Safety Quantity Distance (ESQD) requirements apply to the concentration of ammunition, explosives, and other hazardous materials at Naval Shore Establishments for development; manufacturing; test and maintenance; storage, loading and off-loading of vehicles, railcars and aircraft; disposal; and all related handling incidents. Explosive Safety Quantity Distance (ESQD) requirements are based on records of actual fires and explosions involving ammunition and explosives. ESQD requirements safeguard personnel against possible serious injury or equipment destruction from possible fires or explosions.

These requirements also protect the inhabitants of nearby communities, private and public property.. These requirements keep the loss of valuable ammunition stores (including inert ordnance items) to a minimum if there were a fire or explosion. The Department of Defense (DOD) ESQD hazard classification system is based on a system recommended for international use by the United Nations Organization (UNO). The UNO system has nine classes of hazardous material; but, DOD only uses three of the nine classes—Class 1, explosives; Class 2, Division 3, poison A; and Class 6, poisonous (toxic) and infectious substances. The table identifies each of the nine classes.

Table 1. Type of hazardous material

CLASS	TYPE OF HAZARDOUS MATERIAL
1	Ammunition and explosives, DOT Classes A, B, and C; Blasting Agents
2*	Compressed gases, flammable and nonflammable, Poison gases (Poison A)



3	Flammable liquids
4	Flammable solids or substances
5	Oxidizing materials
6*	Poisonous substances (Poison B); Irritating materials; Etiological agents
7	Radioactive materials
8	Corrosive material
9	Miscellaneous dangerous substances (other regulated materials)

\*Includes ammunition without explosive components which contain toxic chemical agents, and containers of toxic chemical agents in bulk. Formerly ESQD Class 8

### 3. SIMPLIFIED CALCULATION FORMULA OF QD

#### Type of Formula

The “current” QD’s are determined based on the current U.S. and NATO safety standards. They are based on 3 principle factors. The first is the amount of explosive in a given storage unit, called the net explosive weight (NEW), if measured in pounds, or the net explosive quantity (NEQ), if in kilograms. The second factor is related to the type of storage; i.e., open storage, storage in a light structure, in an earth-covered magazine, etc. The third factor is the level of risk that is acceptable, such as a one-percent probability of a casualty for exposed personnel. The risk factors in turn, are used to establish hazard criteria, such as a maximum level of airblast pressure or a maximum number of fragment impacts per unit area [3].

Throughout these standards, NEW is used to calculate distance by means of formula of the type  $D=K \cdot W^{1/3}$ , when D is the distance in feet, K is a factor depending upon the risk assumed or permitted, and W is the NEW in pounds. When metric units are used, the symbol Q denotes NEQ in kilograms. In the formula  $D=K \cdot Q^{1/3}$ , the distance D is expressed in meters. Thus, the respective units of K are  $\text{ft}/\text{lb}^{1/3}$  and  $\text{m}/\text{kg}^{1/3}$  in the 2 systems [4]. The value of K in English units is approximately 2.5 times its value in metric units. For example, if  $D(\text{m})=6 \cdot Q^{1/3}$ , then  $D(\text{ft})=15 \cdot W^{1/3}$ . In this paper we follow the metric units.

In addition the QD computations sometimes are expressed as  $D=K \cdot W^{1/2}$  in some reference. Of course the value of K is modified accordingly. So the essential and principle of the 2 formulas above go all the way actually. Thus we continue to use the idiomatic “cube root” formula.

#### Value of K

In the QD calculation K is a variable adapt to relevant explosive and depot. We can take a constant extremum replace the coefficient in order to reduce the complicated process of calculation.

We know that the principal hazards of concern may be airblast, fragments (primary fragments are from munition casings; secondary fragments or debris are from items, material, or structures around the detonation source), or ground shock. Among all factors the airblast is the most important to bring hazard. It has been proved by many testing results that person will be flesh wounded, and the common building and airplane will be destroyed when the blast overpressure reaches 0.2-0.3 kPa. The person will be grievous bodily harm or died, and the concrete building will be broken down, and the landmine will be detonated when the blast overpressure reaches 0.5-1.0 kPa.

In order to reduce the complicated process of calculation we should select the appropriate value of K on some assumption at first. For example we take no account of the tropism of magazine and the barricade placed near a donor or acceptor unit to intercept fragment and/or defect airblast loads. In addition we consider that the type of field magazine belongs to the mass detonating items. To field magazine without barricade we calculate the intermagazine distance based on the floor level of the blast overpressure ( $\leq 0.5$  kPa), here the value of K is 4.4 when mass detonates [1].

Because the value aims at the condition when the blast overpressure is lower limit and the sympathetic detonation of most ammunition can’t occur when the blast overpressure is lower than it. In addition the ammunition packaging has some fence performance. So it has surplus that we decide the value of K as 4.4 and it can ensure the safety of field ammunition avoiding propagation. The decision is accordant

to the experiment result of ground magazine without barricade in US correlative standards [1,7,8].

In the same way we can get the assurance coefficient to calculate the inhabited building and public traffic route distances. Separation distances required from standard earth-covered magazines and other types of ground magazines must satisfy some request. For example the missionary of magazine and the conveyance must keep appropriate distance to ammunition magazine. On the one hand they should be near to magazine in order to response as soon as possible when meet emergent accident. On the other hand they should be safe enough in order to continue to carry out task after some blast accident. In this paper we decide the value of  $K$  as 9.6 when calculate the inhabited building and public traffic route distances. It is corresponding to the blast overpressure as 0.16 kPa. The distance gives some attention to both safety and reaction of person and vehicle contemporary.

**Determination of NEQ**

The first step in defining the QD’s for mixed loads of ammunition is to determine the total NEQ in each load [4,5]. NEQ is the net explosive quantity, in kilograms, of a unit of explosive material. The unit referred to may be a single round, a stack, a container load, a storage area, etc. The usual modus operandi is to calculate the NEQ of every kind of munition’s explosive and change it for equivalent weight of TNT. The formula is showed in follow.

$$W = W_I Q_V / Q_T \tag{1}$$

$W$  — equivalent TNT weight of explosive

$W_I$  — quantity of explosive, kg

$Q_V$  — explosive heat of explosive, kJ/kg

$Q_T$  — explosive heat of TNT, kJ/kg

In fact the kind of ammunition and explosive is so various that the calculation becomes much complicated, especially in battlefield. In order to reduce the process we classify and compute the quantity of all kind’s of ammunition’s explosive. The statistical data is analyzed

synthetically then we can find the correlation coefficient of the quantity of ammunition and the equivalent TNT weight of explosive. Thus we can calculate the equivalent TNT weight quickly when only know the quantity of ammunition. The formula is showed as

$$W' = \alpha \cdot W_D \tag{2}$$

$W'$  — equivalent TNT weight of ammunition

$\alpha$  — coefficient converting into equivalent TNT weight

$W_D$  — quantity of ammunition (including packaging)

We classify all ammunition based on the calculation result of the equivalent TNT weight of ammunition and the quantity of ammunition (including packaging). This includes the 4 principal divisions in Table 2 [1]. They are “non-robust” munitions, “robust” munitions, rocket ammunition, recoilless ammunition and grenade et al.

Table 2. Coefficient of converting into equivalent TNT weight [1].

Name	Value range of $\alpha$	Authentic value of $\alpha$
cartridge	0.02-0.10	0.10
signal shell, flares, smoke rounds, etc.	0.02	
grenade	0.01-0.05	
mortar shell	0.08-0.14	0.16
breech-loading ammunition	0.10-0.16	
rocket ammunition	0.16-0.26	0.26
rocker launcher shell	0.12-0.26	
recoilless ammunition	0.14-0.20	0.20
hand grenade	0.09-0.18	

### Reduced Formula of ESQD

From the determination of assurance coefficient and NEQ we get the ESQD of field ammunition as follow.

$$R_s = 4.4(\sum_{i=1}^n \alpha_i W_{Di})^{1/3} \quad (3)$$

$$R_d = 9.6(\sum_{i=1}^n \alpha_i W_{Di})^{1/3} \quad (4)$$

$R_s$  — QD prevent sympathetic detonation (i.e. the intermagazine distance)

$R_d$  — QD prevent detonation damage (i.e. the inhabited building and public traffic route distances)

$\alpha_i$  — coefficient converting into equivalent TNT weight of some ammunition

$W_{Di}$  — quantity of some ammunition (including packaging)

From the formula we can calculate the ESQD quickly on if we know the quality of all kinds of ammunition in magazine when design and deploy the field magazine or pile.

In the reduced calculation ESQD has enough safety for the follow reasons. 1) We have a hypothesis that the field ammunition (magazine, stowage or load) belongs to mass detonating items. 2) We think the explosion is under the condition of no barricade. 3) We adopt the upper limit of  $K$  and  $\alpha$ .

Based on the regulation that the capability of filed magazine can't exceed 30 T, the max ESQD according to reduced formula should be 87.3 m when we adopt the max coefficient 0.26 converting into equivalent TNT weight. The least ESQD according to reduced formula should be 63.5 m when we adopt the least coefficient 0.10 converting into equivalent TNT weight. The calculation result is reasonable by contrast with the fact. Of course the ESQD should reduce properly when there is barricade such as hill between the magazines.

### 4. CONCLUSIONS

The requirements of the current QD are a constant equation between 2 variables. The first variable describes effects of an explosion, and the second, more constant variable defines the

permissible exposures for personnel. To decide the ESQD of field ammunition, many factors must be considered and the calculation is very complex [6]. The reduced formula based on the hypothesis including mass detonation and no barricade has security to deposit field ammunition which according to upper value. The consolidated formula from the effects of explosions and the permissible exposure for personnel allows for the determination of safe distance arcs for any given quantity and type of explosive. The reduced formula is very feasible to distribute the field magazine in a normal field condition. It can shorten the period of deciding the distribution of field ammunition in the war which is very important to improve our support capability.

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## EXPERIMENTAL PROGRAMMING IN MATERIALS SCIENCE

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**Abstract:** *The main stage in solving an optimization problem is finding the performance function (the target function) of the analyzed process. In most of the real problems the process's efficiency is appreciated not through an indicator but through more. In this situation it is necessary to peak one of this indicators, the most complete or the most representative and finally check the way in which the optimum solution corresponds from the other indicators point of view.*

**Key words:** *optimization, material, science, .*

### 1. INTRODUCTION

In all technical and economical fields being familiar with the technological processes and facts of all kind is based on processing and improving the information obtained after performing some tests.

In the context of the contemporary technical and scientific revolution, in which our country is profoundly involved, a special attention is granted to the qualitative increase, the diversification and the improvement of the material production.

The special task that is put in front of our industry in the actual stage can be at a higher qualitative level and entirely solved only through a scientifically approach and an optimum management of the technological processes.

By using science as a productive force, people work is moving towards reasoning and taking decisions, operational work being gradually taken by machineries and automatic equipment.

For reasoning and taking decisions, in the management of a process, science puts at our disposal necessary means as patterns – physical and mathematical – able to reach at any change in the working conditions.

Taking into consideration that researching on physical patterns has important shortcoming, like long standing of researching involving a higher consumption of intellectual

activity and the impossibility to cover economical factors, the actual purpose in managing technological processes is the use of the mathematical patterns on a large scale. These patterns reproduce the process studied using some functional relations and they allow finding most favorable conditions to work duly and spending less money than using physical patterns.

The experiment has always served as a way of knowing the reality, being a good criterion to verify the hypothesis and theories. For a long time, it has been thought that choosing the experiments' strategy and materializing it are determined by the experience and tester's intuition, Mathematics being used only at processing the results.

The rapid growth of experiments research volume has led in the centre of attention the problem of experiments efficient growth. The appearance of electronic computers has allowed the realization of such experimental schemes that contribute to the output's sensitive increase in research

In this content appeared the mathematical theory of the experiment as part of it (within the fragment of it) the experiment's organization. The experiment is programmed according to a determined plan which is perfect from the algorithm's point of view referring to the factor's modification. Realizing the experiment provides a complex

influence concerning variable conditions of the researched object.

The variety of the purposes is followed in research; generate a multitude of experimental programs. The mathematical experiments theory places in hand a series of necessary concepts to achieve the research's goals.

Generally, experimental research is realized without a very well determined logic, without programming the laborious experiments and without establishing from the very beginning and with accuracy what there is to do and where to aim it. Many times, those experiment something new. Do so as to obtain what they want and not what they must obtain.

Processing the experimental data through statistic methods presumes having a very good general knowledge.

The leading process is an informational process based on a methodology that must cover:

- collecting and preparing the information about the state of the object that is managed;
- processing the obtained information to get to the necessary decision;
- sending forth the execution for the leading decisions.

The systems can be studied through different methods. No matter what method is used to the base of these theories stands the "modeling concept".

Modeling is the studying method of the technological processes where the experiment is on a certain object and not on the original.

## 2. THE STAGES OF SOLVING AND OPTIMISATION OF THE PROBLEM

The main stages that must be followed to solve and optimise a problem are:

1 – **By gathering the information referring to the studied process**, we understand the gathering of statistic data and information that describe the specific process.

2 – **The elaboration of the mathematical model**. The mathematical model of a process defines as being the equation's and inequation's system capable to describe correctly the interdependences between the process's variables.

The mathematical models of the technological processes are of two kinds:

- theoretical models, obtained on the basis of some determined relations between the elements of the process; and on the relations that make the models equations;
- statistical models obtained by the statistic processing of the experimental data.

The elaboration of the mathematical model includes the next principal stages:

- the formulation of the model is made in four stages:
  - establishing the model's purpose;
  - the determination of the modeled process;
  - establishing the process's parameters;
  - the determination of the model's necessary type.

• establishing the performance function. The performance function is a unique univocal and objective criterion, through which the efficiency of the technological process is estimate (the economical criterion).

- establishing the equations of the mathematical model is done through theoretical and empirical methods in other words through verified theoretical methods and completed through empirical methods (statistical and mathematical).

3 – **The examination of the mathematical model**. Verifying the model contains the next stages:

- analyzing the errors on the model's equation;
- simulating the process on a computer;
- trying the model on an "on-line" computer.

4 – **The determination of the optimum solution**. Finding the optimum solution is made through the determination of some values of the independent variables, so that the best value for the performance function is obtained. Through the best value of the performance function it is understood, from case to case, its maximum or minimum value.

5 – **The application of the optimum solution**. Applying the optimum solution consists in exploiting it in normal conditions and observing its behavior in process of the realized optimization.

### 3. CONCLUSIONS

The enhancing of the volume of experimental research had brought into attention the problem of enhancing of the experiment efficiency. The introduction of electronic computers enabled the achieving of such schemes of testing to contribute at the sensible growing of the efficiency in research. In this context the mathematical theory of experiment programming. The experiments are being programmed according a determined plan, previously established, optimum from the point of view of the algorithm of modification of factors, its achievement ensuring a complex influence on the variable state of the researched object..

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## STUDIES REGARDING OF SUPERFICIAL HEAT TREATMENTS EFFECTUATED WITH MODERN TECHNOLOGIES

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*Abstract:* This paper refers to studies regarding of superficial heat treatments effectuated with laser. Remarkable results obtained in this domain justify the utility of using laser in superficial heat treatments. It has been studied the improvement of hardness of some metal castings by several methods: superficial alloying with Mo-Si powder, aluminium alloying and superficial cladding using core wire addition.

*keywords:* superficial heat treatments, laser technology, Mo-Si powder, hardness

### INTRODUCTION

The main concern of researchers is based on finding new technological solutions for industry. Increased efficiency in service of metal parts is determined by the resistance at wear. With laser technology can achieve the deposition on the surface of a metal part of a layer material nature different from the material of origin (basic) modifying as less as possible the characteristics of the base material.

#### Laser heat treatment

At actual stage a special interest it presents the improvement of the physical properties and mechanical properties of parts, by superficial heat treatment using external source of concentrated power. This paper is the subject of study heat treatments by laser. For heat treatment there are used laser equipments with active solid medium or with gaseous medium. Lasers with the active solid medium, they have

an optical pumping with the help of a strong lamp, and as an active medium used glass bar ally with neodymium, crystals aluminum garnet or yttrium (YAG: Nd), or ruby bars. These types of lasers are called optical quantum generators (GCO). Lasers work as generating continuous or intermittent (pulse).

$$F_m = \frac{4E_i}{\pi a^2 \tau_i} \quad (1)$$

where:

$F_m$  is the average energy flow

$E_i$  is the energy of an impulse

$\tau_i$  is the impulse duration

In this paper were considered characteristic of the impulse energy of the order (10<sup>-2</sup> - 10<sup>3</sup>) J, impulse duration of the order (10<sup>-3</sup> - 10<sup>-9</sup>) s and the maximum power of the order (10<sup>7</sup> - 10<sup>8</sup>) W. Frequency repeated impulses is (10<sup>2</sup> - 10<sup>3</sup>) Hz. By heat treatment with laser beam are obtained effects of hardening the superficial layer of the part, increase the resistance to wear and corrosion. For

improvement of physical and mechanical properties well determined and restore dimensions of worn parts, there have made a series of laser heat treatments on samples of metal OLC 45. The purpose was to obtain a protective layer of different chemical composition, and then doing the comparison with classical methods .[1]

Samples with protective layer of different chemical composition were then placed in solution of 3% NaCl and maintained for a period of three months doing so attempts to anticorrosive stability. Experimental data have allowed comparative analysis of the values obtained for samples of steel with chrome coating and chrome. Scientific results obtained after tests ,have revealed that laser heat treatment led to the formation made in the layer structure of a quantity of carbonyl compounds compared larger ,impacting hardness bimetallic composition. Brought to conclusion ,referring on the anticorrosive properties and high wear resistance, of the protective layer produced by laser method, which shows that they have improved appreciably from the layers of protection obtained by other metode [2].

#### **Heat treatments superficial by powder using laser technology**

The powder is the material composed of particles (grains) of pure metals, alloys of intermetallic compounds, chemical compounds of metals or mixtures of several mechanical components. Metallic powders are characterized by a series of physical and chemical properties which determine in large measure the properties of final products obtained.  $\text{MoSi}_2$  presents a number of important characteristics such as : is

particularly resistant to oxidation - including high temperatures, has a high fusibility , high electrical and thermal conductivity . Due to formation of a protective film of  $\text{SiO}_2$  on the granular surface of  $\text{MoSi}_2$ , it comes under the category of modern refractory and efficiency materials .The most representative method of powder coating on substrates ,realized using laser technology is the method of injection side ,which was the subject of this paper. To implement this method were used 3 different powders, namely: powders of Mo, powder of Si and powders of  $\text{MoSi}_2$ . Were proposed two stages of heat treatment superficial. Thus, the first stage consists in forming the coating layer by mixing the two powders: silicon and molybdenum, and the second consists in direct application of powder  $\text{MoSi}_2$  in the interaction area between the laser and the surface part. In this experiment it has been utilized a laser type Nd: YAG with a maximum power of 3 kW ,and a speed of 300 to 600 mm / min. The samples that have been used in the experiment were iron steel. Due to the fact that the melting point of Mo is higher than the melting point of Si , from Mo-Si diagram , results that the melting temperature obtained by mixing of the two powders is over  $2617^\circ \text{C}$ . In the process of coverage with laser ,was obtained appreciably improvement of surface properties.*First stage*. It is emphasize the fact that it uses a smaller amount of energy compared with the second stage, due to reaction that takes place between Mo and Si, which is an exothermic one. The physical properties of the two powders such as the melting temperature, and also the differences in particle size can have a major influence in the proceses of forming the layer. Thus,it may form a secondary phase in the first stage.



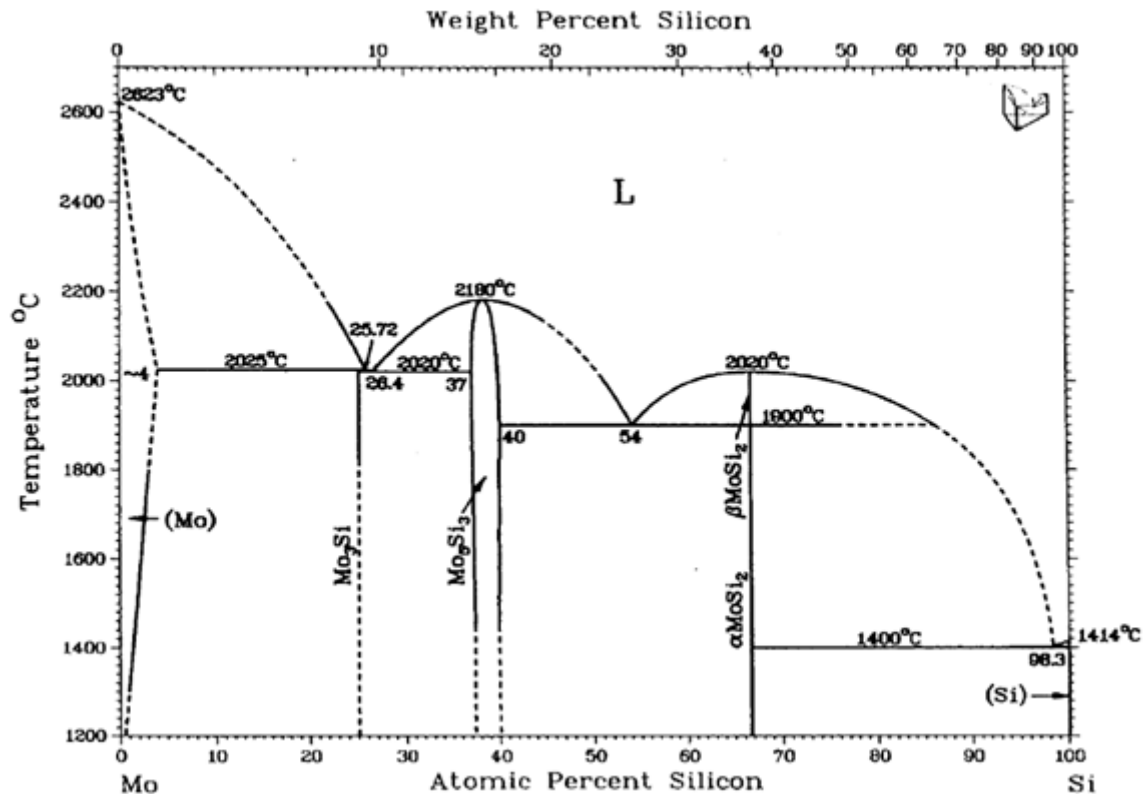


Figure 1. Mo-Si diagram

*The second stage.* Different from the first stage, the second one uses the same powder particle size. For comparison the results of the two stages, in the second stage, the laser beam power it has been increased. In the second stage, were observed appreciable improvement of properties substitution in the area of interaction.

Hardness. Micro-hardness allowed the evaluation of the results obtained for the laser cladding with  $\text{MoSi}_2$ . The method application using laser technology is to obtain a final superior hardness compared with the substrate. The conclusion reached after analysis of results was that were obtained HV in layer 1200 cover, almost 700 HV in the interaction and close to 200 HV in the substrate. Also observed an increase in the value of hardness with growth rate at a constant power of the process, respectively of laser power. Once increase the process speed, increase the speed

of solidification, which explaining the increase of hardness. It has been observed that samples with a higher hardness are more brittle. When it has been used a lower speed in the process the brittleness was decreasing. It was observed also a structure more homogenous. The results obtained showed that the coating layer has a hardness of 6 times greater than the substrate, approximately 1200 HV. Hardness in different areas have different values.

**Superficial heat treatment of aluminum alloys by using laser technology.** Aluminium is remarkable for its ability to resist to corrosion (due to the phenomenon of passivation) and its low density, being about one-third the density and stiffness of steel. It is ductile, and easily machined, cast, and extruded. Structural components made from aluminium and its alloys are vital to the aerospace industry and very important in other areas of transportation and building.

Since magnesium is less dense than aluminum, these alloys are prized for their relative lightness and strength. Magnesium, in its purest form, can be compared with aluminium, and is strong and light, so it is used in several high volume part manufacturing applications, including automotive and truck components. Magnesium compounds, are used mainly as refractory material in furnace linings for producing iron, steel, nonferrous metals. The second application field of magnesium is electronic devices. Due to low weight, good mechanical and electrical properties, magnesium is widely used for manufacturing of electronic components. To improve

corrosion resistance of magnesium alloy, it has been used the method of lateral injection of aluminum powder using laser technology. In this experiment it has been utilized a laser type Nd: YAG with a maximum power of 3 kW, and a speed of 300 to 1300 mm / min. The samples that have been used in the experiment were magnesium alloy. It has been proposed the experiment in two different ways. In the first way, it has been applied a single layer of aluminum powder using the method of lateral injection, and in the second way, were applied three consecutive layers of aluminum powder.

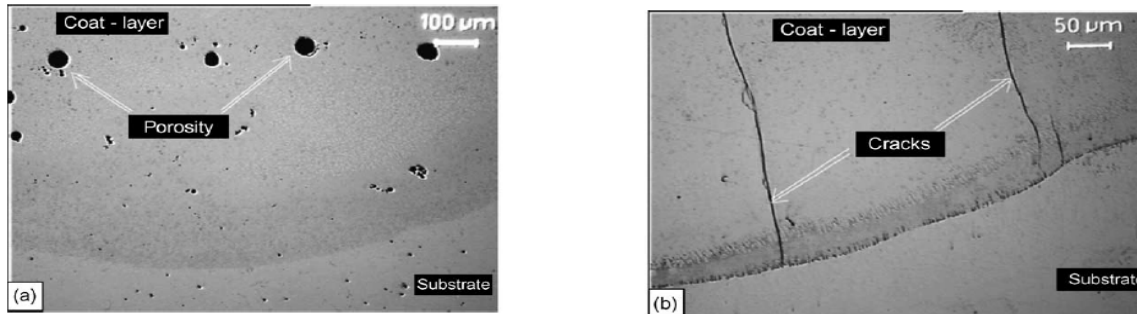


Figure 2 Porosities and Cracks in clad layer

**Macro and micro-structures.**

*One layer* In figure 2 it has been observed porosities and cracks in the layer of aluminum powder applied using the method of lateral injection by laser technology. Porosities are formed during solidification and cracks appeared due to the stress level inside the coat layer. *Multi-coat layers.* In case of application of multi-coat layers it has been noticed a

considerable improvement parameters of formed layer. Thus no porosities appear and cracks due the stress inside layer is no longer the case. In applying several layers was required increasing the speed process between two consecutive layers because in this way was avoided excessive heating of the sublayer.

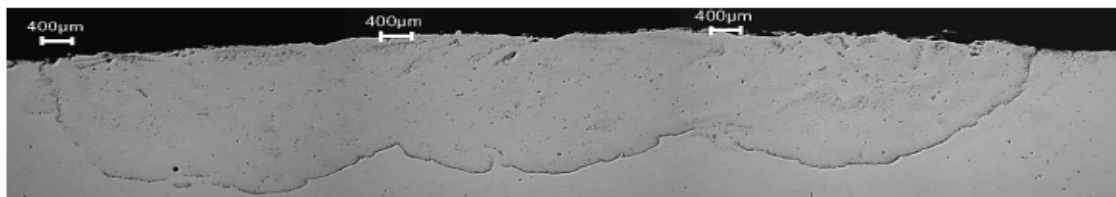


Figure 3 Multi- coat layers

Hardness. Scientific results obtained after tests ,have revealed that the increasing hardness was from about 60 HV to about 200 HV,which emphasized the improve of hardness with the method of aluminum alloys by using laser technology.

**Method of coating metal laser alloy by forming a protective refractory filled with core wire.**

Metal-cored wire is a tubular electrode that consists of a metal sheath and a core of various powdered materials, primarily iron. The core of metal-cored wire contributes almost entirely to the deposited weld metal. Metal-cored wire's current is concentrated on the outside sheet; the metal powders inside are less conductive because of their granular nature. Focusing current on the wire's outer diameter creates a broader, bowl-shaped arc cone. It also can create finer molten droplets and a less

turbulent weld pool. Due to phenomena which appear between cored wire, and laser in this experiment it has been important optimazing geometrical and kinematic parameters . It has been established criteria such as :a good structure porosity free and a uniform surface coverage. In this experiment it has been utilized a laser type HPDL(the high-power diode laser), the samples were from steel substrate and the adding material was a super-ferrite stainless steel. The method of coating metal laser alloy by forming a protective refractory filled with core wire presented few differences in comparison with other adding material techniques .This aspect refered to the air trapped inside when the wire was heated by the laser beam during the process as showed in figure 5.The air trapped must be evacuated,so the interaction time between laser beam and materials was around 1 s.

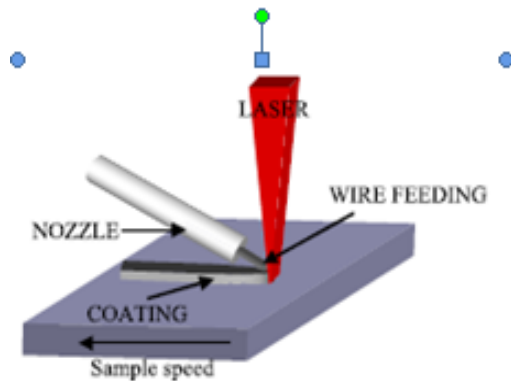


Figure 4 Coating with core wire

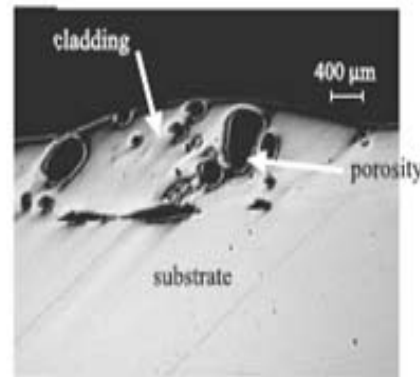


Figure 5 Air trapped inside the coat layer

**CONCLUSIONS**

In this paper there have been studied experiments in which it have been used laser technologies obtaining protective layer of different chemical composition, on different samples of metal substrate.Thus in the method of injection side of MoSi<sub>2</sub> powder using Nd:

YAG laser on samples of steel substrate, hardness it have been improved appreciably . Superficial heat treatment of aluminum alloys by using Nd: YAG laser on samples of magnesium alloy,using the method of injection side powder, showed that the coating layer has a hardness of several times greater than the substrate. In the method of coating metal laser

alloy by forming a protective refractory filled with core wire, it has been achieved the purpose obtaining an increase hardness compared to the material substrate.

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## 6. MATHEMATICS, COMPUTER SCIENCES AND INFORMATION TECHNOLOGY

„SPARSE PIXELS VECTORIZATION (SPV) ALGORITHM”, <b>Adrian ALEXEI, Raoul DRAGOMIR</b>	1031
„VECTORIZATION ALGORITHMS THROUGH 8 PROXIMITIES”, <b>Adrian ALEXEI, Tiberius TOMOIAGĂ, Claudiu DASCĂLU</b>	1035
„ASYMPTOTIC STABILITY OF A HIGHER ORDER DIFFERENCE EQUATION”, <b>Gheorghe ANTON, Gheorghe RADU</b>	1039
„THE IMPLEMENTATION OF AN AIR POLLUTION WARNING SYSTEM USING ELEMENTS OF FUZZY LOGIC”, <b>Mădălina CĂRBUREANU</b>	1043
„A PROBABILISTIC PROOF OF AN ASYMPTOTIC FORMULA FOR EXPONENTIAL OPERATORS”, <b>Cristina Sanda CISMAȘIU</b>	1049
„TRAINING PROCESS – AIM: AUTOMATIZATION” <b>Iuliana DOBRE</b>	1054
„DECISION – TREE SEARCH METHODS”, <b>Gabriela – Simona DUMITRESCU</b>	1058
„THE RAMSEY ALGORITHM”, <b>Gabriela – Simona DUMITRESCU</b>	1062
„THE ANALYSE OF A SYSTEM OBJECT”, <b>Vasile DUMITRU</b>	1066
„EDUCATION IN INFORMATION ERA”, <b>Vasile DUMITRU, Constantin POSEA</b>	1076
„BROWNIAN MOVEMENT USED IN DEMOGRAPHY”, <b>Cornelia GABER, Maria STOICA</b>	1081
„COMPLEX TELETRAFFIC ANALYSIS AND OPTIMIZATION SYSTEM FOR COMMUNICATION NETWORKS BASED ON TECHNOLOGICAL DIVERSITY AND SERVICE CONVERGENCE”, <b>Constantin GROZEA</b>	1087
„ON INDUCED COMPLEX VECTOR PSEUDO-FIELDS ON AFFINE FIBERED MANIFOLDS”, <b>CRISTIAN IDA</b>	1091
„IMPLEMENTING SIMULATED ANNEALING ON GPU FOR IMAGE PROCESSING TASKS”, <b>István LŐRENTZ, Alexandru SUCIU</b>	1095
“THE STUDY OF SOME TRACKING, INTERCEPTING OR GUIDED PULLING PROBLEMS WITH APPLICATIONS IN BALLISTICS OR TRAFFIC”, <b>Mircea LUPU, Ernest</b>	
„STATISTICAL TESTING OF RANDOM NUMBER GENERATORS”, <b>Mihai MARIN, Florin RĂSTOCEANU, Roxana DRAGOMIR</b>	1099
„ANALYTICAL MODEL OF A QUANTIFYING AND ASSESSING THE COUNTRY RISK “, <b>Constantin POSEA</b>	1104
“EVALUATING THE PERFORMANCE OF PARALLEL SYSTEMS”, <b>Carmen PUGHINEANU, Gheorghe RADU</b>	1110
„ABOUT SURFACE MODELING USING FRACTALS”, <b>Adrian-Gelu RADU, Marcel SULTĂNESCU</b>	1116
„GLOBAL ATTRACTIVITY IN A HIGHER ORDER NONLINEAR DIFFERENCE EQUATION“, <b>Gheorghe RADU, Gheorghe ANTON</b>	1121
„ABOUT SIMULATION WITH FRACTAL INTERPOLATION USING LAGRANGIAN TRACKING OF PARTICLES”, <b>Adrian-Gelu RADU, Marcel SULTĂNESCU</b>	1125
„APPROVED SECURITY FUNCTIONS FOR FIPS PUB 140-2”, <b>Gabriela RĂȘCHITOR, Gheorghe STEFAN</b>	1131
„CRYPTOGRAPHIC MODULES TESTING AGAINST FIPS 140-2”, <b>Gabriela RĂȘCHITOR, Marilena LAZĂR</b>	1137
„AUTOMATIC SPEAKER RECOGNITION ARCHITECTURES”, <b>Florin RĂSTOCEANU, Marilena LAZĂR</b>	1143
“EUROPEAN OPTIONS EVALUATION THROUGH CRANK-NICOLSON METHOD”, <b>Ioan-Gheorghe RATIU</b>	1149
„CRYPTOGRAPHIC ALGORITHMS AND SERVICES IN THE LOCAL AREA NETWORK”, <b>Petru SCURTU</b>	1155

„BHP UNIVERSALITY HYPOTHESIS VERIFICATION FOR BET-FI INDEX FROM BVB”, <b>Tiberiu SOCACIU, Mirela DANUBIANU</b>	<b>1159</b>
„PP PLOT AND QQ PLOT TOOL FOR BHP UNIVERSAL DISTRIBUTION”, <b>Tiberiu SOCACIU, Ioan MAXIM</b>	<b>1162</b>
“AN ANALYSIS OF A H.264MVC REFERENCE ENCODER FOR USING MULTI CORE PROCESSORS”, <b>Alexandru SUCIU, István LŐRENTZ</b>	<b>1165</b>
“PILOT-IN-THE-LOOP PROBLEM AND ITS SOLUTION”, <b>Róbert SZABOLCSI</b>	<b>1169</b>
„STOCHASTIC NOISES AFFECTING DYNAMIC PERFORMANCES OF THE AUTOMATIC FLIGHT CONTROL SYSTEMS”, <b>Róbert SZABOLCSI</b>	<b>1182</b>

## SPARSE PIXELS VECTORIZATION (SPV) ALGORITHM

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**Abstract:** SPV vectorization algorithm belongs to the one step algorithms category. The algorithm has as input data the non-processed raster image and as result the vectorized data. The main purposes of this algorithm are noise filtration and automated vectorization.

**Key words:** vectorization, algorithm, GIS

### 1. INTRODUCTION

The human being has an impressive capacity to assure a high quality interpretation of noise and erroneous data. Although this process is slow and laborious, there is a higher and higher request for algorithms and new methods that will allow the extraction and organization of the map symbolistics as well for areal and linear objects, in a rapid and efficient way.

The raster-to-vector conversion consists in the analysis of a raster image in order to convert it from a matriceal representation of pixels into a vectorial representation (points & lines). The vectorization should not be seen as a whole, as it supposes more steps, including preliminary and post-vectorization.

One of the main problems of vectorization is whether the methods are or not based on a skeletonization algorithm. Skeletonization is the process of thinning the elements of an image, until their thickness becomes a pixel. The raster-to-vector conversion can be considered as a typical application of skeletonization. However, taking into account that a skeletonized image is intended to represent accurately the analysed binary form, this does not always assure the best precision for the extremities of the lines and for intersections. Taking into account these

considerations, two classes of vectorization algorithms developed over time:

- one step algorithms – algorithms that applies directly to the primary image;
- two-step algorithms – algorithms that have as preliminary step the skeletonization.

The one step vectorization algorithms have as input data the non-processed binary raster image and as a result the vectorial image. These algorithms are more complex because they have to preserve the topological characteristics (keeping of intersection, of inclusion etc.) but do not depend on the precision of a preliminary processing (skeletonization) [2].

### 2. SPV ALGORITHM

Sparse Pixel Vectorization (SPV) algorithm examines the whole image at every few pixels. **The interval of the exploration line** is the first parameter in the algorithm, it is expressed in pixels and represents the distance between the exploration lines for the determination of a starting point. When an exploration line meets a pixel that differs from the background the process of finding the first point ( $P_0$ ) begins, the point being the middle point on the horizontal and vertical directions (fig. 1). The longest distance measured on two directions, horizontal or vertical, will become the *tracking*

direction and the smaller one will be called the *direction in width* or *thickness*.

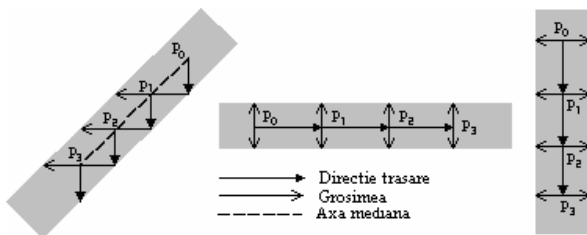


Fig. 1 SPV tracking algorithm.

The vectorization process continues with the next step that comprises from the following of the element on the *tracking direction*. The tracking step is the distance between the current point, on the tracking direction, up to a stopping pixel (pixel belonging to the background), usually a white pixel. The stopping pixel can be:

- a pixel on the edge of the element to be vectorized – the pixel which is anterior to the background pixel;
- a pixel belonging to the linear element, when the tracking step exceeds a maximum imposed value.

The **maximum tracking step** is the second parameter of SPV algorithm and it conditions the raster-to-vector conversion process.

On the stopping pixel, in a direction that is perpendicular to the tracking direction is determined the *thickness*. The current point becomes the middle of the *direction in width* (*thickness*) and the searching process is resumed. The conditions for stopping the searching process are the following:

- the difference in *thickness* is bigger than a default threshold (**maximum difference of thickness**), determined experimentally. This threshold is the third parameter of the algorithm.
- the current point, newly determined has been already found;
- the length of the *tracking direction* is zero.

If one the above-mentioned condition is met, a process for recovering the lost connection occurs. For example, if the difference of *thickness* is bigger than the default threshold, the *tracking step* lowers

until the difference of thickness ( $\Delta g$ ) becomes almost zero (fig. 2). The searching process is resumed from the newly determined point.

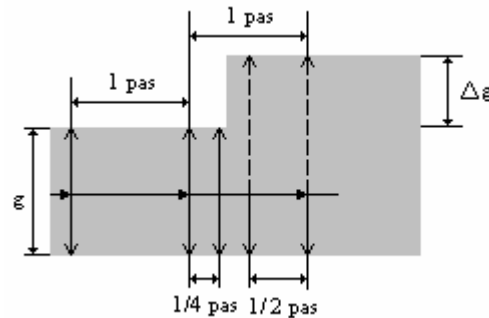


Fig. 2 Stopping conditions.

The result of SPV algorithm is a list of points that forms a polygonal line found on the symmetry axis of the vectorized linear element. Some of the determined points are redundant and they are removed as a consequence of a generalization process. For a point of the determined polyline is calculated the distance up to the straight line determined by the neighbor points (fig. 3).

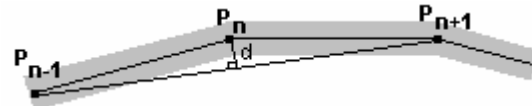


Fig. 3 Elimination of redundant points.

If the **elimination distance**  $d$  is smaller than the default tolerance  $\epsilon$  (the fourth parameter of SPV algorithm) then the current point is eliminated. The algorithm is repeated until points cannot be eliminated any more.

For the evaluation of the vectorization algorithms performance the parameters suggested by Liu Wenyin and Dov Dori in 1997 are used. The most important performance indicator of the algorithm is the raster detection coefficient (*PRI*). The performance of vectorization algorithm increases as the *PRI* gets bigger [1].

The **interval of the exploration** line is the distance expressed in pixels between two adjacent exploration lines. As it can be seen in fig. 4, the raster image is explored line by line. SPV algorithm begins when the exploring line meets a black pixel. If no exploration line



meets a black pixel, it is possible to detect no lines. Therefore, the increase of line exploration interval increases the possibility of losing more lines.



Fig. 4 Exploration lines.

As the interval of the exploration line increases, the total ratio of pixel detection ( $D_p$ ) will decrease. However, the false detection rate of pixels ( $F_p$ ) is not concerned directly as are not detected more false lines. Generally, the raster detection coefficient ( $PR$ ) decreases proportionally with the lowering of the total rate of pixel detection. This phenomenon is often produced when SPV algorithm is applied to images with many thin lines, almost horizontal. Theoretically, if the value of the interval of the exploration line is one pixel, then all the lines in the image will be detected determining a maximum value for the raster detection coefficient ( $PR$ ).

The *maximum tracking step* and the *maximum difference of thickness* can influence the performance of detection for some elements in the raster image. If the tracking step is small (fig. 5a and 5b), the vectorization algorithm can detect the discontinuities issued in the form of elements in the raster image.



Fig. 5 Impact of the modification of the tracking step.

If the maximum tracking step is bigger than the length of the discontinuity in the raster image or if the thickness difference is bigger than the imposed step, then the image is detected as a single line (fig. 5c and 5d).

Generally, the raster detection coefficient ( $PR$ ) is smaller in case of a larger tracking step. As these discontinuities are

much smaller than the size of the elements in the raster image, their impact on SPV algorithm performance will be smaller. Usually, for the maximum tracking step can be considered the value of 20 pixels and for the maximum difference in thickness can be considered the value of 3 pixels.

The bigger the *maximum distance of elimination* of the points determined by SPV algorithm gets, more points will be eliminated. The elimination of a large number of points determines a smaller total ratio of pixel detection ( $D_p$ ) and a larger false detection rate ( $F_p$ ) of the pixels. Therefore, the raster detection coefficient ( $PR$ ) decreases inversely proportional to the increase of the value of the maximum distance of elimination. The choice of a corresponding value for this parameter is essential, especially in case of images containing many arcs. To keep as much as possible of the original form this parameter should be established at a value ranging between 0.5 and 1 pixel.

### 3. POST-VECTORIZATION PROCESSINGS

As a consequence of the vectorization process results a series of vectors with coordinates describing as appropriate as possible the binary raster image. For these vectors to be used as input data for GIS, they should support two types of processing - the ones required for the elimination of vectorization errors and the necessary processing for the adjustment of vectors form. The first processing category can be totally automatized, the operator making the decision concerning the noise elimination, the completion of some vectorization gaps etc. In the second processing category are follows:

- contour approximation – it presumes the elimination of the excess of points resulted as a consequence of the vectorization process (for example a straight line segment should be memorized only through the ending points);
- constraints imposed to the contour (for example, the corners of a house generally form right angles).

For the elimination of some exceeding points, the path is generalized using the Douglas – Parker algorithm. The algorithm begins by defining the first point (for a closed contour this point is defined as the furthest point from the weight center of the areal element) and the ending point (ending point – the furthest contour point of the first point). Based on these two found points a segment will be determined. From every point of the contour is calculated the distance to this segment and is determined the point with the biggest distance (fig. 6). If this distance is smaller than an imposed threshold value, this segment represents the best approximation; otherwise, the point corresponding to the biggest distance becomes again a new starting point. The cycle is repeated until there are not found any more points whose distance against the approximation segment exceeds the imposed threshold value..

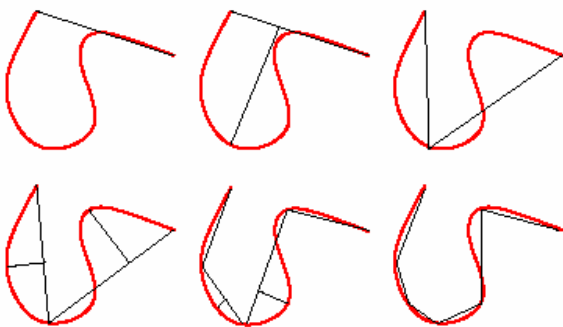


Fig. 6 Generalization of a linear segment through Douglas – Parker algorithm.

The value of the threshold distance can vary on case-to-case basis, as the clear delineation between the information that needs to be kept and the information that can be omitted is very difficult to be established and in many times a compromise value is accepted. For example, for a map sheet of 1 : 25,000 scale scanned at a resolution of 500 dpi can be adopted a threshold value of one pixel, about 1.25 meters.

#### 4. CONCLUSIONS

The automation of a map interpretation in order to identify the geographic elements and their relationships is a difficult mission that goes beyond the transformation of map raster images into a vector representation.

The sparse pixel algorithm belongs to the category of one step vectorization algorithms that does not require preliminary processing. The one step algorithms are more complex, as they have to preserve the topological characteristics (keeping of intersection, of inclusion etc.) but do not depend on skeletonization accuracy.

In order to compare the performances of this algorithm with the performances of the algorithms used by ArcInfo program were determined the proposed performance indices suggested by Liu Wenyin and Dov Dori. SPV algorithm obtained 0.468 for pixels detection rate and 7.7295 for raster detection coefficient as compared with 0.536, respectively 0.7663 for the algorithms used by ArcInfo program.

SPV algorithm obtained good results and it can be used successfully for the interactive or automated vectorization of the contour lines and hydrography. Pixel detection rate can be improved by lowering the analysis step increasing the number of the detected points.

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## VECTORIZATION ALGORITHMS THROUGH 8 PROXIMITIES

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**Abstract:** The vectorization algorithm through 8 proximities belongs to the category of two-step algorithms. The algorithm has as input data the skeletonized raster binary image and as a result the vectorial image. The main purposes of this algorithm are noise filtration, automated vectorization and the minimization of the lines number, maintaining the topology.

**Key words:** vectorization, algorithm, GIS

### 1. INTRODUCTION

The two-step vectorization algorithms have as input data a binary skeletonized image (the thickness of any image line is of one pixel). Skeletonization, the preliminary stage to vectorization, leads to an image that doesn't lose the precision of elements position.

For the skeletonization algorithms there are two basic methods: the iterative thinning of the original image until no pixel can be removed without the modification of the topological and morphological properties of the shape and the thinning by calculation of some distances in two successive passes (fig. 1).

$V_2$	$V_3$	$V_4$
$V_1$	$X$	$V_5$
$V_8$	$V_7$	$V_6$

Pentru pixelul  $X$

- primul pas:

$$Y = \min(V_1 + 3, V_2 + 4, V_3 + 3, V_4 + 4)$$

- al doilea pas:

$$Z = \min(Y, V_5 + 3, V_6 + 4, V_7 + 3, V_8 + 4)$$

Fig. 1 Calculation of the distance in two passes.

The correct positioning of junctions is often very important in the applications of graphic recognition. All the methods based on skeletonization are deficient as concerns the correct determination of the junctions. This is a direct consequence of the fact that the skeleton of the image follows the centre of the maximum group of pixels (fig. 2).

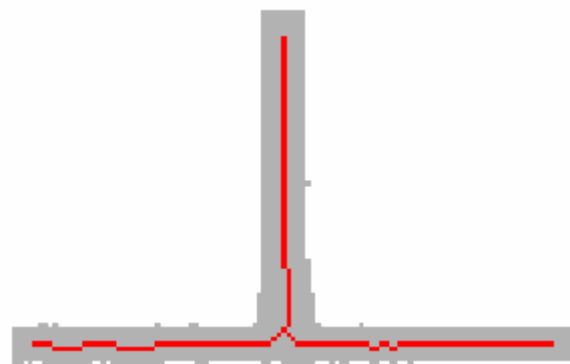


Fig. 2 Determination of junctions.

Whereas the skeletonization methods are independent of any *a priori* information about the drawing nature it is often required to add contextual knowledge in a certain stage of the process. For example, it is well known that in a raster image containing contour lines, junctions will not appear.

## 2. VECTORIZATION ALGORITHM THROUGH 8 PROXIMITIES

Vectorization consists in detecting and tracking edges. The first step in a vectorization process consists in the division of raster image into segments. This division is required because of the restrictions induced by the performance of computers, allowing in this way the processing of very large size raster images.

After data segmentation, the directional indicators are created for each pixel. The directional indicators are set in order to indicate the tracking direction. For each pixel are used eight directional indicators. These indicators are set on the basis of eight pixels in the proximity of the current pixel. A bit is utilized to represent each indicator. The eight indicators are memorized together in an octet through a logical operation OR.

An additional bit called „intersection” is set when are set three or many directional indicators. This bit is used in line tracking to determine when a line is finished for keeping the topological integrity (it is determined an intersection). The directional indicators are memorized in a vector.

The analysis of the skeletonized image is carried out taking into account the 8 proximities of a pixel (fig. 3). To each neighbor pixel is associated an unique code that determines the direction to be followed.

$(x-1, y-1)$	$(x, y-1)$	$(x+1, y-1)$
$(x-1, y)$	$(x, y)$	$(x+1, y)$
$(x-1, y+1)$	$(x, y+1)$	$(x+1, y+1)$

Fig. 3 The position of the 8 neighbors of the pixel of co-ordinates  $(x, y)$ .

The vectorization algorithm through 8 proximities can be successfully used both for binary images containing contour lines (do not contain intersections) and for some complex ones (planimetry, hydrography etc).

For the current pixel with the co-ordinates  $(x, y)$  can be identified the following cases referring to the number of neighboring pixels set on 1:

- 0 pixels – the current pixel is noise and is eliminated;
- 1 pixel – the current pixel is an ending point;
- 2 pixels – the current pixel belongs to a linear element, but it is not an ending point;
- 3 or many pixels – the current pixel is a node (an intersection).

For vectorizing a binary image using this algorithm the image is covered from top to the bottom, line by line. Each line of image is analyzed, tacking each pixel from the left to the right until the first pixel set on 1 is found. This pixel becomes the starting point, determining the beginning of the following algorithm based on the neighboring pixels and on the directional indicators.

The practical achievement of the algorithm requires the assignment of a state indicator for each pixel in order to memorize the analyzed pixels and a list in which are memorized the nodes, in order to come back in these points and to resume the algorithm on the non-analyzed directions.

The direction indicators are used for the following of the linear element and have the next values according to the position they have in relation with the current point: NW, N, NE, W, E, SW, S and SE (fig 4).

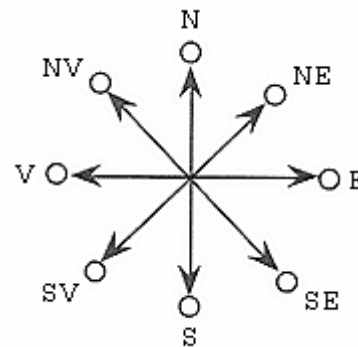


Fig. 4 Direction indicators.

The steps for following a linear element are:

- the analysis of the binary image for determining a starting point;
- the analysis of neighbors of the determined starting point (fig. 3);

- according to the number of the neighboring pixels, the possible cases can appear:

- if no pixel set on 1 was found, the current pixel is a noise and is continued the search of a new starting point (fig. 5, case *a*);
- if only a pixel set on 1 is found, the current position is memorized, the state indicator corresponding to the current pixel assumes the value 1 (“visited”) and is determined the value of the directional indicator (fig. 5 case *b*);
- if two pixels set on 1 are found, the operations is carried out from the previous point only when the both found pixels were not visited; the current point is memorized in the list of nodes in order to come back in this point and to resume the analysis on the other direction (fig. 5 case *c*);
- if three or more pixels set on 1 are found, all the operations are carried out to find only a pixel set on 1, but it is mandatory memorized the current point in the list of nodes to come back in this point (fig. 5 case *d*).

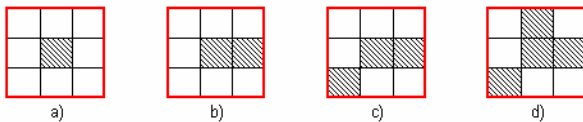


Fig. 5 Analysis cases.

- the current point becomes the point determined by the directional indicator and the analysis process is resumed according to the previous point;
- the tracking of the linear element is finished when an ending point is found;
- the analysis is resumed for every point in the nodes list;
- the analysis of the binary image is ended when all the state indicators have the value 1 (all the pixels have been analyzed).

An example for the image in fig. 6 is presented in Table 1.

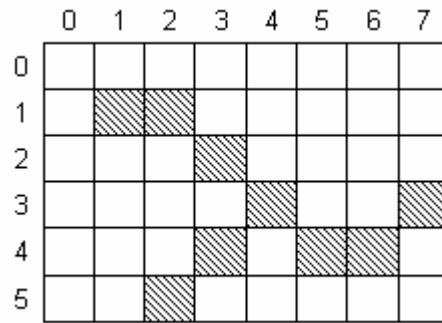


Fig. 6 Binary image with intersection.

Table 1 Example of an analysis.

Current point	Director indices	List of nodes
(1, 1)	E	-
(1, 2)	SE	-
(2, 3)	SE	-
(3, 4)	SE, SV	(3, 4)
(4, 5)	E	(3, 4)
(4, 6)	NE	(3, 4)
(3, 7)	-	(3, 4)
(3, 4)	SV	-
(4, 3)	SV	-
(5, 2)	-	-

In Table 1 is seen that in the point (3, 4) have been identified two new pixels, corresponding to the direction indices SE, respectively SW. In this case, the point (3, 4) is memorized in the list of nodes, the algorithm continuing the search on the direction SE and at the end of the analysis on this direction comes back and begins the search on the direction SV.

### 3. POST-VECTORIZATION PROCESSING

The main purpose of the post-vectorization step is to correct the errors appeared during the automated vectorization. For errors removal there are two methods; most of GIS programs makes available complex functions for corrections:

- the automated method for the elimination of topological errors – for example the topological features of the contour lines are the continuity; they cannot intersect,

a contour lines can be closed or the starting or ending points should be on the boundary of the domain;

- the manual method for the correcting spatial errors appeared among layers – for example a road cannot be superimposed onto a river.

For automated methods there are two types of processing: those required for the elimination of vectorization errors and those required for the adjustment of the vectors shape. The first category processing supposes the noise elimination, the completion of some vectorization gaps etc. In the second category follows:

- contour approximation - it supposes the elimination of the extra points resulted after the vectorization process;
- constraints imposed to the contour.

For the elimination of the useless points, the path is generalized by using Douglas – Peucker algorithm based on a threshold value determined empirically.

The polygonal contours obtained after the automated vectorization process do not pass through the majority of pixels and do not maintain the geometrical restrictions, such as parallelism and perpendicularity [1].

The functional pattern expresses the relationship between the observations and the unknown parameters through a mathematical function. In fig. 7 it is presented a building and its approximated contour, resulted as a consequence of vectorization and the contour resulted after the compensation process.

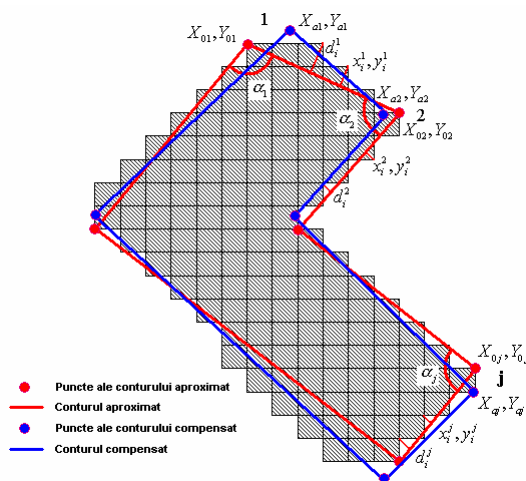


Fig. 7 The compensated contour.

#### 4. CONCLUSIONS

The evaluation of the performance speed of raster-to-vector conversion algorithm is difficult because the lack of a common set of data. Table 2 presents the results obtained for the vectorization of three different raster files. Test 1 is made on a file with vegetation and contains 169 regions (areals). Test 2 is done on a file that is similar to the one in Test 1, but with double density of the line and columns. Test 3 is done on a file with 835 regions (areals).

Table 2 Evaluation of the performance speed.

Size [pixels]	1000 x 1000	2000 x 2000	1000 x 1000
No. of lines	512	512	2580
No. of surfaces	169	169	835
Vectorization duration	40 sec.	1.67 min.	53 sec.
Filtration duration	1.8 min.	3.68 min	21 min.

From Table 2 is seen that the vectorization process achieves very good performances, irrespective of the number of regions (areals). The algorithm converts the raster data independent of their number, allowing steps of pre-processing for the re-classification and subdivision of data [2].

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## ASYMPTOTIC STABILITY OF A HIGHER ORDER DIFFERENCE EQUATION

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**Abstract:** *In this work we study the asymptotic stability of the nonnegative equilibrium points of the difference equation*

$$u_{n+1} = \frac{A u_{n-1}}{B + C \prod_{i=1}^k u_{n-2i}}, \quad n=0, 1, \dots,$$

where  $A, B, C$  are nonnegative real numbers and  $l, k$  are nonnegative integers,  $l \leq k$ . We discuss the conditions under which there exist prime period two solutions and semicycles. Finally we investigate the oscillation and the existence of unbounded solutions.

**2000 Mathematics Subject Classification:** Primary 39A10, 39A11.

### 1. INTRODUCTION AND PRELIMINARIES

Difference equations have always played an important role in the construction and analysis of mathematical models of biology, ecology, physics, economic processes, etc [2]. The study of nonlinear rational difference equations of higher order is of paramount importance, since we still know so little about such equations. Cinar [3] examined the global asymptotic stability of all positive solutions of the rational difference equation

$$u_{n+1} = \frac{a u_{n-1}}{1 + b u_n u_{n-1}}, \quad n=0, 1, \dots,$$

where  $a$  and  $b$  are nonnegative real numbers. Xiaofan Yang *et al.* [4] investigated the asymptotic behavior of solutions of the difference equations

$$u_{n+1} = \frac{a u_n + b u_{n-1}}{c + d u_n u_{n-1}}, \quad n=0, 1, \dots,$$

where  $a \geq 0$  and  $b, c, d$  are nonnegative real numbers. Gibbons *et al.* [5] investigated the

global asymptotic behavior of the difference equation

$$u_{n+1} = \frac{\alpha + \beta u_{n-1}}{\gamma + u_n}, \quad n=0, 1, \dots \quad (1)$$

where  $\beta > 0$  and  $\alpha, \gamma \geq 0$ .

In this study, we study the global asymptotic stability of the difference equation

$$u_{n+1} = \frac{A u_{n-1}}{B + C \prod_{i=1}^k u_{n-2i}}, \quad n=0, 1, \dots \quad (2)$$

where  $A, B, C$  are nonnegative real numbers and  $l, k$  are nonnegative integers,  $l \leq k$ .

The following particular cases can be obtained:

1. When  $A=0$ , equation (2) reduces to the equation  $u_{n+1}=0, n=0, 1, \dots$

2. When  $B=0$ , equation (2) reduces to the equation

$$u_{n+1} = \frac{A u_{n-1}}{C \prod_{i=1}^k u_{n-2i}}, \quad n=0, 1, \dots$$

This equation can be reduced to the linear difference equation

$$v_{n+1} - v_{n-1} + v_{n-2l} + \dots + v_{n-2k} = \gamma, \quad n=0, 1, \dots$$

by taking ,  $v_n = \ln u_n$ ,  $\gamma = \ln(A/C)$

3. When  $C=0$ , equation (2) reduces to the equation  $u_{n+1} = (A/B)u_n$ ,  $n = 0, 1, \dots$  which is a linear difference equation.

4. When  $l=k=0$ , and  $C=1$  equation (2) yields equation (1) with  $\alpha=0$ . For various values of  $l$  and  $k$ , we can get more equations.

Consider the difference equation

$$u_{n+1} = F(u_n, u_{n-1}, \dots, u_{n-k}), n = 0, 1, \dots \quad (3)$$

Where  $f: \mathbb{R}^{k+1} \rightarrow \mathbb{R}$

**Definition 1.** [1] An equilibrium point for equation (3) is a point  $\bar{u} \in \mathbb{R}$  such that ,

$$\bar{u} = f(\bar{u}, \bar{u}, \dots, \bar{u}) .$$

**Definition 2.** [1] The equilibrium point  $\bar{u}$  of equation (3) is said to be:

1. **locally stable** if for every  $\varepsilon > 0$  there exists  $\delta > 0$  such that every solution  $\{u_n\}$  with initial conditions

$$u_0, \dots, u_{n-1} \in (\bar{u} - \delta, \bar{u} + \delta) ,$$

we have  $|u_n - \bar{u}| < \varepsilon$ , for all  $n \in \mathbb{N}$ .

2. **locally asymptotically stable** if it is locally stable and if there exists  $\gamma > 0$  such that for any initial conditions  $u_0, \dots, u_{n-1} \in (\bar{u} - \gamma, \bar{u} + \gamma)$ , the corresponding solution  $\{u_n\}$  tends to  $\bar{u}$ .

3. **global attractor** if every solution  $\{u_n\}$  converges to  $\bar{u}$  as  $n \rightarrow \infty$ .

4. **globally asymptotically stable** if  $\bar{u}$  is locally asymptotically stable and  $\bar{u}$  is also global attractor.

5. **unstable** if  $\bar{u}$  is not locally stable.

The linearized equation associated with equation (3) is

$$z_{n+1} = \sum_{i=0}^k \frac{\partial f}{\partial u_{n-i}}(\bar{u}, \bar{u}, \dots, \bar{u}) z_{n-i}, n = 0, 1, \dots \quad (4)$$

the characteristic equation associated with equation (4) is

$$\lambda^{n+1} - \sum_{i=0}^k \frac{\partial f}{\partial u_{n-i}}(\bar{u}, \bar{u}, \dots, \bar{u}) \lambda^{k-i} = 0 \quad (5)$$

**Theorem 1.** [1] Assume that  $f$  is a  $C^1$  function and let  $\bar{u}$  be an equilibrium point of equation (4). Then statements are true:

1. If all roots of equation (5) lie in the open disk  $|\lambda| < 1$ , then  $\bar{u}$  is locally asymptotically stable.

2. If at least one root of equation (5) has absolute value greater than one, then  $\bar{u}$  is unstable.

The change of variables  $u_n = \sqrt[k-l+1]{B/C} \cdot v_n$  reduces equation (2) to the difference equation

$$v_{n+1} = \frac{\gamma v_{n-1}}{1 + \prod_{i=1}^k v_{n-2i}}, n = 0, 1, \dots \quad (6)$$

where  $\gamma = A/B$ .

## 2. THE MAIN RESULTS

In this section we study the asymptotic stability of the nonnegative equilibrium points of equation (6). We can see that equation (6) has two nonnegative equilibrium points  $\bar{v} = 0$  and  $\bar{v} = \sqrt[k-l+1]{\gamma-1}$  when  $\gamma > 1$  and the zero equilibrium only when  $\gamma \leq 1$ .

The linearized equation associated with equation (6) about  $\bar{v}$  is

$$z_{n+1} - \frac{\gamma}{1 + \bar{v}^{k-l+1}} z_{n-1} + \frac{\gamma \bar{v} \bar{v}^{k-l}}{(1 + \bar{v}^{k-l+1})^2} \sum_{i=1}^k z_{n-2i} = 0, n = 0, 1, \dots \quad (7)$$

the characteristic equation associated with this equation is

$$\lambda^{2k+1} - \frac{\gamma}{1 + \bar{v}^{k-l+1}} \lambda^{2k-l} + \frac{\gamma \bar{v} \bar{v}^{k-l}}{(1 + \bar{v}^{k-l+1})^2} \sum_{i=1}^k \lambda^{2k-2i} = 0 \quad (8)$$

We summarize the results of this section in the following theorems.

**Theorem 2.**

1. If  $\gamma < 1$ , then the zero equilibrium point is locally asymptotically stable.

2. If  $\gamma > 1$ , then the equilibrium points  $\bar{v} = 0$  and  $\bar{v} = \sqrt[k-l+1]{\gamma-1}$  are unstable (saddle points).



**Proof:** The linearized equation associated with equation (6) about  $\bar{v} = 0$  is

$$z_{n+1} - \gamma z_{n-1} = 0, \quad n=0,1,\dots$$

the characteristic equation associated with this equation is

$$\lambda^{2k+1} - \gamma \lambda^{2k-1} = 0.$$

so  $\lambda=0, \pm\sqrt{\gamma}$ .

1. If  $\gamma < 1$ , then  $|\lambda| < 1$  for all roots and  $\bar{v}=0$  is locally asymptotically stable.

2. If  $\gamma > 1$ , it follows that  $\bar{v} = 0$  is unstable (saddle point).

The linearized equation (7) about

$$\bar{v} = k^{-1+1}\sqrt{\gamma-1}$$

becomes

$$z_{n+1} - z_{n-1} + \left(1 - \frac{1}{\gamma}\right) \sum_{i=1}^k z_{n-2i} = 0, \quad n = 0, 1, \dots$$

the associated characteristic equation is

$$\lambda^{2k+1} - \lambda^{2k-1} + \left(1 - \frac{1}{\gamma}\right) \sum_{i=1}^k \lambda^{2k-2i} = 0$$

Let

$$f(\lambda) = \lambda^{2k+1} - \lambda^{2k-1} + \left(1 - \frac{1}{\gamma}\right) \sum_{i=1}^k \lambda^{2k-2i}$$

We can see that  $f(\lambda)$  has a root in  $(-\infty, 1)$ .

Then the point  $\bar{v} = k^{-1+1}\sqrt{\gamma-1}$  is unstable (saddle point).

**Theorem 3.** If  $\gamma < 1$ , then the zero equilibrium of equation (6) point is globally asymptotically stable.

**Proof:** Let  $\{v_n\}$  be a solution of equation (6). Hence

$$v_{n+1} = \frac{\gamma v_{n-1}}{1 + \prod_{i=1}^k v_{n-2i}} < \gamma v_{n-1}, \quad n = 0, 1, \dots$$

This implies that  $\lim_{n \rightarrow \infty} v_n = 0$ . In view of

Theorem 2,  $\bar{v} = 0$  is globally asymptotically stable. The following theorem is devoted to discuss the condition under which there exist prime period two solutions.

**Theorem 4.** A necessary and sufficient condition for equation (6) to have a prime period two solution is that  $\gamma=1$ . In this case the prime period two solution is of the form  $\dots, 0, \rho, 0, \rho, 0, \dots$  where  $\rho > 0$ .

Furthermore, every solution converges to a period two solution.

**Proof:**

**Sufficiency:** Let  $\gamma = 1$ , then for every  $\rho > 0$  we have  $\dots, 0, \rho, 0, \rho, \dots$  is a prime period two solution.

**Necessity:** Assume that equation (6) has a prime period two solution  $\sigma, \rho, \sigma, \rho, \sigma$

$$\text{then } \rho = \frac{\gamma \rho}{1 + \sigma^{k-1+1}}, \quad \sigma = \frac{\gamma \sigma}{1 + \rho^{k-1+1}}$$

Hence  $\rho - \sigma + \rho \sigma (\sigma^{k-1} - \rho^{k-1}) = \gamma (\rho - \sigma)$  this implies

$$\rho \sigma \frac{\sigma^{k-1} - \rho^{k-1}}{\sigma - \rho} = 1 - \gamma \tag{9}$$

So  $1 \leq \gamma$ . Similarly,

$$\rho \sigma \frac{\sigma^{k-1} + \rho^{k-1}}{\sigma + \rho} = \gamma - 1 \tag{10}$$

So  $\gamma \geq 1$ . Therefore  $\gamma = 1$ . From (10) we have  $\rho \sigma = 0$  and the solution is of the form  $\dots, 0, \rho, 0, \rho, 0, \dots$  with  $\rho > 0$ . Now let  $\{v_n\}_{n=2k}^\infty$  be a solution of equation (6) with  $\gamma=1$ .

Then

$$v_{n+1} = \frac{v_{n-1}}{1 + \prod_{i=1}^k v_{n-2i}} < v_{n-1}, \quad n = 0, 1, \dots$$

and so the even terms  $\{v_{2n}\}_{n=-k}^\infty$  decreases to a limit  $\rho$  and the odd terms  $\{v_{2n+1}\}_{n=-k}^\infty$  decreases to a limit  $\sigma$ , where

$$\rho = \frac{\rho}{1 + \sigma^{k-1+1}}, \quad \sigma = \frac{\sigma}{1 + \rho^{k-1+1}}.$$

then  $\sigma^{k-1+1} \rho = 0$  and  $\rho^{k-1+1} \sigma = 0$ .

Therefore,  $\{v_n\}_{n=-2k}^\infty$  converges to the periodic solution  $\dots, 0, \rho, 0, \rho, 0, \dots$  with  $\rho > 0$ . The following theorem we discuss the existence of semicycles.

**Theorem 5.** Assume that  $f \in C([0, \infty)^{2k+1})$  is increasing in the even arguments and decreasing in the others. Let  $\bar{v}$  be an equilibrium point for the difference equation  $v_{n+1} = F(v_n, v_{n-1}, \dots, v_{n-2k})$ ,  $n = 0, 1, \dots$  (11)

Let  $\{v_n\}_{n=-2k}^\infty$  be a solution of equation (11) such that either,

$$\text{(C}_1\text{)} \quad v_{-2k}, v_{-2k+2}, \dots, v_0 > \bar{v},$$

and  $v_{-2k+1}, v_{-2k+3}, \dots, v_{-1} < \bar{v}$

or

$$(C_2) \quad v_{-2k}, v_{-2k+2}, \dots, v_0 < \bar{v}$$

$$\text{and} \quad v_{-2k+1}, v_{-2k+3}, \dots, v_{-1} > \bar{v}$$

is satisfied, then  $\{v_n\}_{n=-2k}^\infty$  oscillates about  $\bar{v}$  with semicycles of length one.

**Proof:** Assume that  $f$  is increasing in the even arguments and decreasing in the others. Let  $f$  be satisfying condition  $(C_1)$  we have

$$v_1 = f(v_0, v_{-1}, \dots, v_{-2k}) < f(\bar{v}, v_{-1}, \bar{v}, \dots, \bar{v}) < f(\bar{v}, \bar{v}, \bar{v}, \dots, \bar{v}) = \bar{v}$$

$$v_2 = f(v_1, v_0, \dots, v_{-2k+1}) > f(\bar{v}, v_0, \bar{v}, \dots, \bar{v}) > f(\bar{v}, \bar{v}, \bar{v}, \dots, \bar{v}) = \bar{v}$$

By induction we obtain the result. If  $f$  satisfies condition  $(C_2)$ , we can prove the result similarly.

**Corollary 1.** Assume that  $\gamma > 1$  and let  $\{v_n\}_{n=-2k}^\infty$  be a solution of equation (6) such that either  $(C_1)$  or  $2 (C_2)$  is satisfied. Then  $\{v_n\}_{n=-2k}^\infty$  oscillates about the positive equilibrium point  $\bar{v} = k^{-1+1}\sqrt{\gamma-1}$  with semicycles of length one.

**Proof:** The proof follows directly from the previous theorem. Finally we show that, under certain initial conditions, unbounded solution will be obtained.

**Theorem 6.** Assume that  $\gamma > 1$ . Let  $\{v_n\}_{n=-2k}^\infty$  be a solution of equation (6) and  $\bar{v} = k^{-1+1}\sqrt{\gamma-1}$ , the positive equilibrium point. Then the following statements are true:

1. If

$$v_{-2k}, v_{-2k+2}, \dots, v_0 > \bar{v}$$

$$\text{and} \quad v_{-2k+1}, v_{-2k+3}, \dots, v_{-1} < \bar{v},$$

then  $\{v_n\}_{n=-2k}^\infty$  increases to  $\infty$  and  $\{v_{2n+1}\}_{n=k}^\infty$  decreases to 0.

2. If

$$v_{-2k}, v_{-2k+2}, \dots, v_0 < \bar{v}$$

$$\text{and} \quad v_{-2k+1}, v_{-2k+3}, \dots, v_{-1} > \bar{v},$$

then  $\{\bar{v}_n\}_{n=-2k}^\infty$  decreases to 0 and  $\{v_{2n+1}\}_{n=k}^\infty$  increases to  $\infty$ .

**Proof:**

1. Let  $\{v_n\}_{n=-2k}^\infty$  be a solution of equation (6) with initial conditions,

$$v_{-2k}, v_{-2k+2}, \dots, v_0 > \bar{v}$$

$$\text{and} \quad v_{-2k+1}, v_{-2k+3}, \dots, v_{-1} < \bar{v}.$$

then

$$v_{2n+2} = \frac{\gamma v_{2n}}{1 + \prod_{i=1}^k v_{2n-2i+1}} > \frac{\gamma v_{2n}}{1 + \bar{v}^{k-1+1}} = v_{2n} \quad \text{a}$$

nd

$$v_{2n+1} = \frac{\gamma v_{2n+1}}{1 + \prod_{i=1}^k v_{2n-2i+1}} < \frac{\gamma v_{2n+1}}{1 + \bar{v}^{k-1+1}} = v_{2n+1} \quad \text{S}$$

o  $\{v_{2n}\}_{n=k}^\infty$  increases to  $\infty$  and  $\{v_{2n+1}\}_{n=k}^\infty$  decreases to 0.

2. The proof is similar and will be omitted.

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## THE IMPLEMENTATION OF AN AIR POLLUTION WARNING SYSTEM USING ELEMENTS OF FUZZY LOGIC

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**Abstract:** Nowadays, the air pollution problem is of present interest. In our country, are institutions, as the National Network of Air Quality Control, which purpose is the permanently monitoring of air quality. In this paper, using instruments of Fuzzy Logic Toolbox from Matlab7.1 software, is presented an implementation of an air pollution warning system. This type of logic has various applications in the meteorology domain, in the solving process of different types of problems, concerning the air pollution gases effects, on air quality. In accordance with the specific index of each air pollution gas, is determined the level of general index. With other words, is determined the air quality level, in accordance with the values of each air pollution gas. Also, are determined the limit situations, in which some of the air pollution gases surpass the alert level, case in which the air pollution is excessively.

**Key words:** air pollution, specific index, general index, fuzzy logic, Fuzzy Logic Toolbox, air quality level, alert level

### 1. FEW WORDS ABOUT FUZZY LOGIC

When the analyzed processes are very complex, processes for which are not available simple mathematical models, then fuzzy logic represents a possible solution at this problem.

One of the many fuzzy logic definitions, describe this type of logic, to be a problem solving control methodology with implementation in various systems, from simple to large, networked or data acquisition and control ones [3].

Having at disposal vague, ambiguous, imprecise or missing data, fuzzy logic represents a simple way for obtaining a definite conclusion, in the solving process of a certain problem [2].

The application domains for fuzzy logic are various, starting with those regarding the consumer products making, industrial process control, medical instrumentation production, decision support systems control, medicine, meteorology, education, and many others [1].

Also, for building fuzzy systems is available a wide range of software instruments, for instance:

- Fuzzy Knowledge Builder;
- Judgement Maker;
- Fuzzy Engine;
- *Fuzzy Logic Toolbox*;
- Flex Tools;
- FLOPS, etc.

Some of the specific domains in which different types of companies, organizations, are using fuzzy based software, are the following [4]:

- The optimal sequence determination for the automobile assemble, soft build by FLS (Qualicision Sequencing Software);
- The robots control for rubber setting;
- Banking advising (Fuzzy Decision Desk);
- Advising for credit loan: system which make the difference between a good client and a bad one, used by CITIBANK;
- Robots control (TOSHIBA, HIROTA);
- The efficiency control of car motors (NISSAN);
- Earthquake prediction systems;
- Cancer diagnose (Kawasaki Medical School);
- The form recognition in pictures (CANON, MINOLTA);

- The light control at video devices (SANYO);
- The increase of assurance for the nuclear reactors;
- Software design for industrial processes (APTRONIX, HARIMA), etc.

## 2. AIR POLLUTION ASPECTS

The goal of the *National Network of Air Quality Control* institution is the monitoring of the air quality parameters by using its stations (about one hundred) wide spread on the entire Romania surface.

Any substance directly or indirectly introduced by man in surrounded air and which can have harmful effects on people's health or on environment is considered to be a noxious substance.

The main air pollution gases are the following:

- Sulfur dioxide (SO<sub>2</sub> – colorless gas which inflame the eyes and the respiratory ways );
- Nitrogen dioxide (NO<sub>2</sub> – brawn colored gas, very reactive gas and the long human exposure at this type of gas, can be fatal, by destroying the lungs tissue);
- Ozone (O<sub>3</sub> – has approximately the same effects like SO<sub>2</sub>);
- Carbon monoxide (CO – toxic gas which, in sufficient concentrations, can be fatal by destroying the respiratory and cardiovascular system );
- Dust in suspension (PM<sub>10</sub> – complex of very small particles and liquid particles and the exposure on long term can cause dead or cancer).

Another air pollution gases, are the following:

- Benzene (C<sub>6</sub>H<sub>6</sub>);
- Lead and other toxic metals (Pb, Cd, As and Hg);
- Aromatic hydrocarbon's (HAP).

For encode the register concentration for each of the main gases mentioned below is used the so called *specific index*. For establish the level of air pollution is used the so called *general index*. Both of these indexes have values between one and six.

The *specific index* for each of the main air pollution gases is established by associating

the hour medium value of the concentrations, in one of the concentrations domains. For instance, the *specific index* for sulfur dioxide (SO<sub>2</sub>) is presented in Table 1[5]:

Table 1 Specific index for SO<sub>2</sub>

Concentrations domain (ug/m <sup>3</sup> )	Specific index
0-49	1
50-74	2
75-124	3
125-349	4
350-499	5
>500	6

The values for the so called *general index* are presented in Table 2:

Table 2 General index values

Value	Meaning
1	Excellent (the purest air)
2	Very good (very limited presence of air pollution gases)
3	Good (limited presence of air pollution gases)
4	Medium (the presence of pollution gases is between acceptable limits)
5	Bad (irrespirable air)
6	Very bad (noxious air)

For each of the main air pollution gases, there is an alert level, which means the level upon which there is a risk for people's health, as a consequence of a short period of time exposure, case in which must be taken at once the necessary measures.

## 3. AIRPOLWARNING SYSTEM IMPLEMENTATION

The so called *AirPolWarning* system has the following purposes:

- The establishing of the alert level for each of the main air pollution gases;

- The determination of the *general index* values, with other words the determination of the air quality level.

For accomplish these, we used the *Fuzzy Logic Toolbox* instruments from Matlab7.1 software.

The inputs for AirPolWarning system are the following: Specific-index-SO2, Specific-index-NO2, Specific-index-O3, Specific-index-CO and Specific-index-PM10.

The outputs are: Alert-levelSO2, Alert-levelNO2, Alert-levelO3, Alert-levelCO, Alert-levelPM10 and General-index. The inputs and outputs are presented in Figure 1:

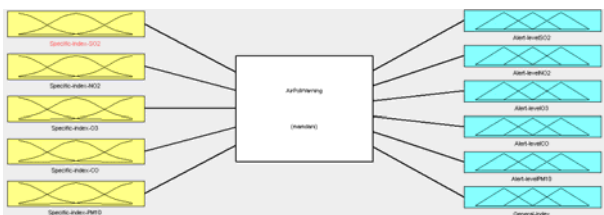


Fig.1 The AirPolWarning inputs and outputs

Using the concentrations domains offered by *National Network of Air Quality Control* [5], we establish for each input and output the necessary values.

For instance, the input Specific-index-SO2, has the values presented in Table 3:

Table 3 Specific-index-SO2 values

Concentrations domain (ug/m3)	Values
0 - 49	Excellent
50 - 74	Very-good
75 - 124	Good
125 - 349	Medium
350 - 499	Bad
500 - 525	Very-bad

For output Alert-levelSO2, the values are those presented in Table 4:

Table 4 Alert-levelSO2 values

Concentrations domain (ug/m3)	Values
0 - 349.99	Non-alert-SO2
350 - 439.99	Alert-possibility-SO2
440 - 525	Alert-SO2

For output Alert-levelNO2, the values are presented in Table 5:

Table 5 Alert-levelNO2 values

Concentrations domain (ug/m3)	Values
0 - 250	Non-alert-NO2
251 - 350	Alert-possibility-NO2
351 - 450	Alert-NO2

For output Alert-levelO3, the values are those presented in Table 6:

Table 6 Alert-levelO3 values

Concentrations domain (ug/m3)	Values
0 - 145	Non-alert-O3
146 - 223	Alert-possibility-O3
224 - 300	Alert-O3

For output Alert-levelCO, the values are those presented in Table 7:

Table 7 Alert-levelCO values

Concentrations domain (ug/m3)	Values
0 - 10	Non-alert-CO
11 - 15	Alert-possibility-CO
15.1 - 20	Alert-CO

For output Alert-levelPM10, the values are those presented in Table 8:

Table 8 Alert-levelPM10 values

Concentrations domain (ug/m3)	Values
0 - 54	Non-alert-PM10
55 - 81.2	Alert-possibility-PM10
81.3 - 110	Alert-PM10

Some of the decision rules used for determine the alert level for each air pollution gas are the following:

- If (Specific-index-SO2 is Excellent) and (Specific-index-NO2 is Excellent) and (Specific-index-O3 is Excellent) and (Specific-index-CO is Excellent) and (Specific-index-PM10 is Excellent) then (Alert-levelSO2 is Non-alert-SO2)(Alert-levelNO2 is Non-

alertNO2)(Alert-levelO3 is Non-alert-O3)(Alert-levelCO is Non-alertCO)(Alert-levelPM10 is Non-alertPM10);

- If (Specific-index-SO2 is Very-good) and (Specific-index-NO2 is Good) and (Specific-index-O3 is Medium) and (Specific-index-CO is Bad) and (Specific-index-PM10 is Very-bad) then (Alert-levelSO2 is Non-alert-SO2)(Alert-levelNO2 is Non-alertNO2)(Alert-levelO3 is Alert-possibilityO3)(Alert-levelCO is Alert-CO)(Alert-levelPM10 is Alert-PM10);

- If (Specific-index-SO2 is Medium) and (Specific-index-NO2 is Bad) and (Specific-index-O3 is Very-bad) and (Specific-index-CO is Excellent) and (Specific-index-PM10 is Very-good) then (Alert-levelSO2 is Alert-possibility-SO2)(Alert-levelNO2 is Alert-NO2)(Alert-levelO3 is Alert-O3)(Alert-levelCO is Non-alertCO)(Alert-levelPM10 is Non-alertPM10);

- If (Specific-index-SO2 is Bad) and (Specific-index-NO2 is Very-bad) and (Specific-index-O3 is Excellent) and (Specific-index-CO is Very-good) and (Specific-index-PM10 is Medium) then (Alert-levelSO2 is Alert-SO2)(Alert-levelNO2 is Alert-NO2)(Alert-levelO3 is Non-alert-O3)(Alert-levelCO is Non-alertCO)(Alert-levelPM10 is Alert-possibilityPM10);

- If (Specific-index-SO2 is Very-bad) and (Specific-index-NO2 is Excellent) and (Specific-index-O3 is Very-good) and (Specific-index-CO is Good) and (Specific-index-PM10 is Bad) then (Alert-levelSO2 is Alert-SO2)(Alert-levelNO2 is Non-alertNO2)(Alert-levelO3 is Non-alert-O3)(Alert-levelCO is Non-alertCO)(Alert-levelPM10 is Alert-PM10).

For verifying the correct functionality of the AirPolWarning system we will use the following training data:

Table 9 Specific index values

SO2	NO2	O3	CO	PM 10
0-49.99	0-49.99	0-39.99	0-2.99	0-19.99
50-76.21	100-140	120-180	10-14.99	100-110
125-350	200-401	240-301	0-2.99	20-29.99

350-500	400-450	0-39.99	3-4.99	50-79.99
500-525	0-49.99	40-80	5-7.04	80-99.99

Using the mentioned rules, on the data from table 9, the AirPolWarning system provides the following results:

Table 10 The AirPolWarning results

SO2	NO2	O3	CO	PM 10
Non-alert	Non-alert	Non-alert	Non-alert	Non-alert
Non-alert	Non-alert	Alert-possibility	Alert	Alert
Alert-possibility	Alert	Alert	Non-alert	Non-alert
Alert	Alert	Non-alert	Non-alert	Alert-possibility
Alert	Non-alert	Non-alert	Non-alert	Alert

The AirPolWarning system outputs dependence on the system inputs is represented under a graphical form in the following figures.

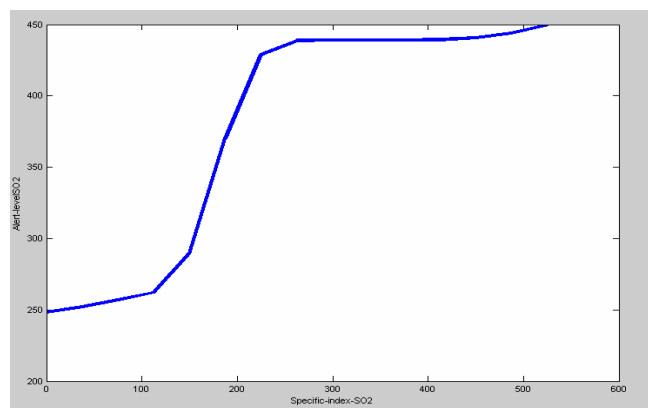


Fig.2 The dependence between Alert-levelSO2 output and Specific-index-SO2 input

In Figure 2 are presented the Alert-levelSO2 output values in accordance with the values of the input Specific-index-SO2.

For another output, for instance for Alert-levelCO, the values in accordance with the values of Specific-index-CO input, are presented is Figure 3.

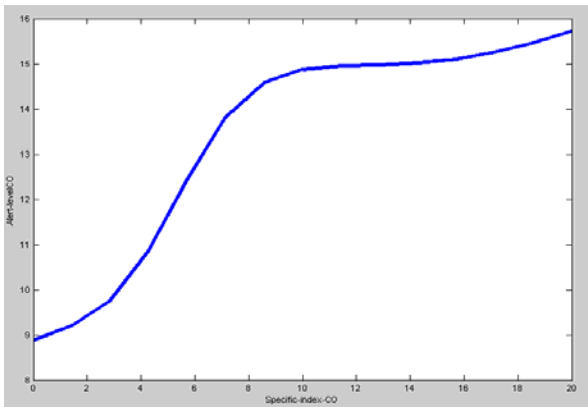


Fig.3 The dependence between Alert-levelCO output and Specific-index-CO input

Is well-known the fact that the air pollution gas SO2 accelerate the pollution gas O3 dangerous effects, on peoples health. This relation between this two types of gases, are presented in figure 4:

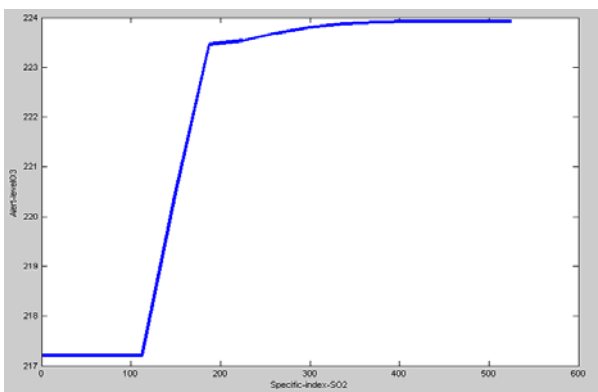


Fig.4 The relation between SO2 and O3

For establish the air quality level represented by general index parameter, we used the following intervals, presented in table11:

Table 11 General-index values

Intervals	General-index
0-49	Excellent
50-99	Very good
100-124	Good
125-200	Medium
201-399	Bad
400-525	Very bad

Some of the decision rules used for determine the general-index values are the following:

- . If (Specific-index-SO2 is Excellent) and (Specific-index-NO2 is Excellent) and (Specific-index-O3 is Excellent) and (Specific-index-CO is Excellent) and (Specific-index-PM10 is Excellent) then (General-index is 1-Excellent);
- . If (Specific-index-SO2 is Very-good) and (Specific-index-NO2 is Good) and (Specific-index-O3 is Medium) and (Specific-index-CO is Bad) and (Specific-index-PM10 is Very-bad) then (General-index is 5-Bad);
- . If (Specific-index-SO2 is Medium) and (Specific-index-NO2 is Bad) and (Specific-index-O3 is Very-bad) and (Specific-index-CO is Medium) and (Specific-index-PM10 is Bad) then (General-index is 6-Very-Bad).

Using the mentioned rules, on the data from table 9, the AirPolWarning system provides the following results:

Table 12 The AirPolWarning results

SO2	NO2	O3	CO	PM 10	General-index level
0-49.99	0-49.99	0-39.99	0-2.99	0-19.99	0-49
50-76.21	100-140	120-180	10-14.99	100-110	201-399
125-350	200-401	240-301	7-9.99	80-99.99	400-525

The general-index values dependence on the pollution gases values is represented under a graphical form in the following figure 5 and figure 6:

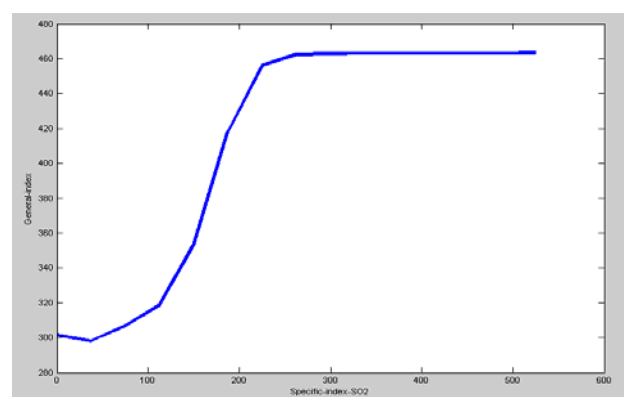


Fig.5 General-index values depending on Specific-indexSO2 values

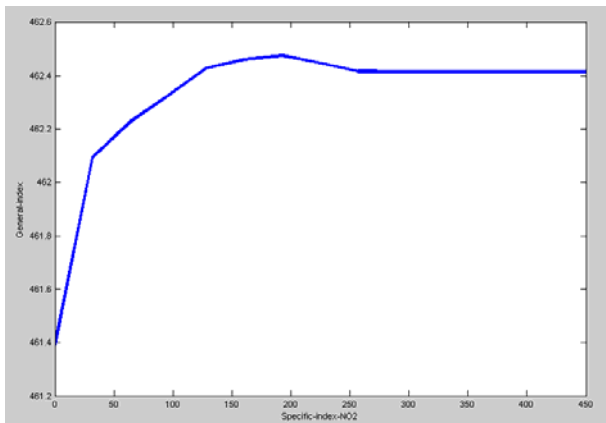


Fig.6 General-index values depending on Specific-indexNO2 values

The General-index values dependence on two pollution gases values is represented in figure 7.

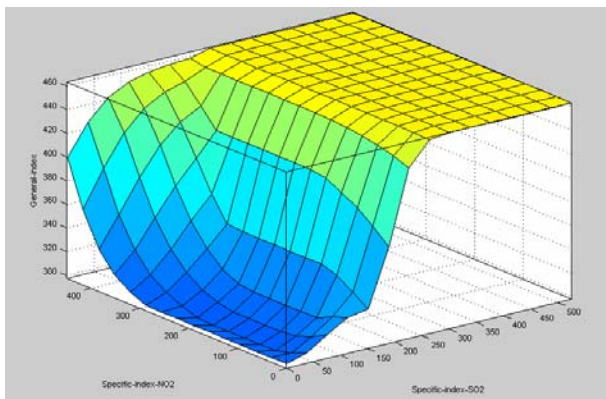


Fig.7 General-index values depending on two air pollution gases

Also in figure 7 is presented a three-dimensional curve that represents the mapping from Specific-indexNO<sub>2</sub> and Specific-indexSO<sub>2</sub> values to General-index values. This plot was generated by three rules from the total number of twenty eight rules used within the framework of fuzzy inference system of our application. For AirPolWarning system, we used the Mandami's fuzzy inference method, which represents the most commonly seen fuzzy methodology. Is known the fact that this type of inference, expects the output membership functions to be fuzzy sets.

Using the last of the basic Fuzzy Logic Toolbox GUI tools, respective Surface Viewer, we can represent in an easy manner, the relationships between all five main pollution gases. Also, we can represent the influence of these gases values on the alert level and general index values.

#### 4. CONCLUSIONS

For solving the air pollution problem in our country is necessary the developing of systems which not only goal is the monitoring of air pollution gases level but also the identification of air pollution gases alert level.

In this article, using fuzzy logic, we obtained an air pollution warning system which establishes the relationships between main air pollution gases, the alert level for each one and the air quality level.

Therefore, the usage of fuzzy logic supplies useful and efficient air pollution warning systems which can be applied with success for keep under control the air pollution problem.

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## A PROBABILISTIC PROOF OF AN ASYMPTOTIC FORMULA FOR EXPONENTIAL OPERATORS

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**Abstract:** In this paper, we present a probabilistic proof of an asymptotic formula for bidimensional exponential operators .

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**Key words:** exponential operators, asymptotic formula, probabilistic proof.

### 1. Introduction

The exponential operators was introduced and studied, for the first time, by May (1976) and Ismail and May (1978).

All these operators have the property of reproducing linear functions and are the classical operators of approximation theory, like the Bernstein operators, the Szasz-Mirakjan operators, the Baskakov operators, the Gauss- Weirstrass operators and the Ismail and May operators. We considered a generalization of exponential operators in bi- and multidimensional case, in our papers (2006,1,2 ) and studied their approximation properties . In paper (2008), Cismașiu and Păltănea R. obtain the asymptotic formula for multidimensional exponential operators, in a classical form.

In this paper, we present a simple probabilistic proof of an asymptotic formula, for the bidimensional exponential operators, using a probabilistic interpretation of these operators.

Let be, a sequence of bidimensional random variables,

$$Z_k = (X_k, Y_k), k \in \mathbb{N}$$

and let  $W_n = (U_n, V_n), n \in \mathbb{N}$  be a sequence random vectors with the components  $U_n$  respective  $V_n$  represent the arithmetic means

of the first  $n$  components  $X_k, k = \overline{1, n}$  respective  $Y_k, k = \overline{1, n}$  i.e.

$$U_n = \frac{1}{n} \sum_{k=1}^n X_k, V_n = \frac{1}{n} \sum_{k=1}^n Y_k$$

We make the assumption that, for any  $n \in \mathbb{N}$  the random vectors  $Z_1, Z_2, \dots, Z_n$  are independent and identically distributed with mean value  $(x, y) = (E[X_k], E[Y_k]), k \in \mathbb{N}$  and so for each  $n \in \mathbb{N}$  the components of  $W_n$  are independent and identically distributed. If  $f$  is a real-valued function defined and bounded on  $R^2$  such that the mean value of the random vector  $f(U_n, V_n)$  exists for  $n \in \mathbb{N}$  then

$$\begin{aligned} L_n f(x, y) &= E[f(U_n, V_n)] = \\ &= \iint_{R^2} f(u, v) dF_n(u, v; x, y) \end{aligned} \quad (1)$$

is a positive linear operator, where  $F_n(u, v; x, y)$  is the distribution function of the random vector  $(U_n, V_n)$  with  $(u, v) \in R^2$  and  $(x, y)$  a real bidimensional parameter varying in a parameter space  $D \subseteq R^2$ , which represents the mean value of this distribution, i.e.

$$\begin{aligned} F_n(u, v; x, y) &= P(U_n \leq u, V_n \leq v; x, y), \\ &(u, v) \in R^2, (x, y) \in D \end{aligned} \quad (2)$$

$$\begin{aligned} (x, y) &= (E(U_n), E(V_n)) = \\ &= \left( E\left(\frac{1}{n} \sum_{k=1}^n X_k\right), E\left(\frac{1}{n} \sum_{k=1}^n Y_k\right) \right) = \\ &= (E(X_k), E(Y_k)) \end{aligned}$$

This probabilistic method for obtaining concrete positive operators was developed for approximation of functions of several variables by D.D. Stancu (1970). Assuming that, the random vector  $(U_n, V_n)$  has a discrete distribution, then the distribution function (2) is a step function so that  $P(U_n = u, V_n = v; x, y) = 0$  at every point  $(u, v) \in R^2$  except at a finite or countable infinite number of points  $(a_i, b_j)$ ,  $(i, j) \in I \times J$ ,  $I \subseteq N$ ,  $J \subseteq N$  and every such point is taken with a positive probability:

$$\begin{aligned} p_n(a_i, b_j; x, y) &= P(U_n = a_i, V_n = b_j; x, y) \geq 0 \\ \sum_i \sum_j p_n(a_i, b_j; x, y) &= 1, (\forall) n \in N, (x, y) \in D \end{aligned} \tag{3}$$

In this discrete case the operator (1) become:

$$\begin{aligned} L_n f(x, y) &= \sum_i \sum_j f(a_i, b_j) p_n(a_i, b_j; x, y), (x, y) \in D. \end{aligned} \tag{4}$$

If the random vector  $(U_n, V_n)$  has a continuous distribution, having the probability density  $\rho_n(u, v; x, y)$  then, the operator (1) can be written as follows:

$$L_n f(x, y) = \iint_{R^2} f(u, v) \rho_n(u, v; x, y) dx dy \tag{5}$$

with  $\rho_n(u, v; x, y) \geq 0, (\forall) n \in N, (u, v) \in R^2,$

$$\begin{aligned} (x, y) \in D, \iint_{R^2} \rho_n(u, v; x, y) du dv = \\ = 1, (x, y) \in D. \end{aligned}$$

Suppose on, that the distribution of the random vector  $W_n = (U_n, V_n)$  is so that, for any  $(x, y) \in \text{Int}(D)$ , in the discrete case the probability  $p_n(a_i, b_j; x, y)$  satisfy the conditions:

$$\begin{aligned} \text{(i). } \frac{\partial}{\partial x} p_n(a_i, b_j; x, y) &= [n(a_i - x)/p(x)] p_n(a_i, \\ b_j; x, y) \end{aligned} \tag{6}$$

$$\begin{aligned} \text{(ii). } \frac{\partial}{\partial y} p_n(a_i, b_j; x, y) &= \\ &= [n(b_j - y)/q(y)] p_n(a_i, b_j; x, y) \end{aligned}$$

and respective in continuous case, the density probability  $\rho_n(u, v; x, y)$  verify the analogous conditions:

$$\begin{aligned} \text{(i). } \frac{\partial}{\partial x} \rho_n(u, v; x, y) &= \\ &= [n(u - x)/p(x)] \rho_n(u, v; x, y) \end{aligned} \tag{7}$$

$$\begin{aligned} \text{(ii). } \frac{\partial}{\partial y} \rho_n(u, v; x, y) &= \\ &= [n(v - y)/q(y)] \rho_n(u, v; x, y), \end{aligned}$$

where  $p(x)$  and  $q(y)$  are algebraical polynomials of degree 2 at the most, which represent the components of variance of the random vector  $Z_k = (X_k, Y_k)$ :  
 $D^2(Z_k) = (D^2(X_k), D^2(Y_k)) = (p(x), q(y)), k \in N$  and  $p(x) > 0, q(y) > 0, (x, y) \in \text{Int}(D)$ .  $(8)$   
 The approximation properties of these operators are giving in our paper (2006, 1).

## 2. Asymptotic formula

**Theorema 1.** *If  $f \in C^2(D)$ ,  $D \subseteq R^2$  is a function which has bounded partial derivatives of second order on  $D$ , then for any  $(x, y) \in D$  we have for the operators (1) with conditions (4),(6) in discrete case respective (5),(7) in continuous case, that*

$$\begin{aligned} \lim_{n \rightarrow \infty} n(L_n f(x, y) - f(x, y)) &= \\ &= \frac{1}{2} \left( p(x) \frac{\partial^2 f}{\partial x^2} + q(x) \frac{\partial^2 f}{\partial y^2} \right), \end{aligned}$$

$p(x) > 0, q(x) > 0$

*and the limit is uniform with respect  $(x, y)$  on any compact and convex part of  $D$ .*

*Proof.* If  $f \in C^2(D)$ ,  $D \subseteq R^2$  and  $(x, y) \in D$ , then the Taylor's formula of second order gives:

$$f(U_n, V_n) = f(x, y) + df(x, y)(U_n - x, V_n - y) + \frac{1}{2} d^2 f(x, y)(U_n - x, V_n - y)^2 + \\ + \frac{1}{2} \left[ d^2 f(\alpha_n, \beta_n)(U_n - x, V_n - y)^2 - d^2 f(x, y)(U_n - x, V_n - y)^2 \right], \quad x < \alpha_n < U_n, \quad y < \beta_n < V_n.$$

Taking formal, the mean value on both sides, with  $x = E(U_n)$ ,  $y = E(V_n)$  we obtain

$$L_n f(x, y) = E[f(U_n, V_n)] = \\ = f(x, y) + \frac{1}{2} \left\{ \frac{\partial^2 f}{\partial x^2}(x, y) E(U_n - x)^2 + 2 \frac{\partial^2 f}{\partial x \partial y}(x, y) E[(U_n - x)(V_n - y)] + \frac{\partial^2 f}{\partial y^2}(x, y) E(V_n - x)^2 \right\} + \\ + \varepsilon_n(x, y)$$

with

$$\varepsilon_n(x, y) = \\ = \frac{1}{2} E \left\{ \left[ \frac{\partial^2 f}{\partial x^2}(\alpha_n, \beta_n)(U_n - x)^2 + 2 \frac{\partial^2 f}{\partial x \partial y}(\alpha_n, \beta_n)(U_n - x)(V_n - y) + \frac{\partial^2 f}{\partial y^2}(\alpha_n, \beta_n)(V_n - y)^2 \right] - \right. \\ \left. - \left[ \frac{\partial^2 f}{\partial x^2}(x, y)(U_n - x)^2 + 2 \frac{\partial^2 f}{\partial x \partial y}(x, y)(U_n - x)(V_n - y) + \frac{\partial^2 f}{\partial y^2}(x, y)(V_n - y)^2 \right] \right\}$$

and  $x < \alpha_n < U_n$ ,  $y < \beta_n < V_n$ .

Then, because  $D^2(U_n) = \frac{1}{n} D^2(X_k) = \frac{p(x)}{n}$ ,  $D^2(V_n) = \frac{1}{n} D^2(Y_k) = \frac{q(y)}{n}$  and

$E[(U_n - x)(V_n - y)] = T_{n,1,1}(x, y) = 0$ , ( see (2006,1) ) we have

$$L_n f(x, y) - f(x, y) = \frac{1}{2} \left\{ \frac{\partial^2 f}{\partial x^2} D^2(U_n) + 2 \frac{\partial^2 f}{\partial x \partial y} E[(U_n - x)(V_n - y)] + \frac{\partial^2 f}{\partial y^2} D^2(V_n) \right\} + \varepsilon_n(x, y) = \\ = \frac{1}{2} \left( \frac{\partial^2 f}{\partial x^2} \cdot \frac{p(x)}{n} + \frac{\partial^2 f}{\partial y^2} \cdot \frac{q(y)}{n} \right) + \varepsilon_n(x, y)$$

respective

$$n(L_n f(x, y) - f(x, y)) = \frac{1}{2} \left( \frac{\partial^2 f}{\partial x^2} p(x) + \frac{\partial^2 f}{\partial y^2} q(y) \right) + n\varepsilon_n(x, y).$$

If we prove, that  $|\varepsilon_n(x, y)| = o\left(\frac{1}{n}\right)$ ,  $n \rightarrow \infty$ , then the theorem follows.

Now, with the modulus of continuity of  $f$

$$\omega(f; \delta_1, \delta_2) = \sup \left\{ |f(x, y) - f(\alpha, \beta)|, (x, y), (\alpha, \beta) \in D, |x - \alpha| \leq \delta_1, |y - \beta| \leq \delta_2 \right\}, \delta_1, \delta_2 > 0$$

and  $\|f\| = \sup \left\{ |f(x, y)|, (x, y) \in D \right\}$  we obtain

$$\begin{aligned}
 |\varepsilon_n(x, y)| \leq & \frac{1}{2} E \left\{ \left| \frac{\partial^2 f(\alpha_n, \beta_n)}{\partial x^2} - \frac{\partial^2 f(x, y)}{\partial x^2} \right| (U_n - x)^2 : |U_n - x| \leq \delta_1 \text{ and } |V_n - y| \leq \delta_2 \right\} + \\
 & + \frac{1}{2} E \left\{ \left| \frac{\partial^2 f(\alpha_n, \beta_n)}{\partial x^2} - \frac{\partial^2 f(x, y)}{\partial x^2} \right| (U_n - x)^2 : |U_n - x| > \delta_1 \text{ or } |V_n - y| > \delta_2 \right\} + \\
 & + E \left\{ \left| \frac{\partial^2 f(\alpha_n, \beta_n)}{\partial x \partial y} - \frac{\partial^2 f(x, y)}{\partial x \partial y} \right| (U_n - x)(V_n - y) \right\} + \\
 & + \frac{1}{2} E \left\{ \left| \frac{\partial^2 f(\alpha_n, \beta_n)}{\partial y^2} - \frac{\partial^2 f(x, y)}{\partial y^2} \right| (V_n - y)^2 : |V_n - y| \leq \delta_2 \text{ and } |U_n - x| \leq \delta_1 \right\} + \\
 & + \frac{1}{2} E \left\{ \left| \frac{\partial^2 f(\alpha_n, \beta_n)}{\partial y^2} - \frac{\partial^2 f(x, y)}{\partial y^2} \right| (V_n - y)^2 : |V_n - y| > \delta_2 \text{ or } |U_n - x| > \delta_1 \right\},
 \end{aligned}$$

$$\begin{aligned}
 |\varepsilon_n(x, y)| \leq & \frac{1}{2} \omega(f''_{x^2}; \delta_1, \delta_2) E(U_n - x)^2 + \|f''_{x^2}\| E(U_n - x)^2 \cdot [P(|U_n - x| > \delta_1) + P(|V_n - y| > \delta_2)] + \\
 & + \frac{1}{2} \omega(f''_{y^2}; \delta_1, \delta_2) E(V_n - y)^2 + \|f''_{y^2}\| E(V_n - y)^2 \cdot [P(|V_n - y| > \delta_2) + P(|U_n - x| > \delta_1)].
 \end{aligned}$$

Using the Cebâsev's inequality  $P(|U_n - x| > \delta_1) \leq \frac{D^2(U_n)}{\delta_1^2}$  respective  $P(|V_n - y| > \delta_2) \leq \frac{D^2(V_n)}{\delta_2^2}$

and the variation  $D^2(U_n) = E(U_n - x)^2$  respective  $D^2(V_n) = E(V_n - y)^2$  we have

$$\begin{aligned}
 |\varepsilon_n(x, y)| \leq & \frac{1}{2} D^2(U_n) \left[ \omega(f''_{x^2}; \delta_1, \delta_2) + 2 \|f''_{x^2}\| \left( \frac{1}{\delta_1^2} D^2(U_n) + \frac{1}{\delta_2^2} D^2(V_n) \right) \right] + \\
 & + \frac{1}{2} D^2(V_n) \left[ \omega(f''_{y^2}; \delta_1, \delta_2) + 2 \|f''_{y^2}\| \left( \frac{1}{\delta_2^2} D^2(V_n) + \frac{1}{\delta_1^2} D^2(U_n) \right) \right],
 \end{aligned}$$

$$\begin{aligned}
 |\varepsilon_n(x, y)| \leq & \frac{1}{2} \cdot \frac{p(x)}{n} \left[ \omega(f''_{x^2}; \delta_1, \delta_2) + 2 \|f''_{x^2}\| \left( \frac{1}{\delta_1^2} \cdot \frac{p(x)}{n} + \frac{1}{\delta_2^2} \cdot \frac{q(y)}{n} \right) \right] + \\
 & + \frac{1}{2} \cdot \frac{q(y)}{n} \left[ \omega(f''_{y^2}; \delta_1, \delta_2) + 2 \|f''_{y^2}\| \left( \frac{1}{\delta_2^2} \cdot \frac{q(y)}{n} + \frac{1}{\delta_1^2} \cdot \frac{p(x)}{n} \right) \right],
 \end{aligned}$$

$$\begin{aligned}
 |\varepsilon_n(x, y)| \leq & \frac{1}{2n} \left( p(x) \omega(f''_{x^2}; \delta_1, \delta_2) + q(y) \omega(f''_{y^2}; \delta_1, \delta_2) \right) + \\
 & + \frac{1}{n^2} \left( \frac{p(x)}{\delta_1^2} + \frac{q(y)}{\delta_2^2} \right) \left( p(x) \|f''_{x^2}\| + q(y) \|f''_{y^2}\| \right).
 \end{aligned}$$

So,  $|\varepsilon_n(x, y)| = o\left(\frac{1}{n}\right)$ ,  $n \rightarrow \infty$  and the theorem is prove.

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## TRAINING PROCESS – AIM: AUTOMATIZATION

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**Abstract:** *Computer Assisted Instruction is a planned activity for teaching-learning-evaluating different knowledge, aiming to be assimilated by the trainees in their own rhythm, synchronous or asynchronous, without the compulsory presence of the trainer, using techniques and technologies from Informatics, Electronics, educational sciences, communications. In case of such an approach, trainer's main role is to organize and present rigorously the matter taught on modules and sub-modules, in order to tackle and treat the subject systematically, as any other process following to be automated. The article is setting the stages necessary to be covered by the trainer in order to clearly elaborate the training and evaluation program. PC's program is made according to some data sampling, organizing and processing procedures specific to the training process, in order to determine training's outcomes. The success of implementing such a training and evaluation system depends on many factors, which follow to be presented in the article.*

**Key words:** *training, trainee, trainer, simulation, evaluation, training program, training/evaluation program for computer.*

### 1. INTRODUCTION

„*Training is the main activity attained during the training process according with the pedagogical general objectives evolved at system level, in terms of training policy*”([1]).

The remarkable progresses achieved in domains such as automation, electronics, informatics, robotics, information technology, communications through mass media means etc. have made possible a new approach of the training and evaluation processes, with consistent results in regards of efficiency and quality of these processes. This new approach made possible the transfer from the classic system where the programs attaining were exclusively done by the trainer to a new system where such programs are attained by the trainers supported by PC's.

In this new approach the trainer role is not diminished but is changing in a way that the presence of the trainer is not anymore required during the knowledge transmittal process and during the skills achievement process

necessary for a specific specialization, this function being over taken by the computer eventually associated with simulators and other means for data and knowledge processing. These didactical methods, known also as Computer Assisted Training (CAT) or Computer Assisted Instruction (CAI), capitalize the principles of modelling and cybernetic analysis governing the training activity for the new information technologies and communications” ([1]).

In the moment when the limitations of the classic training systems become evident, new adaptive programs were developed, capable to present the curriculum based on the trainee knowledge model, identifying and explaining the trainee capabilities. These programs are part of the *Intelligent Computer Assisted Training (ICAT)*, known also like *Intelligent Computer Assisted Instruction (ICAI)*, defined through programs capable to generate a pedagogical path in conformity with each individual particularity, through the following:

- ✓ Optimal lessons sequence selection for each student;
- ✓ Dynamic modification, in conjunction with student evolution and pedagogical applied strategies;
- ✓ Student failures causes analysis;
- ✓ Correct answers acceptance, but unexpected, as well as the dialog and natural language with the student ([9]).

## 2. NECESSARY METHODOLOGY TO ATTAIN AN INTELIGENT SYSTEM FOR STUDENTS TRAINING AND EVALUATION

In a such approach, the main role is belonging to the trainer and consists in a careful and attentive structuring of training process in modules and sub-modules in order to be easy approachable and accessible in a systematic manner like any other process possible to be automated.

The elaboration of a methodology scientifically based for an automated intelligent training and evaluation system of training process will involve the following phases:

*Phase 1* – Presentation of terms and concepts used in computer assisted education process through:

- ✓ The most important aspects presentation regarding training and evaluation theory, communication theory and systems theory;
- ✓ The most important terms and concepts presentation used in computer assisted education process;
- ✓ Presentation of theoretic fundamentals of the training and students knowledge & skills evaluation processes regarding modelling and management aspects;
- ✓ Performing a critical study research in regards of the actual stage achieved in evaluation techniques and technologies development.

*Phase 2* – Training systems study as an objective for automation through:

- ✓ Establishing training objectives;

- ✓ Establishing the knowledge and skills quantum which has to be assimilated;
- ✓ Studying and utilisation of artificial techniques for knowledge representation;
- ✓ Establishing the training form;
- ✓ Establishing the necessary human resources and material resources;
- ✓ Training process organization;
- ✓ Definition of training process specific terms and indicators such as:
  - Normative regarding education quality;
  - Performance indicators regarding the efficiency and quality regarding:
    - a) Training program achievement;
    - b) Graduation;
    - c) Costs;
    - d) Training quality.
- ✓ Characterization and structuring the adopted training system:
  - Input measures, state measures and output measures;
  - System models.
- ✓ Realisation and students knowledge evaluation sub-system characterization through:
  - Adoption of a procedure for evaluation of the knowledge level achievement;
  - Establishing the control (examination) subjects (questions);
  - Establishing the correct answers to the questions formulated.

*Phase 3* – Training program rendition by the computer in acceptable terms through:

- ✓ Training and evaluation process modelling;
- ✓ Establishing the programming languages which will be used for data and knowledge codification and processing as well as of the necessary hardware resources;
- ✓ Establishing the accessing way of the programs package and the way how this package will be used by authorized

persons (trainers, trainee, administrators);

- ✓ Knowledge and skills codification;
- ✓ Implementation of a procedure for evaluation of the knowledge level achievement;
- ✓ Training program elaboration and running up assisted by the computer.

*Phase 4* – Data assay procedures and equipments in order to establish training results for:

- ✓ Training sequences scheduling;
- ✓ Trainees evaluation at the end of each module and at the end of the training;
- ✓ Replaying some training sequences depending on the needs;
- ✓ Training success rate evaluation (key performance indicators);
- ✓ Results communication to the trainee and trainer;
- ✓ Establishing the statistical indicators referring to the obtained results.

*Phase 5* – Training and evaluation programs package implementation and use of the results obtained for:

- ✓ Effective optimal conducting of the training process;
- ✓ An eventual re-structure of the training program;
- ✓ An overall evaluation of all didactic activities;
- ✓ Establish the impact of such training system;
- ✓ Compare the developed system with similar systems for training and evaluation.

### **3. COMPUTER ASSISTED TRAINING AND EVALUATION**

As shown previously results that the development and the success of such educational system depends mainly on the trainers ability to develop the training program for computers and on trainees abilities in computers and other system elements use.

In fact, not all trainers have to elaborate themselves and also to implement their own

computer assisted training and evaluation program, because several professional associations and specialised companies have launched on the market such programs for different disciplines or groups of similar disciplines. In such conditions the discipline senior trainers can adopt a program from a company in order to develop and implement his own training and evaluation program.

To achieve this objective, the trainers needs to have a very good knowledge about the principles and concepts which form the fundament of the purchased programs in order to use these correctly and with maximum effectiveness. Only like this, the trainers and the trainees can manage the impact produced by such adoption of such automated training program. For sure the use of such system can provide several advantages which will show in time the effectiveness of computer assisted training programs.

In order to have the training plans developed “in clear” recognized and used by the computer, these must be transformed in accessible terms for PC’s. To achieve this following phases needs to be accomplished:

- ✓ Develop the training and evaluation system mathematical model;
- ✓ Select a programming language for training program codification;
- ✓ Training program codification and upload on a support in a data base/knowledge base;
- ✓ Establish the program accessing mode and the user mode for the authorised persons (trainers, trainees, administrators);
- ✓ Select the necessary equipments to accomplish all required operations.

The computer program should be developed based on assay, organization and processing procedures of the data from training process in order to determinate the training results, as follows:

- ✓ Procedures for planning and execution of various training sequences;
- ✓ Procedures for trainees examination at the end of each training sequences and at the end of the training program;
- ✓ Procedures for replaying the unsuccessful training sequences;



- ✓ Procedures for trainees knowledge level evaluation;
- ✓ Procedures for results communications to trainees and trainers;
- ✓ Procedures to establish statistical indicators, histograms etc.

When the training plan is transposed into a computer program all aspects concerning the progress scheduling of the training and evaluation process will be rigorously ordered by introduction of objective evaluation criteria.

To run such program it is necessary to select properly the necessary equipments and the interconnection mode, which means to establish the hardware type and structure followed by the implementation, testing and running up of this.

The evaluation results can be used for an effective management of the training program, including for a eventual re-structure of the training system or for an overall of the entire assembly of the didactic activities.

## CONCLUSION

The computer assisted training system discussed requires that the trainer is a *feed-forward regulator*. The trainer is issuing predictive commands, selects pedagogical resources adequate to the training context and defines the operational objectives to be achieved taking into consideration the discipline specific curriculum, training plan and general objectives. Also, the *feedback* regulator corrects the errors in such way that the trainee knowledge level could achieve the required level through the training program. The feedback is defined through the grade of achievement of the pre-established operational objectives.

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## DECISION – TREE SEARCH METHODS

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**ABSTRACT:** The basic principle involved in decision – tree search methods is the partition of an initial problem  $P_0$  into a number of subproblems  $P_1, P_2, \dots, P_k$  (whose totality represent problem  $P_0$ ), followed by an attempt to resolve each one of these subproblems. By resolve we mean:

Either (i) Find an optimal solution,

or (ii) Show that the value of the optimal solution is worse than the best solution obtained so far,

or (iii) Show that the subproblem is infeasible.

The reason for partitioning a problem  $P_0$  into a number of subproblems is that these subproblems are easier to resolve, either because of their smaller size, or because of their structure which may not be shared by the initial problem  $P_0$ .

**Keywords:** decision, tree, vertex, depth-first.

### 1. INTRODUCTION

This partition is represented by the tree of Fig. 1.1, where a vertex represents a subproblem.

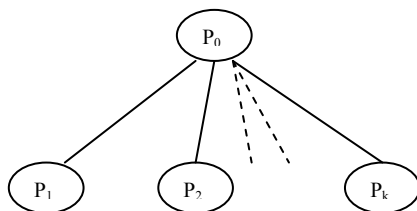


Fig. 1.1 Partition of problem  $P_0$  into subproblems

The reason for partitioning a problem  $P_0$  into a number of subproblems is that these subproblems are easier to resolve, either because of their smaller size, or because of their structure which may not be shared by the initial problem  $P_0$ .

### 2. THE DECISION-TREE SEARCH PRINCIPLE

In general, it may still be impossible to resolve a subproblem  $P_i$  and this subproblem is

then partitioned further into yet smaller subproblems  $P_{i1}, P_{i2}, \dots, P_{ir}$  as shown in Fig. 2.1.

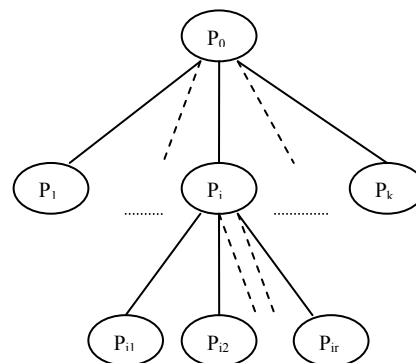


Fig. 2.1. Tree after branching from  $P_i$

This partitioning, (also called branching), is repeated for every subproblem which cannot be resolved.

At any one stage the complete set of subproblems requiring resolution is represented by all the extreme vertices, on all paths emanating from the root of the decision-tree. The root of this tree represents the initial problem  $P_0$ . These vertices are called pendant vertices and in Fig.1.2 they are:

$P_1, \dots, P_{i-1}, P_{i1}, \dots, P_{ir}, P_{i+1}, \dots, P_k$ .

Obviously, if the search is to be exhaustive, the set of sub-problems into which a problem is partitioned must represent

the whole problem. Thus, if problem  $P_i$  is partitioned into  $r$  subproblems  $P_{i1}, \dots, P_{ir}$  we must have:

$$\{P_{i1}\} \cup \{P_{i2}\} \cup \dots \cup \{P_{ir}\} = \{P_i\} \quad (2.1)$$

where  $\{P\}$  is used to represent the set of all feasible solutions to problem  $P$ .

Since eqn (2.1) must apply for every partition we have:

$$\{P_0\} = \bigcup \{P(j) | P(j) : \text{pendant vertex of tree}\} \quad (2.2)$$

In situations where it is required to enumerate all solutions to a problem  $P_0$  (rather than just find the optimal solution), it is desirable to be able to enumerate these by partitioning the problem into subproblems as above and then enumerate the solutions to each one of the subproblems. What is then required is to have no duplications in the generated solutions, i.e. a problem  $P_i$  must be partitioned into subproblems  $P_{i1}, \dots, P_{ir}$  in such a way so that

$$\{P_{is}\} \cap \{P_{iq}\} = \Phi \quad (2.3)$$

for any two subproblems  $P_{is}$  and  $P_{iq}$  with  $s \neq q$ .

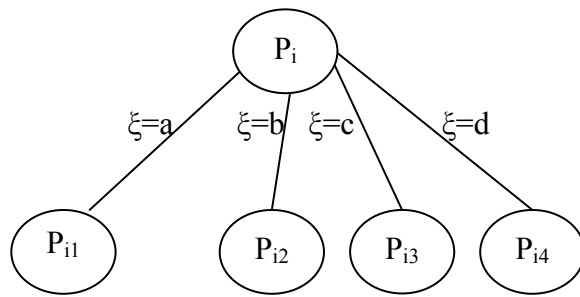
Equation (2.3) then defines a proper partition of problem  $P_i$ . Although condition (2.3) is not necessary for a valid decision-tree search it is nevertheless computationally very advantageous since then:

(a) For an optimization problem  $P_0$ : the optimal solution to one and only one subproblem represented by a pendant vertex.

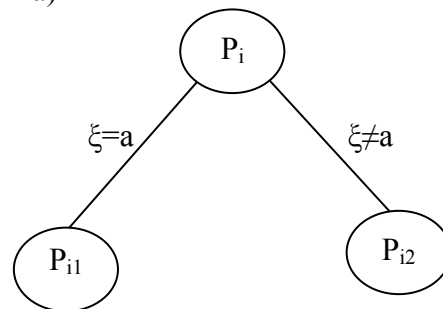
(b) For a complete enumeration problem: the union of the sets of solutions to the subproblems represented by the pendant vertices is the complete set of solutions to  $P_0$  without duplications.

### 3. SOME EXAMPLES OF VALID BRANCHING

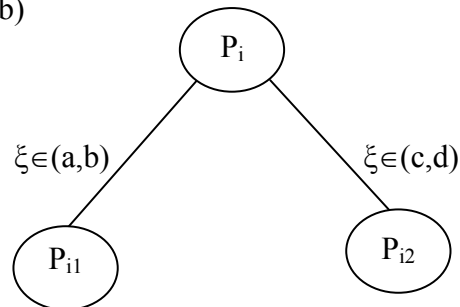
Consider a problem  $P_i$  involving  $n$  variables in which some variable  $\xi$  can have one of four possible values say  $a, b, c$  or  $d$ .



a)



b)



c)

Fig. 3.1. Three possible ways of branching from  $P_i$

(a) One possible partition of  $P_i$  is into four subproblems  $P_{i1}, P_{i2}, P_{i3}$  and  $P_{i4}$ , where for subproblem  $P_{i1}$  we set  $\xi = a$ , for  $P_{i2}$  we set  $\xi = b$ , for  $P_{i3}$  we set  $\xi = c$  and for  $P_{i4}$  we set  $\xi = d$ . The subproblems  $P_{i1}, \dots, P_{i4}$  each have  $n-1$  variables and hence are easier to solve than problem  $P_i$ . (Fig. 3.1. (a)).

(b) Another possible partition of  $P_i$  is into two subproblems  $P_{i1}$  and  $P_{i2}$ , where for  $P_{i1}$  we set  $\xi = a$  and for  $P_{i2}$  we set  $\xi \neq a$ , i.e.  $\xi$  is either  $b, c$  or  $d$ . (Fig. 3.1 (b)).

(c) Yet another possible partition of  $P_i$  is into two subproblems  $P_{i1}$  and  $P_{i2}$ , where for  $P_{i1}$  we set  $\xi = a$  or  $b$  and for  $P_{i2}$  we set  $\xi = c$  or  $d$ . (Fig. 3.1 (c)).

All the above branching possibilities are feasible and satisfy conditions 3.1. Which one

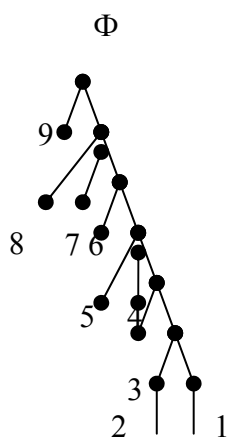
is preferable depends on the nature of the problem being solved, with possibilities of types (a) or (b) being the ones which are most often found to be useful.

#### 4. TYPES OF DECISION-TREE SEARCH

From what has been said above, any subproblem represented by a pendant vertex and which cannot be resolved, can be branched from at any time by partitioning it into smaller subproblems. There are, however, only two basic types of search depending on the way of choosing the next pendant vertex to be branched from:

##### 4.1. DEPTH-FIRST SEARCH

In this type of search branching is continued from the latest generated



Start branching from here next  
Problem resolved  
Fig. 4.1 (a) Depth-first tree

##### 4.2. BREADTH – FIRST SEARCH

In breadth-first search the branching proceeds from level to level so that if the initial problem  $P_0$  is partitioned into subproblems  $P_1, P_2, \dots, P_k$  at level 1, each one of these subproblems is investigated before the investigation of any subproblem at level 2. The subproblems at level 1 which could not be resolved, are partitioned into subproblems at level 2 and, once more, all of these are

subproblem until finally a subproblem is generated which can be resolved. At that point a backtracking step is taken, i.e. the last-but –one subproblem generated is chosen and branching continues again from the corresponding vertex. In this type of search problems are stored in a pushdown stack with the topmost problem chosen for investigation (resolution or partitioning) at every stage. The newly generated subproblems are put on top of this stack, and when a subproblem is resolved it is removed from the stack. The shape of the decision tree when the first subproblem is resolved with this type of search is shown in Fig. 4.1 (a), where the order of priority for investigation amongst the existing subproblems at this stage is indicated by the numbering.

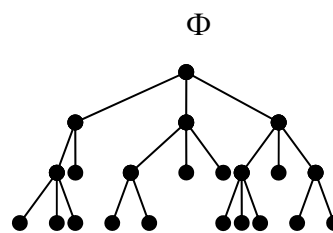


Fig.4.1 (b) Breadth-first tree  
Φ: Problem resolved

investigated before investigating any subproblems that may be produced at level 3 etc. The shape of the decision-tree resulting from this type of search is shown in Fig. 4.1.(b).

#### 5. USE OF BOUNDS

If the problem  $P_0$  to be solved is an optimization problem, then regardless of the type of search, the search is complete only when all the subproblems which are

represented by pendant vertices are resolved. In order to speed up this resolution process, lower or upper bounds (for the cases of minimization or maximization problems respectively), are calculated for each of the pendant vertices. The bound represents the lowest (or highest) possible value of an optimal solution to the subproblem corresponding to the pendant vertex. Thus, (for a minimization problem), if the lower bound for a vertex corresponding to  $P_i$  happens to be greater than the value of the best answer obtained in the search so far, then it is unnecessary to consider further branching from  $P_i$  since no solution in  $\{P_i\}$  can be better than the currently best answer. Subproblem  $P_i$  is then automatically resolved according to (ii) in section 1.

## 6. BRANCHING FUNCTIONS

In both the depth-first and breadth-first searches the choice of which vertex to branch from next has not been completely specified.

For the depth-first search where a problem  $P_i$  has just been branched from to produce subproblems  $P_{i1}, \dots, P_{ir}$ , then we have already said that the next branching must be from one of these last-generated subproblems; we did not, however, specify which one, and any of these could be considered as „last-generated”. For the breadth-first search we have already said that all subproblems at a given level must be investigated before proceeding to the next level but did not specify in which order they are to be investigated.

The branching function is a function that calculates which one of the allowable vertices should be branched from next. For a vertex corresponding to subproblem  $P_j$  this function is some measure of the probability

that the optimal solution to the whole problem  $P_0$  is a solution to  $P_j$ . Quite obviously, that vertex corresponding to the subproblem with the greatest chance of containing the optimal solution may be the best choice for the next branching. Several heuristic measures of this probability can be used, a useful one being simply related to the lower or upper bounds calculated for the vertices. With such a measure, a vertex with a low lower bound (for the minimization case) is considered as having a high probability.

## 7. CONCLUSIONS

By using a branching function another type of decision-tree search immediately suggests itself in addition to the depth and breadth-first searches described earlier. Thus, one could use the branching function to completely choose which vertex to branch from next. For example, if the vertex bounds are also used as the branching function as mentioned earlier, then one could always branch from that pendant vertex whose lower bound is smallest. This type of search is, in general, a hybrid between the depth and breadth-first searches, although in the literature it is often referred to as breadth-first.

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# THE RAMSEY ALGORITHM

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**ABSTRACT :** *This algorithm improved the best bounds known for approximating the independent set and graph coloring problems and prove that the approaches used to date to obtain such results can not be improved much further. I start with the Ramsey algorithm for finding independent sets in graphs, which is actually a schema of algorithms parameterized by the pivoting function applied, similar to the greedy algorithm. It has the property that its solution on any graph is at least as large as the one the corresponding greedy algorithm finds.*

*The algorithm Ramsey is related to a classical problem in extremal graph theory [1].*

**Keywords:** Ramsey , algorithm, graph, greedy .

## 1. INTRODUCTION

The greedy scheme is a generally useful and practical means of finding an independent set of approximate size. However, as the worst case examples show, it has the inconvenient property that it completely ignores nodes neighboring the pivot nodes, even if that neighborhood was large and fully independent.

I am led to a new rule for searching for an independent set. As in the greedy method, choose a vertex and search in the non-neighborhood of that node. But this time also search in the neighborhood of the pivot node, and use whichever result is bigger. Again, a dual rule applies to the cliques.

## 2. GRAPHS, COLORINGS AND INDEPENDENT SETS

### 2.1 Properties of graphs:

A graph  $G$  is a pair  $(V,E)$  of a set of vertices (or nodes)  $V$ , and a set of edges, or unordered pairs of vertices,  $E$ . Two vertices are *adjacent* if the pair is contained in the edge set, and *non-adjacent* otherwise.

An *independent set* in a graph is a set of vertices that are mutually non-adjacent, and a *clique* is a

set of mutually adjacent vertices. The *complement*  $\bar{G}$  of a graph  $G$  is a graph with the same vertex set, but an edge between two vertices if there was no edge between them in  $G$ . A clique in  $G$  is an independent set in  $\bar{G}$ , an vice versa.

A *vertex coloring* of a graph, or simply *coloring* for short, is an assignment of values to the vertices such that no two adjacent vertices are assigned the same value. Alternatively, a coloring is a partition of the vertex sets into a collection of vertex-disjoint independent sets. The dual of a coloring is a clique cover, which is a partition of the vertices into disjoint cliques; a clique cover of the complement of a graph implies a coloring of the original graph.

A *vertex cover* of a graph is a set of vertices with the property that every edge in the graph has one of the vertices in the vertex cover as an endpoint. Since two vertices not in a vertex cover can not be adjacent, the vertices not in a given vertex cover form an independent set and vice versa.

### 2.2 Graph Notation

For an undirected graph  $G = (V,E)$ :  
 $\alpha(G)$  is the *independence number* of the graph or the size of the largest independent set;

$i(G)$  is the *independence ratio* or the independence number divided by the order of the graph;

$cl(G)$  is the *clique number*;

$\chi(G)$  is the *chromatic number* (the number of colors needed to vertex color  $G$ ).

The size of a set  $S$  is denoted by  $|S|$ , in particular,  $|V(G)|$  is the order of  $G$  or the number of vertices,  $|E(G)|$  the number of edges, and  $|C|$  the number of nodes in a clique  $C$ .

For a vertex  $v$ ,  $N(v)$  refers to the subgraph induced by the neighbors of  $v$ , and  $\overline{N}(v)$ , similarly, the subgraph induced by the non-neighbors of  $v$ . A graph is  $H$ -free if it contains no subgraph (edge subset) isomorphic to  $H$ . Unless otherwise stated,  $G$  is the input graph,  $n$  is the order of  $G$ ,  $m$  is the number of edges in  $G$ , and  $H$  is a fixed forbidden subgraph.

### 3. THE RAMSEY ALGORITHM

Choose  $v \in V(G)$

$I(G) \leftarrow \max(\{v\} \cup I(\overline{N}(v)), I(N(v)))$

$C(G) \leftarrow \max(\{v\} \cup C(N(v)), C(\overline{N}(v)))$

The resulting algorithm is shown in figure 3.1.

Ramsey ( $G$ )

begin

if  $G = \Phi$  then return  $(\Phi, \Phi)$

choose some  $v \in G$

$(C_1, I_1) \leftarrow \text{Ramsey}(N(v))$

$(C_2, I_2) \leftarrow \text{Ramsey}(\overline{N}(v))$

Return (larger of  $(C_1 \cup \{v\}, C_2)$ , larger of  $(I_1, I_2 \cup \{v\})$ )

end.

Fig. 3.1 Algorithm 3.1 : The Ramsey algorithm

If we look at the behavior of the algorithm, we see that it breaks the problem into a tree-like structure of subproblems. In one sense, the algorithm transforms the graph into a binary tree where each internal node is adjacent to all of its left descendents and non-adjacent to all of its right descendents. Under

this interpretation, the independent set found by the algorithm is intimately related to a path in the tree with the largest number of right edges. Specifically, it consists of the leaf, and the parents of the right edges in that path. Hence, the size of the independent set found is exactly the maximum number of right edges in any path in the tree, plus one. Similarly, the size of the clique found is the maximum number of left edges in any path, plus one.

As an example, assume the input graph  $G$  contains no triangles. Clearly, the algorithm cannot find any cliques of size more than 2, hence no path in the tree can have more than a single left edge. It follows that either the rightmost path has  $\sqrt{n}$  nodes, or there are fewer than  $\sqrt{n}$  paths in the tree, in which case one of them has more than  $\sqrt{n}$  nodes. Either way, the algorithm finds an independent set of size no less than  $\sqrt{n}$ .

This formulation gives us an effective way of the approximations. A computation of the algorithm that produces a clique of size  $s$  and an independent set of size  $t$  corresponds to a binary tree where the largest number of left edges in a path is  $s-1$  and the largest number of right edges is  $t-1$ . Let  $r(s,t)$  denote the smallest integer  $n$  such that all trees of size  $n$  have paths with at least that many left or right edges. This value is one larger than the size of the largest tree with no path having  $s-1$  left edges or  $t-1$  right edges, which again is one less than the number of external nodes in that tree. Since each external node has an associated unique path, there can be no more

than  $\binom{(s-1)+(t-1)}{(t-1)}$  such nodes.

Hence,  $r(s,t) \leq \binom{s+t-2}{(t-1)}$

**Theorem 3.1** The algorithm Ramsey finds an independent set  $I$  and a clique  $C$  such that  $r(|I|, |C|) \geq n$ .

The algorithm Ramsey is related to a classical problem in extremal graph theory. Let  $R(s,t)$  denote the smallest integer  $n$  such

that all graphs of order  $n$  either contain an independent set of size  $t$  or a clique of size  $s$ . This function was named after the English mathematician Frank P. Ramsey who first showed that it was well-defined. Algorithm and the associated analysis, provides another proof to an upper bound for the Ramsey function, first proved by Erdős and Szekeres in 1934 [2].

**Theorem 3.2**  $R(s,t) \leq r(s,t) \leq \binom{s+t-2}{s-1}$

**Corollary 3.1.** Ramsey finds an independent set  $I$  and a clique  $C$  such that  $|I| \cdot |C| \geq \frac{1}{4}(\log n)^2$ .

**Wheels**

A wheel, denoted by  $W_{p,q}$ , is a graph that consists of an odd cycle of  $q \geq 3$  nodes, and  $p \geq 0$  spokes, which are nodes that connect to all other nodes in the graph. A wheel with  $p$  spokes is referred to as a  $p$ -wheel. The clique number of an  $p$ -wheel is  $p+2$  (except when  $q=3$ ), whereas the chromatic number is  $p+3$ .

Note that if a graph does not contain a  $p$ -wheel, then its neighborhood graph cannot contain a  $(p-1)$ -wheel nor can its non-neighborhood graph contain a  $p$ -wheel. Hence we obtain the same recursive relationship as in Ramsey algorithm. Only the base case is different; we capitalize on the fact that coloring a bipartite graph is easily solvable in linear time.

**WheelFreeRamsey (G)**

```

begin
  if (G is bipartite) then return ( $\Phi$ , the larger color set)
  choose some  $v \in G$ 
  ( $W_1, I_1$ )  $\leftarrow$  WheelFreeRamsey ( $N(v)$ )
  ( $W_2, I_2$ )  $\leftarrow$  WheelFreeRamsey ( $\overline{N}(v)$ )
  return (larger of ( $W_1 \cup \{v\}$ ,  $W_2$ ), larger of ( $I_1, I_2 \cup \{v\}$ ))
end.
```

Fig. 3.2 Algorithm 3.2 : Ramsey algorithm for wheels

Define  $R(W_p, K_t)$  to be the minimal  $n$  such that all graphs of order  $n$  contain some  $p$ -wheel or an independent set of size  $t$ . We find that

$R(W_p, K_t) \leq R(W_{p-1}, K_t) + R(W_p, K_{t-1})$   
 and  $R(W_0, K_t) = 2t-1$  and  $R(W_p, K_2) = p+3$ .

An inductive argument shows that  $R(W_p, K_t) \leq 2 \binom{p+t}{t-1}$ , only a factor of two from the upper bound of the regular Ramsey function.

Given a graph with no  $(k-2)$ -wheels, WheelFreeRamsey finds an independent set of size at least  $\Omega(kn^{1/(k-1)})$ . By applying a version of algorithm 3.3 that utilizes WheelFreeRamsey, we can color a graph without  $(k-2)$ -wheels using  $O(n^{(k-2)/(k-1)} / k)$  colors.

Algorithm 3.2 is strongly related to Wigderson's [3] coloring algorithm. By considering the whole uncolored portion of the graph in each iteration, instead of fully coloring the pivot nodes' neighborhoods before coloring their non-neighbors, WheelFreeRamsey improves the approximation by a factor of  $k$ . Also, by focusing alternately on neighborhoods and non-neighborhoods, another factor of  $k$  is gained. Wigderson's method, however, has the advantage of  $O(\chi(G)(n+m))$  time complexity, compared to the  $O(\text{COLORS}(n+m))$  complexity of our method. Compared with the graph coloring algorithm deduced from the Ramsey algorithm for clique-free graphs, this algorithm improves the exponent from  $\frac{k-1}{k}$  to  $\frac{k-2}{k-1}$ .

We are led to a simple method:  
 Remove a maximal set of disjoint  $k$ -cliques from  $G$ , for some constant  $k$ .  
 Apply Ramsey to the remaining graph.  
 The first concern is whether anything will be left of the graph once we have



removed all vertices in disjoint  $k$ -cliques. For an arbitrary graph, no, but if the graph contains a large enough independent set, the remaining graph will be sizable. A key observation is that a clique and an independent set can share no more than a single vertex. If the independence number of the graph is at least  $(1/k + \epsilon)n$  for some constant  $\epsilon > 0$ , then at least a fraction  $\epsilon / (1 - \frac{1}{k})$  of the vertices remain.

CliqueRemoval repeatedly calls Ramsey and removes the clique found until the graph is exhausted. It then returns the largest of the independent sets found along with the sequence of cliques found. Since that collection is a partition of the vertex set into cliques, it forms an approximation to the CLIQUE COVER problem. If the algorithm is applied to the complement of the graph, we obtain approximations to the CLIQUE and the GRAPH COLORING problems.

We can now prove tight bounds on the sizes of the approximations.

```

CliqueRemoval (G)
begin
  i ← 1
  (Ci, Ii) ← Ramsey (G)
  while G ≠ ∅ do
    G ← G - Ci
    i ← i + 1
    (Ci, Ii) ← Ramsey (G)
  od
  return (( maxj=1i Ij), {C1, C2, ..., Ci})
end.
    
```

Fig. 3.3 Algorithm 3.3: Algorithm for approximating independent sets

#### 4. CONCLUSIONS

We have seen that if the graph contains no large cliques, then Ramsey performs quite well. Unfortunately, if that precondition does not hold, we cannot make any statement about its performance. If we could somehow get rid

of these large cliques, we could do well on the remaining graph.

The pervasive problem is resolving the question of the approximability of GRAPH COLORING and INDEPENDENT SET.

It is highly unlikely that the performance guarantees we have given will remain the best possible. Not much more may be needed to knock off some logarithmic or doubly logarithmic factors. All the algorithms given run in time with a low polynomial, and a proper analysis of the more "heavy duty" methods, such as local search, is bound to yield some improvement. Randomization may also be another source of improvements.

*Conjecture 1.* GRAPH COLORING is  $\Omega(n / \text{poly log})$  approximable.

Since INDEPENDENT SET is strictly harder to approximate than GRAPH COLORING, the conjecture applies to it as well, but it is an interesting question if their approximabilities differ asymptotically.

#### 5. ACKNOWLEDGMENTS

As the pinnacle of my education, this thesis is distilled from the input and advice of great many teachers. I can name only a few, perhaps the most pronounced.

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From University of Constanta: prof. univ. dr. ZAHARESCU.

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## **THE ANALYSE OF A SYSTEM OBJECT**

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System object by means structure (organization) or the system that defines a relational structure. Analysis of an object includes:

- knowledge of structural and functional organization;
- flow dynamics and activities;
- the flow of information that characterizes the system.

Any system is characterized by the existence of three subsystems: management, execution and information.

Information system is the body organs, which generate, transmit and process information, methods, techniques, processes, procedures, languages and means that are used in a uniform design to provide the necessary information of the management and the execution. This is determined by the organizational structure of the system and its features are three elements: information flow, information flow and network information.

In the system there is always an information processing system, which can be manually, mechanically or automatically combined. When the processing is defined by the use of computers are told that we are dealing with a system. In this idea, designing a computer system involves the analysis and design of information system based on technical computing and information technology. Study and analysis of information system of an object's main objective is the establishment of information management, needs of the reaction system and develop proposals to achieve a system.

Can start, so the assumption that existing

information is denied aprile realities timing and / or existing information technology. In this situation it is considered that the existing system has sufficient information to the minimum needs of the management, they are not judiciously distributed to carriers of information on the decision and it is necessary to streamline information flows and how judicious processing an increased volume of information . Old information feeds, documents, used by taking their information content and will be the parameters on which to start the new system. Knowing precisely the regulatory framework governing the object allows the system to determine "free zone" on which to act. Activities in this phase (study and analysis of information system) can be grouped as follows:

- Study the existing system;
- Analyzing and evaluating the existing system;
- Defining the directions of improvement of the current system.

Analysis of the existing system  
Conduct analysis phase involves the establishment of a specialized team that includes decision makers, good knowledge of the object, analysts and staff informaticieni, the stage is set and the precise definition of the problem. Analysis of the existing system lies in the performance evaluation, the existing information system limits in terms of the management system and evaluate the degree of preparation for the introduction of economic structure system.

Performance and limitations of the existing system the following main aspects:

- defining the general characteristics of the system object:
    - Profile and tasks (objectives) of object;
    - The place and its role in the economic system;
    - Reports on the vertical and horizontal with other supraordinate, subordinate or parallel;
    - Key indicators and analytical system;
    - The perspective of time.
  - activities of the system and how to implement the functions for which it was created:
    - Analysis of orders, provisions, rules of organization and functioning of the internal and the general activity normative system;
    - The organization of the unit, the functional structure of peace in a situation of crisis or war;
    - The insurance resources, their quality and how to use them;
  - existing information system:
    - The causal information-decision;
    - The system of management;
    - The volume of information, the processing time to react.
- Performance and limitations of the existing system is based on the following criteria:
- The extent to which the information system ensures the achievement of the objectives, functions and performance of basic tasks of the structure and attributes of leadership;
  - The insurance information necessary and sufficient leadership at various levels, functional compartments;
  - Efficiency in collecting and transmitting information and data which characterize the response of the information system;
  - Quality of information obtained from processing, considered in terms of expression and accuracy in terms of flexibility;
  - Quality and safety information links, information flows;
  - Information system can refer to trends in the evolution of business structure in question;
  - Possibilities for control and making corrections, the response to the occurrence of external events, the possibilities for the timely correction of irregularities;
  - The integration of information system, both in terms of reducing redundant information,

compatibility information output to the input of data organization and in terms of ensuring an appropriate organizational framework;

- The automation of operations for the gathering, transmission, processing and query data intensive recovery information obtained from processing, personnel training and information system for processing etc..

Assessment training unit for economic planning and implementation system includes:

- Setting the level of staff training and experience in automatic data processing;
- The existence of technological disciplines;
- The existence of appropriate organizational framework;
- The fund of data necessary for system etc..

Critical analysis aimed at the organization and operation of information system and seeks to identify negative aspects, to capture the reasons generating "disturbance" of the system and ultimately to negative aspects systematized by grouping them in critical points. An important place it occupies in the analysis data analysis and review procedures.

### 3. Techniques used in the study, analysis and representation of information systems

Analysis of information system is in general focused on the object, the techniques used are generally common with the systemic analysis techniques.

When an analysis is necessary overall project development of system logic, analytical techniques generally fall into the methods of approach downward.

When you make a detailed analysis to develop the project's technical system, analytical techniques are covered in general methods of ascending and descending approach.

Among the techniques used to study and analyze the existing system include: direct observation, interview, questionnaire, diagnostic analysis, cell analysis, analysis of the consistency of entries and exits; HIBO; tables Decision Analysis OP (Study Organization Plan), dot-matrix information models.

Direct observation is used as a method for collecting information on the history of the object changes over time to its development of basic indicators, organizational, înzestrării, activities and tasks to be performed by the system. By this technique to record the type of operations performed, results, execution time, efficiency of information system existing processing techniques used, the compartments and personnel documents in circulation. If objectives are clearly defined, then by applying this technique to obtain the real and objective conclusions on the analysis. It is based on the use of specific instruments of work: surveys, timing, analysis of work through the volume and importance of place. Interview is a technique in widespread use for collecting information from the information system. Users of this technique are generally analysts who are not familiar with the unit and studied its problems. Not a very rigorous technical advantages that allow a lot of creative freedom in the analyst's construction and deployment. Has the disadvantage that this technique is not a critical review of the existing information system.

The questionnaire is very much used by analysts as the beginning and the advanced, or not familiar with the information unit. Using his disappearing "information filter" which is the analyst, and who can provide information to focus better on the replies. Using this technique, involved a large number of information providers. Limits questionnaire is that it is a technical verification of prior knowledge, which involves prior knowledge of the field. Questionnaire also has a wide range of use. Diagnostic analysis used in this stage allows controlling and evaluating the performance of the information system, identification and localization of negative phenomena and cause their occurrence and finding solutions for their effective functioning. Everyone who uses this technique should be largely familiar problems investigated. Consists of monitoring and

evaluation of the performance management system and led the identification and localization of the negative aspects of their case occurrence, and develop recommendations designed to permit efficient operation of the system. Proceeding involves the following steps:

- gathering information about the object;
- systematic collection of information;
- Evaluate operation of the existing system;
- report analysis.

The advantage lies in the method that highlights critical issues grouped by "critical points" and allow the orientation analysis in the following steps to implement the system.

Cell analysis is a technique used in the method of approach of the object downward, both the departments and activities. It is done automatically by GIS software package (Image Generator System). The concepts used in this technique are the General Systems Theory and the Theory Analysis Celulare. System management is considered as a cybernetic system composed of connected elements and the environment. Each element can be considered a system that can independently analyze, and therefore split into other elements. Each element is associated with a cellular structure. The base of such structures is the cell, ie on the last level of aggregation, which can not be divided. Each component is associated rank. The cell has rank zero. A cell is described by entries; operators. If you exit the cell entry for another cell then form a chain. Two or more chains of cells that have at least a common form of a tree cell. Two or more trees in series, parallel or form a joint structure. In the hierarchy of components of information system by applying this technique to be used:

- operanzi primary - the primary data entry;
- I operanzi generation - are obtained by transforming the primary.

In this technique can work with one of the concepts of structure:

- Oriented organization - a description of the organizational structure through decomposition (economic unit-compartment-post);
- Oriented activity - describe the structure of

functional (task-based activity-task-procedure). The purpose of this technique is to determine and analyze the cellular structures. It provides a complete and detailed coverage of object. Consistency entry is a technique that is used both in analysis and design. It starts from the information fundamental decisions. On the basis of their primary causes of many information system. In the analysis can go from the functions and powers of decision-makers at various levels of management. Based on these functions can be identified by the decision. Based on the identified decisions is determined the information out of the information system needed fundamental those decisions. In terms of complexity, this information may be viewed as a reunion of three submulțimi ED, EC and EP where: ED - output derived information, ie information that is obtained based on an algorithm (model) for calculation of two or more input; EC - information for aggregate output, ie information that is obtained by aggregation to a certain level of aggregation of a single information; EP - information output, which are identical with data entry. Using this information out, fundamental necessary decisions, using a scale analysis of the consistency of output and input can cause information input into the system. On top of all the many EP are listed in the dictionary entry information, they are not passed through the process. For the other two groups achieving consistency is descompunând each information output based on algorithms or model calculations. Next, check whether the information underlying obtain their information included in the dictionary entry. If not found, pass in the dictionary. Simultaneously, it retains the model, algorithm or formula for calculating underlying obtaining final information. This method of determining the input information based on the output is very useful for complex systems vehiculează more. It is easy to apply and also allows identification of not only information input but also the

procedures or operations of these procedures. Also it allows the grouping of information and elimination of redundant. Analysis approach can be made from the entries and exits to reach the information system. This approach involves identifying all information in the primary system and the logical links between them. Knowing the inputs can identify different types of output required fundamental decisions.

This approach has the disadvantage that it is not possible the evidence of links between all the existing primary system, which at one time that it creates difficulty to obtain certain data output. Technical hypo Hierarchical Input-Process-Output). Being subject to downward method (TOP-DOWN), hypo is designed to address hierarchical system describing the flow of information seeking entry-PROCESSING-EXIT.

With this technique, a complex system can be logically decompose into simple elements, achieving it in the end the following components: the structure of functional information system, the flow of entries on each hierarchical level, the processes on each hierarchical level, the flow exits on each hierarchical level.

Analysis and design of technical systems using hypo is materialized in the development of documentation consists of 3 parts: general hypo, hypo detail; hypo maintenance. Hypo-General contains general description of the structure function of the system and underlying design and communication within the team to design the system. In preparation, hypo-General receives a name that will find and hypo detail.

Hypo detail is based on hypo-General, as a detail in depth, the components of the product information to pseudocod level, thus ensuring an overall and detailed structure of all files / entities / relations used. Hypo maintenance documentation is corrected and supplemented by testing and implementing the system. This underpins the operation of the system and will be complemented and

developed throughout its life. Each of the three hypo documentation must contain three components: a table of contents, a general chart, a chart for details.

Table of contents includes the decomposition of the hierarchical levels, reflected by the hierarchical structure of functional connections between components. Hierarchical decomposition must comply with the basic concept of this technique (input-PROCESSING-out) and an association for each decomposed level of at least one diagram overall. Prepare tables of content require the following rules:

- specifying the requirements of users (recipients of information);
- to draw up the list the major functions that meet the requirements specified;
- Analysis of major functions and grouping is done according to the logic established by the designer;
- each major function will decompose the hierarchical levels to elementary functions. Through symbolic representation scheme of service is established on hierarchical levels. The chart reflects the overall system's major functions, including graphical representation of the flow input-processing-output of these functions in detail steps of achievement. To obtain such lists of possible major entry-PROCESSING - Out, which are then analyzed, sorted and correlated so as to obtain separate streams each major function.

Diagram contains detailed analytical description of each major function of the general decomposition chart until the final level to obtain all information concerning the flow ENTRY - processing-output relations and the last stream of the last level of detail. In applying the technique hypo respectively for the preparation of documentation, the one set of rules of which we mention:

- determine all the processes needed to achieve a particular function;
- the orders are processed in terms of logical sequence;

- to produce lists of entries and exits required processing set out above, and orders are correlated with outputs between entries;
- describe the scheme all the links between entry-PROCESSING - exit;
- each entry point - will set out exactly and will receive a designation;
- Each chart will indicate which is the same box with the appropriate function from the table of content;
- when a chart is deleted, after checking and testing, to verify if that is not involving changes in the upper levels or lower in order to correct the chain;
- if the implications of changes affecting the original design of the system, then waive these changes or try another solution;
- if a function is diffuse (retrieval is more subfuncții), this rule is not deleted;
- if you deleted a chart for a basic function, it will ensure that processes are absolutely necessary, be taken to the processing of the immediately higher level, so as not to affect the proper functioning of the system.

Technical tables decision departing from the concept of decision table. A decision table is a two-dimensional table with double entry.

The entry-CONDITIONS - a two-dimensional table  $N * K$  in which write various logical values (AJK) conditions. The entry-ACTIONS - a two-dimensional table  $M * K$  in which different values are written with boolean meaning "action  $a_j$  is running or not running the  $a_j$ . In a rule, but the actions and  $a_j$  can be linked together by logical operators "AND" or "OR". So the significance of a rule  $R_k$  is as follows:  $R_k / \text{IF } c_1 \text{ and } c_2 \dots c_n \text{ and THEN } A_1 \text{ and } A_2 \text{ and } \dots \text{ and } A_n$ .  $R_k$  rules are linked together by logical operator "OR EXCLUSIVE. This means that only one rule will express a particular case of a problem. If there is a set of entries that satisfy simultaneously two rules, they are additive.

Otherwise they are independent. If the input sets and actions are identical for two or more rules, then they are redundant. If the input sets and actions are different for two or more rules, they are contradictory. Maximum possible number of distinct rules of decision tables is determined by the formula:

$$K = \prod_{i=1}^n v_i$$

where:

N - number of conditions;  
 Vi - the number of possible entries for a condition Ci.

If a decision table contains all possible rules, the table entry is complete. If not defined all the rules, those missing may be formed in a single rule (the "ELSE"). Depending on the values of logical conditions (input-output) and the Boolean operations (input-output) tables are classified in the decision:

- Tables of limited entry decision;
- Tables of extended-entry decision;
- Decision tables with mixed inputs.

If all the "inputs-conditions" (Vi, i = 1, N) are two (proper condition, false condition), and "entry-actions" to have one of "x" or "b", then the table is called table decision with limited entries (restricted).

If there is at least one condition, but with more than two values of "entry" of this condition, then the table is called decision table entries extended (multiple).

An extended entry table may be represented as a table with limited conditions by increasing the number of conditions.

In a decision table with extensive input conditions and actions are not fully defined in the descriptions. To complete the definition of their required information from the entries.

If in a table so there is limited entry type and entry type of extended table called decision table entries mixed.

Tables of mixed entry decision may be transformed into decision tables with entries limited by general procedures. Depending on the type of relationship that can

exist between different tables differentiate:

- Decision tables open;
- Decision tables closed.

Often a problem can not be represented in a single table because of the large number of rules, conditions and actions. In this case, the problem, if possible, be divided into several subprobleme to be represented separately by each table a decision. These tables are linked through a stream of instructions achieved by concatenation and the identification of each table.

Is called decision table open when the last action for "okay" which is reference to another table is GO TO TAB-n.

Instruction GO TO TAB-n is an unconditional jump instruction, without returning.

Is called decision table closed if there is a "DO TAB-n" through which a table by calling the implementation to the next.

Theory of decision tables can be used for synthetic playing and finding the best solutions of all problems in the process of achieving the system because they provide a description logic, full of all intelligible rules, conditions, actions that appear. However, in practice they are used only when there is certainty that they will achieve good results through their application.

In the process of decomposition and analysis of complex information problems as the decision tables need more tables connected by links of the "GO TO" and "DO". This decomposition should lead to:

- Subprobleme size limited;
- Avoid or minimize repetition conditions and actions;
- Sufficient syntactic features of input.

In applying the technique of decomposition is departing from a scale information processing or decision.

Information grid or grid decision reflects a problem and contain the information input, the output and how to obtain information out of the entrance.

This grid enables finding groups of conditions and actions of a decision to have a weak link

between them. It does not necessarily involve a precise description of entries, but only if there is a marked logical connection between actions and conditions. Building scale is at the stage of analyzing the problem information. In the next step is analyzing key information in order decomposition and transformation into tables (subtable) decision.

For analysis and decomposition starts with the first action, which determines the conditions. Proceed like the following while checking if the many conditions necessary to change them or not, in conclusion we aim to build a group of actions with the same number of conditions. The analysis ends when all actions are separated into distinct groups. Result will be achieved by decision tables grouping all actions with the same number of conditions. To specify these tables is also needed to determine what kind of logical links between actions and conditions. The tables are built first listând conditions and actions in the decision table and filling first "entry-conditions" and "entry-actions" specified in the time scale information. The next step is to specify transfers from one table to another according to decision logic indicated by the scale information.

Finally, rules can be combined or eliminated if the conditions are related nerecursive. If the results tables conditions are repeated, due to complicated relations between conditions and actions, then they should be minimized. Grid provides information for each decision situation more decision rules. Unlike the grid, the table provides a single decision rule of decision for each situation of decision making in this way the appropriate instrument of communication, meaning that to find the actions that should be executed, the time needed is small.

The table allows decision to be taken into account information on combinations of conditions, ie for example, to specify that a specific condition not be considered if another condition was satisfied. However it is not possible to verify the completeness of key decision. As grid information describing the

relationship between each and every action, it does not permit consideration of information on combinations of conditions. These advantages they offer table make her decision can not be replaced in the grid information. However, in certain phases of systems design, information design is useful because:

- Decision-making logic presented in a compact form;

- Information design presents the relationship between each and every condition, unlike the decision tables which determine the relationship type conditions M N shares; In carrying out systems is necessary in most cases be summarized data or possible alternatives. To this end an important role is the decision tables. An important phase in building the tables of decision in these situations is the clustering results of the analysis, design, etc.. The rules of decision. This can be done and Heuristic, but in this case the activity can lead to: incomplete crowd, many conditions that have common or contradictory actions.

It is necessary to use techniques to synthesize, so that decision rules obtained to participate in decision tables necontradictorii and without ambiguity. Such a technique is that proposed by Cheng and Rabin.

To facilitate understanding and application of these techniques give the following concepts:

- It's called SET OF DECISION RULES many rules of decision that are not necessarily part of a complete decision table;
- Se numește SET DE CONDIȚII mulțimea condițiilor ce apar într-un set de reguli de decizie;
- Se numește condiție semnificativă acea condiție care apare într-un set de reguli de decizie și are ca intrări D sau N, în caz contrar condiția se numește ne semnificativă;
- Se numește SET DE CONDIȚII COMUNE mulțimea de condiții comune tuturor regulilor dintr-un set de reguli de decizie. Reuniunea a două seturi de reguli de decizie este un nou set de reguli. Ea se poate realiza când



cele două mulțimi au același set de condiții și ambele acțiuni sunt complet descrise. Setul de reguli rezultat are toate regulile și acțiunile regulilor de decizie inițiale. Succesiunea acțiunilor în setul de reguli rezultat nu este definită.

Tehnica constă într-un proces de sinteză a oricăror două SETURI DE REGULI DE DECIZIE care are un SET COMUN DE CONDIȚII. Setul obținut din punct de vedere logic este echivalent cu cele două seturi date inițial. În el toate acțiunile specificate separat sunt reguli de decizie comune. Algoritmii de parcurgere a acestor tehnici cuprind următorii pași:

- Pasul 1. Se duplică intrările cu "-" ale setului comun de condiții;
- Pasul 2. Se dezvoltă ambele SETURI DE REGULI de decizie pentru a include toate condițiile din reuniunea setului lor de condiții;
- Pasul 3. Se particularizează setul de reguli de decizie în subseturi de condiții semnificative comune;
- Pasul 4. Dezvoltăm subseturile de perechi prin reuniunea acțiunilor.

4. Tehnici de reprezentare. Pentru sistematizarea informațiilor în urma studiului și analizei sistemului existent se utilizează așa-numitele tehnici de reprezentare. De fapt, ele pot fi utilizate în toate etapele de realizare a sistemelor informatice.

Dintre aceste tehnici enumerăm:

- schemele organizatorice;
- schemele de sistem;
- schemele logice;
- schemele de configurație;
- tehnica diagramelor orizontale;
- tehnica diagramelor verticale;
- grilele informaționale (modele informaționale);
- tabelele de decizie;
- documentația HIPO;
- schemele de prelucrare;
- schemele bloc.

Schemele organizatorice (organigrame) reprezintă structura organizatorică, funcțională a

unei structuri economice. Simbolurile utilizate în construirea organismelor sunt standardizate, astfel:

- Serviciu funcțional / secție / compartiment  
nivel de conducere;

- Relație de subordonare;  
Printr-o organigramă se pun în evidență, nivelul de conducere, structurile funcționale sau compartimentele și modul de subordonare. Pot fi puse în evidență, de asemenea, tipurile de decizii la nivelul fiecărui factor de decizie. În cazul unei aplicații informatice poate fi delimitată structura organizatorică pe care este grefată aplicația informațională.

Se utilizează analiza sistemelor informaționale și în prezentarea sistemului informatic. În organigramă pot apărea structuri specializate care se ocupă cu informatica în cadrul unității respective.

Prin schemele de sistem se descriu purtătorii de informații, legătura dintre ei, fluxul circulației informației între purtători. Schemele de sistem se utilizează în etapa de analiză, concepere proiectare tehnică, elaborarea programelor. Prin intermediul lor se pun în evidență intrările, ieșirile și prelucrările fără a intra în detaliu. Procedura de prelucrare poate fi detaliată ulterior. Ele constituie o parte componentă a documentației sistemelor informatice. Se pot utiliza și pentru a pune în evidență, intrările, ieșirile pentru o aplicație informatică.

Schemele logice descriu cu un înalt grad de detaliere algoritmul de rezolvare a unei probleme, constituie un mod grafic, convențional de reprezentare al unui algoritm. O alternativă a utilizării schemelor logice clasice este utilizarea diagramelor de structură sau a altor forme echivalente. Schemele de configurație descriu unitățile fizice care fac parte dintr-un sistem de prelucrare a datelor (sistem de calcul, rețea de calculatoare). Utilizând simbolurile prezentate la schemele de sistem împreună cu precizările referitoare la

unitățile, terminalele sau alți suportați de memorare și/sau prelucrare se pot realiza schemele de configurație. Iată câteva exemple de simboluri utilizate pentru configurarea unui sistem:

Scheme de prelucrare (diagramele globale de flux) descriu prelucrările în cadrul unui sistem informațional sau informatic. Sunt larg utilizate datorită simplității convențiilor de reprezentare și vizualizare a structurii și funcționării sistemului. Ele constituie un mod eficient de comunicare între specialiștii din domenii de activitate diferită. Este un instrument al cunoașterii ansamblului activităților desfășurate în sistem. Pentru aspecte de detaliu privind circuitul informațional ele sunt insuficiente în reflectarea legăturilor informaționale. Tehnica diagramelor de flux orizontal. Identificarea caracteristicilor sistemului de conducere necesită o analiză riguroasă a sistemului informațional. Pentru aceasta se poate apela la tehnica diagramelor orizontale de flux a documentelor

Tehnica diagramelor orizontale de flux se bazează pe următoarele convenții:

- un document se reprezintă pe o aceeași linie orizontală de la crearea sau apariția în circuit și până la arhivare sau distrugere;
- când un document este creat în mai multe exemplare atunci fluxul informațional se urmărește pentru fiecare exemplar în parte;
- pentru orice operație de completare a unui document trebuie să se precizeze documentul sau documentele pe care se bazează;
- operațiile se grupează pe compartimente în scopul reflectării conținutului activității desfășurate în fiecare compartiment și a legăturilor dintre compartimente.

Diagrama verticală de flux al documentelor. Principalele caracteristici ale diagramei sunt: fluxul documentului - se reprezintă de la apariție până la arhivare sau distrugere în aceeași coloană verticală; simbolurile reprezentare - pe același rând exprimă legăturile între documentele respective; scoate în evidență cu ușurință suprapunerile unor operații sau frecvență mărită a acestora (excesive).

Definirea direcțiilor de perfecționare a actualului sistem

Pe baza activităților de evaluare și analiză critică se identifică neajunsurile actualului sistem și se propun soluții de înlăturare a acestora. Se formulează variante de soluții, iar în cadrul acestora se definesc cerințele și restricțiile de realizare a sistemului informatic.

Definirea direcțiilor de perfecționare presupune:

- Specificarea obiectivelor și a performanțelor sistemului informatic;
  - Stabilirea domeniilor de probleme și a principalelor funcțiuni ale sistemului informatic;
  - Definirea cerințelor și restricțiilor informaționale pe domenii de probleme și funcțiuni care constă în:
    - definirea principalelor intrări/ieșiri;
    - definirea soluției de organizare a datelor;
    - definirea variantelor tehnologice de prelucrare;
    - definirea restricțiilor informaționale și de control.
  - Formularea condițiilor pentru realizarea sistemului informatic, care constă în:
    - specificarea termenelor și duratelor solicitate;
    - precizarea priorităților în realizarea obiectivelor sistemului informatic;
    - specificarea cerințelor speciale privind flexibilitatea, compatibilitatea cu alte sisteme, gradul de generalizare al sistemului.
- Pentru fiecare variantă de soluție informatică se procedează la:
- evaluarea resurselor necesare (costurile de sistem);
  - evaluarea efectelor economice directe și indirecte;
  - calculul indicatorilor de eficiență.
- Avizarea și alegerea variantei de sistem de către beneficiar pe baza indicatorilor de eficiență.

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## EDUCATION IN INFORMATION ERA

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### *Abstract*

*The premise of a paradigm change in the high-performance education system represents the starting point for my work - Education in The Information Age.*

*This paradigm change is about to take place and it views education as a process in which the beneficiaries are actively involved. As a result of such an approach to the education system, the latter is oriented towards the workforce demand and is no longer a provider of unemployed graduates.*

*In this respect, education is different from training. Consequently, its aim must become information processing so that information itself becomes a tool for formation and welfare.*

### 1. GENERAL CONSIDERATIONS

Quality of human resources is a factor of major importance for all nations in the present context. Intellectual capital begins to become more important than natural resources and financial capital in the ability of a country is competing in a globalized economy. This ability to generate, absorb and disseminate knowledge will be strong point of any company, people or nation. Innovations in information technology and telecommunications open new educational perspective. Constraints of time, distance, language, power and resources away more and more quickly. New models of teaching and learning are tested all over the world. Starting from debândirea some basic knowledge to advanced search, every effort is under the educational impact of new technologies. Each model already known educational practice, as they are known throughout the world, will be reviewed in light of influențatele performed by information technology. Masteranzii today must understand and master the tools if they wish to conduct business in full compliance with the requirements of the XXI century.

### 2. Distance learning

2.1. Distance learning  
In conditions of rapid technological change and different social conditions, the education system should provide increasing

opportunities for training in the absence of increases in the budget. Many educational institutions meet this challenge and develop programs of distance education. Distance learning is achieved when there is a physical distance between teacher and student, and information technology facilitates communication between the two.

2.2. Effectiveness of distance education  
We can ask if students in higher learning at a distance as much that those who attend a traditional education. Research carried out to compare distance learning with traditional education shows that efficiency is the same in both cases when the methods and technologies used are appropriate educational requirements, where students interact and the activities taking place at the front right time. The effective distance education based on careful planning and an understanding of course requirements and needs of learners. Only when these factors were taken into account can be selected appropriate technology. There is no secret that over the way in developing a distance education effectively.

To meet requirement of effectiveness, it must be under the influence of a sustained effort from individuals and organizations. In fact, programs of distance education that are successful are the result of constant efforts made by joint and students, faculty, teachers and administrative support staff.  
2.3. How does distance learning?

Distance learning has a wide range of technological options. These can be grouped into four categories:

- Audio - audio tools are interactive and consist of telephone, audio-conference and short-wave radio. There are passive audio tools such as tapes and radio.
- Video - video tools include stop-frame images such as slides are images stored video (eg movies, videos) and pictures in real time combined with audioconferințe.
- Data - computers send and receive information electronically. For this reason, the term "data" describes the wide range of educational tools.
- Listing - is the base from which all others have started transmission systems. There are different forms of listing: courses, study guides, books and case studies.

#### 2.4. Technology in transmitting information to remote

Although technology has a key role in transmitting information at a distance, those involved in the transmission of knowledge should take into consideration the results of this process. Focusing on the needs of learners, the requirements on content and teacher constraints exerted on the selection of transmission is a key element of distance education. Obviously, this systematic approach will result in a combined use of media that serve specific purposes. Starting from this approach, the teacher is to select carefully the technological options. The aim is to achieve a combination of media used in the educational process so that student needs are met efficiently and economically.

### 3. A STRATEGY FOR THE REMOTE ÎNVĂȚĂMÂNTULUI

3.1. What brings new distance learning Learners to share information, teachers rely on visual signals transmitted by the students. In a quick, for example, can see who is preoccupied with taking notes, who thinks deeply about a complex concept, or who are preparing to say something. The teacher becomes aware of such information, at both conscious and subconscious level, and accordingly adjust its course so that the audience needs in terms of a particular theme

are taken into consideration. Unlike the case presented above, the teacher involved in distance learning are handy little visual clues. Even those who are faced with are filtered through technological devices such as video monitors. It is difficult to have a discussion when frontal exciting spontaneity is marked by technical requirements and distance.

If you use a visual means to provide information in real time, the teacher does not have visual contact with at remote locations. Also, distance is an impediment in the feedback given by the teacher group.

#### 3.2. WWW system for use in distance learning

The WWW (World Wide Web) has transformed the Internet into a more suitable use in distance learning. The ability to insert graphics, text and sounds, even if the user is a novice, facilitates the learning process. In addition, organizations and individuals can create home-pages (personal pages) without help and can access other pages on the computer or other network. For teachers, the WWW provides a new and exciting opportunity to teach at a distance. This system can be used to create a page group destudenți giving information on time, exercises, discussion topics, bibliographic references and teacher biography. The latter may also give information on possible sources of documentation that can be accessed on the WWW. Other links facilitate access to library files or personal page of each student or student. In addition, through page personal participant in the process of open distance education can get in touch with other students using email.

#### 3.3. Ways to improve the planning and organization

Where are the development or adaptation of a system of distance learning, content remains largely unchanged, although there is a need for new strategies and time to get up. Here are some suggestions for planning and organizing a course at a distance:

- Investigation of research which took into account the distance learning when you start planning course;
- Reviewing the existing materials, analyzing the content and the presentation of these prior to coming with something new;
- Analyzing and identifying strengths and

weaknesses of the systems for transmitting information that are available, taking into account the ways in which this can be done and the students' needs and course requirements before selecting a group of IT means

training;  
- Practical activities are extremely important for both teachers and students, and therefore is required informal meeting to precede the course itself and to consider training in the use of IT and that the knowledge of the role and responsibilities incumbent staff maintenance thereof;

- Rules and standards are established at the beginning of the first course in an open discussion, once established, they must remain in force throughout the course;

- Equipment available to students must be operable, and to eliminate potential problems that can occur to provide a free line open at all times;

- Well before the start of a new theme to ensure receipt of ongoing support using the postal services;

- The course should start with a reasonable number of participants and sites.

3.4. Ways of evaluating students' needs  
A key requirement in improving the assimilation of information to students is to adapt quickly to conditions imposed by distance learning.

To better motivate students and to meet their needs, both in terms of content and specific methods of learning should be considered a system of transmitting information more flexible.

In this regard, several strategies for assessing students' needs may be:

- Students must be helped to acquire the technological ways of transmitting and receiving information, and also those aimed at resolving potential technical problems, the emphasis should be on solving common problems and avoid cramponării the occasional technical dificultăți;

- Mutual knowledge regarding the past and concerns of students and teachers is important;

- Different cultural styles of communication and should be accepted;

- Students must be active during the course and assume responsibility for results obtained from the effort.

#### **4. ROLE OF COMPUTER IN distance learning**

##### 4.1. General Considerations

Teachers face a growing development of computer networks and more improvements in processing power of PCs. Thus, new and interactive ways to help remove the disadvantages of distance and time, computers have become an important atuu distance education.

Computer applications in distance education system fall into four broad categories:

- Computer Aided (IAC) is to use the computer as a means of teaching characterized by self-sufficient; through it to reach the

the thematic courses with different educational goals which, although precisely defined, however, are limited. Among the different ways of IAC include activities such as problem solving, simulations and games, advice, exercises absorption of structures by repeating them ("drill and practice").

- Computer Managed Instruction (IGC) uses the ability of computer networking, storage and finding information in order to comply with the educational process of keeping the record of files and tracking the extent to which students have progressed. There is a need for education to be made via computer, although often IAC and educational component, is used together with the IGC.

- the Computer mediated communication (CMC) refers to computer applications that facilitate communication. E-mail and conference support through computer are just two illustrative examples in this regard.

- The Multimedia Application on the calculator is an area which in recent years has attracted the attention of those involved in providing distance education. Because of this interest is a generation of powerful computational tools, sophisticated and flexible that is still growing. The purpose of this field is to reach a system accessible only to distribute information from one place to the various technologies of audio, video and computational.

##### 4.2. The advantages of using computers

Computers facilitate the study. If, for

example, take the functioning of IAC see that the individualization of the learning process, ensure the resumption of computer concepts already presented and feedback. Computers are a multimedia tool. They can inter-relate with different technologies of graphics, audio, video, and for printing. Video technology and CD-ROM can be used in different situations of learning lessons and chapters. Computers are interactive. Microcomputational systems that include various software packages are highly flexible and maximizes control over the learners.

IT is has a high degree of development.

Innovations are constantly emerging, and their costs decrease. Understanding current and future requirements of its IT vendor to provide distance education to be oriented to cost effectively access the market for hardware and software that is constantly changing. The link between resources and individuals, regardless of geographic location, shall be made through local networks, regional and national.

#### 4.3. Limits the use of computer

Development costs of computer networks are large. Although personal computers are pretty cheap, and markets hardware and software is competitive, the development of networks and the purchase of educational software (by which the network to become functional) are still quite expensive.

Technology advances quickly, IT is developing so quickly that, in an attempt to keep pace with technological innovation of cutting-edge, distributor of distance education is only oriented to them, but they correspond to real needs, will change the times. There are still many people who do not know how to use computer or do not have access to it. Participants must be motivated and knows how to use the computer well before being involved in a distance course, which means that the basic operational computer.

### **5. Argument for and against the distance learning (ID)**

5.1. Advantages and disadvantages of distance education  
Participants in the ID utilize existing IT resources at a time (audio, video, multimedia

CD-ROM and e-mail) to connect with teachers, peers and their counselors. ID has become a popular option among adult learners because there is no need for meetings to follow a fixed program and offers the opportunity to complete a course in parallel with their regular program. However, despite this, it is recommended that those intending to follow courses at a distance to take into account all advantages and disadvantages of this educational system.

Advantages:

- Due to the rapid development of the Internet more and more students use the ID. Low cost, flexible schedules and independence from the geographical positioning are the reasons why students opt for adult ID. This study finds that online offers the opportunity to choose the place and time suitable for the study. Moreover, unlike traditional courses, distance courses offer participants the opportunity to move into a proper rhythm.
- While teachers are away, students can send an e-mail with questions and get answers to them just by one click of the mouse.
- Transmission of information remotely via the Internet presents many advantages. Some of these include: lower costs compared to satellite transmission, to facilitate updating and archiving possibilities, a time short compared to that required for video or CR-ROM.

- ID seems to be considered a key element of communication education in current society. As Lisa says Petrillo, from San Diego Union - Tribune: "It is estimated that 5 million people in the U.S. have the technology needed to connect to Sdn (Satellite Dish Network), and those charged with the education system are satisfied that future would ID. ID shows the advantage of being cheaper and maiușor for students who have physical or financial opportunities to participate lacursurile traditional type. One of the biggest advantages offered by the ID is the possibility of giving the same attention to requests from the community, education, employment, and not least, family.

Disadvantages:

- ID is different from the traditional. Due to the rapid development of IT some teachers feel threatened. They feel that the education system required to convert the "information authority" to "facilitators". Other issues raised

by the time they must spend it to meet the students and the brevity which must show the explanations offered by electronic mail.

- The need for participants to know the ID, if not, learn how to enroll in courses, how to use the registration forms and passwords, how to surf the Internet and how to participate in discussions with other participants are in a another disadvantage.
- The complexity of IT stakeholders may raise problems. Weight to access Internet or temporary inability to use the network because of some defects or due supraaglomerării prevents these students not able to complete projects on time.
- The large number of participants also raised issues. Involving more teachers can be a solution.

### CONCLUSIONS

ID problems all participants. Possible solutions to solve them are developing jointly by teachers and learners of objectives, good communication between students, analysis of results; examples to help students understand the information received; autoaprecierii encouraging, an objective analysis of results and evaluation similar information. With the challenges and opportunities that they generate, ID is a modern way by which information can function as an instrument of human well-being and becoming.

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## BROWNIAN MOVEMENT USED IN DEMOGRAPHY

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**Abstract:** *The paper presents some results of Markov theoretical process for the finite element method, revealing some elements of the quasi-stationary distributions, for general spaces respectively finite of the states. The main idea consists of the presentation of the connections between asymptotical finite rates for Markov processes and invariable functions.*

*The convergence to the quasi-stationary distributions and the finite rates of mortality can not be guaranteed for an absolute generalization, the complete results being given when Markov processes are diffusions especially one dimensional.*

*In the present paper there are characterized the hazard rates that can be obtained from the constant differential pattern, varying the initial distribution. In nature there are not enough elements to show us a direction to the appropriate initial state, therefore the non defining of the initial distribution transforms a lot in order to give shape to a mortality rate in the used patterns.*

The present paper presents some results of Markov theoretical process for the finite element method. By "finite element" Markov means a process which is "abolished" at a random moment, according to the Markov process behavior.

The demonstration of the Markov process nature is relatively simple because the complex current state is randomly made so that it comprises memory factors which influence the future moments of the process. Markov models with simple state spaces represent a "living value".

Markov process state is influenced by: the aleatory movement which tends to spread mass and move it towards chosen directions, and death which abolishes the mass at every point, at a fixed period.

There are distributions of mass, whose forms are stable, so that their levels should drop proportionally to each location; therefore mass is concentrated on locations with lower mortality rates, so that mortality and birth remain in balance. Sometimes it can be proven that no matter where the process starts, if waited for a time, the distribution of the surviving individuals will come close to a quasi stationary

distribution, and mortality rate will get close to the average mortality rate within this distribution.

A mortality rate begins to rise ,not because it was chosen an exceptional subpopulation (to fulfill certain conditions),but because the survivors' conditions are reflected in the surviving beings, even if they started at the same time with all the others.

### 1. Spaces of finite states.

An organism has two possible states: healthy and ill. It can be said that healthy individuals could remain healthy or get ill and ill individuals could stay ill or could get well or could die. The rate of healthy individuals who get ill is  $\alpha$ , the rate of ill individuals who get well is  $\beta$  and the demise rate is  $\delta$ . The described Markov process is represented by a matrix  $Q$ , having the entrances  $q_{ij}$  where  $q_{ij}$  represents the rate at which a developing process passes at state  $j$ , with the observation that  $\sum_j q_{ij} = 0$ , for each line.

$$Q = \begin{pmatrix} -\alpha & \alpha & 0 \\ \beta & -\beta - \delta & \delta \\ 0 & 0 & 0 \end{pmatrix}$$

(1)

Observation: you can work with the submarkov transitional matrix:

$$Q = \begin{pmatrix} -\alpha & \alpha \\ \beta & -\beta - \delta \end{pmatrix} \quad (2)$$

which has the characteristic equation:

$$\det(Q - \lambda I_2) = 0$$

(2')

whose roots are:

$$r_{1,2} = \frac{-(\alpha + \beta + \delta)}{2} \pm \sqrt{\frac{(\alpha + \beta + \delta)^2}{4} - \alpha\delta}$$

(2'')

Solutions  $r_1, r_2$  are real and negative because  $S = r_1 + r_2 < 0$ ,  $P = r_1 \cdot r_2 > 0$ ,  $\Delta_r > 0$ .

The biggest among them represent the mortality rate.

If the initial distribution is  $(p_h, p_s)$ ; where  $h$  – healthy,  $s$  – ill, then the distribution in time  $t$  will be  $(p_h, p_s)\exp(tQ)$ .

This healthy-ill distribution, which is the same with the multitude of possibilities, corresponds to a quasi stationary distribution.

A pattern of discrete space can be represented by an organism as an ensemble of independent elements and  $K$  independent elements generate an “organ system”. A system is considered failed when all elements have failed, but the organism dies when each of its organs fail.

Failure times of the components are independent aleatory with expectancies  $1/\lambda$ , where  $\lambda$  is a time constant.

The pattern represents a Markov process with state space made of  $k$  full nonnegative.

When the process is at state  $(i_1, i_2, \dots, i_r, \dots, i_k)$  with all  $i_j$  positive, the rate of the transition from state  $(i_1, i_2, \dots, i_{r-1}, \dots, i_k)$  is  $i_r \lambda$ , for any  $1 \leq r \leq k$ .

Note  $T$  time of death and  $t$  time when the component  $i$  reaches first the value 0 and  $T = \min T_i$ , where  $T_i$  represents the sum of some exponential expectancy times with the rates  $\lambda, 2\lambda, \dots, x_i \lambda$ , where  $x_i$  represents the initial number of elements from system  $i$ .  $T_i$  has the same distribution as its maximum  $x_i$ , exponential expectancy times independent from rate  $\lambda$ , so that:

$$P\{T_i > t\} = 1 - (1 - e^{-\lambda t})^{x_i} \quad (3)$$

This gives the distribution:

$$P\{T_i > t\} = \prod_{i=1}^k [1 - (1 - e^{-\lambda t})^{x_i}] \quad (4)$$

Hazard rate is given by the logarithmical derivative in time  $t$ .

$$\begin{aligned} h(t) &= \sum_{i=1}^k \frac{\lambda e^{-\lambda t} x_i (1 - e^{-\lambda t})^{x_i - 1}}{1 - (1 - e^{-\lambda t})^{x_i - 1}} = \\ &= kx \frac{\lambda e^{-\lambda t} (1 - e^{-\lambda t})^{x-1}}{1 - (1 - e^{-\lambda t})^{x-1}} \end{aligned} \quad (5)$$

when all  $x_i, i = \overline{1, k}$  have the same value  $x$ .

$$\text{Therefore } \lim_{t \rightarrow \infty} h(t) = k\lambda.$$

This can be interpreted as a quasi stationary distribution. Conditioning a single system given surviving until time  $t$ , when  $t$  becomes very big, the number of the components surviving in the system converges to 1. The systems being independent, the distribution of total state converges to a whole having the form of  $(1, 1, \dots, 1)$  state in which all systems have a single surviving component. Thus we can assert that hazard rate is  $k\lambda$ .

The mathematical pattern which succeeds in reproducing the traits of a process met in real life is considered correct. Mathematical patterns are sometimes too vague and leave the possibility of the arbitrary interpretation of parameters, offering a lot of significance to the resulted mortality distributions.

Mathematically it has been tried to deduce a formula, but during a certain period of life cycle and this allows arbitrary definitions for “t small” or “t big”.

The freedom to choose an initial distribution can create the impression of a pattern of empirical facts.

The initiators of parallel series have derived the hazard rates. For  $t$  which are small compared to  $1/\lambda$  that is the times when a typical component should work – so that we have the approximation of prime order in  $\lambda t$ .

$$h(t) = \sum_{i=1}^k x_i \lambda^{x_i} t^{x_i-1} = kx\lambda^x t^{x-1} \quad (6)$$

when all  $x_i$  have the same value  $x$ .

But

$$\begin{aligned} h(t) &= k \sum_{x=1}^{\infty} \frac{e^{-\mu} \mu^x}{x!} e^{\lambda x t^{x-1}} = \\ &= \sum_{x=1}^{\infty} \frac{(\mu \lambda t)^{x-1}}{(x-1)!} = e^{\mu \lambda t} = \\ &= k \lambda \mu e^{\mu(\lambda t - 1)} \end{aligned} \quad (7)$$

(which is the hazard rate).

This depends on two errors: The approximation which gives the Weibull hazard rate, is precise and close to  $t = 0$ , while the asymptote is relevant only for big  $t$ . For intermediary values the hazard rate for this pattern isn't similar to the Weibull approximation for the other curves.

A o hazard rate is  $h(t) = -F'(t) / F(t)$ ,

where  $F(t) = P\{T > t\}$

If  $F(t)$  depends on an aleatory variable  $X$  the number of functional components in a system with  $P\{T > t / X = x\} = F_x(t)$  and  $P\{X = x\} = p_x$ , then:

$$F(t) = \sum_x p_x F_x(t). \quad (8)$$

In this case the hazard rate is:

$$h(t) = - \frac{\sum_x p_x F'_x(t)}{\sum_x p_x F_x(t)} \quad (9)$$

Knowing that  $h(t) = \sum_{i=1}^k x_i \lambda^{x_i} t^{x_i-1}$  and

using Poisson distribution, we obtain that:

$$\frac{k}{1-e^{-\mu}} \sum_{x=1}^{\infty} \frac{e^{-\mu} \mu^x}{x!} x \lambda (\lambda t)^{x-1} = \frac{k \lambda \mu}{e^{\mu} - 1} e^{\mu \lambda t} \quad (10)$$

The precise hazard rate has a simple form.

The distribution function is:

$$\begin{aligned} &\left[ \sum_{x=1}^{\infty} \frac{e^{-\mu} \mu^x}{x! (1-e^{-\mu})} (1-(1-e^{-\mu}))^x \right]^k = \\ &= \left( \frac{1-e^{-\mu e^{-\lambda}}}{1-e^{-\mu}} \right) \end{aligned} \quad (11)$$

Thus the hazard rate becomes:

$$\frac{k \mu \lambda e^{-\lambda t}}{e^{\mu e^{-\lambda t}} - 1} \quad (12)$$

In particular, for a  $\mu < 1,8$  the second derivative related to  $t = 0$ , is given by the expression:

$$\frac{\lambda^2 (e^{2\mu} - 2e^{\mu} + 1 - 3\mu e^{2\mu} + 3\mu e^{\mu} + \mu^2 e^{2\mu} + \mu^2 e^{\mu})}{(e^{\mu} - 1)^3} \quad (13)$$

The hazard rate is concave at  $t = 0$  for these values of  $\mu$ . Therefore, no version of this pattern can generate the least a Gompertz hazard rate.

If  $\lambda$  gets a very low value, let us assume 0,05, this will have as a continuing effect a time of mortality curve. This renders the hazard rate extremely low, therefore we can increase it, reaching a very high value for  $k$ , for example 20.000.

## 2. Brownian movement with deviation

We consider gamma distribution:

$$\gamma_{r,\beta}(x) = \Gamma(r)^{-1} \beta^r x^{r-1} e^{-\beta x} \quad (14)$$

where the parameter of the form  $r \geq -1$  and the scale parameter  $\beta$  is any positive number.

An aleatory variable  $\gamma$  has an expectative  $\frac{r}{\beta}$  and variation  $\frac{r}{\beta^2}$ . For  $r = 1$ ,

this is the exponential distribution, while for bigger values of  $r$  it is directed towards the normal distribution.

If  $\mu$  and  $\mu^*$  are the probabilities of the distribution in  $\mathbf{R}$ , we define the distance between them as:

$$d(\mu, \mu^*) = \inf_{\substack{X \sim \mu \\ X^* \sim \mu^*}} E|X - X^*| = \quad (15)$$

$$= \int_0^{\infty} |F(t) - F^*(t)| dt$$

where  $F$  si  $F^*$  are components of the distribution functions. (Infimum is considered over  $X$  and  $X^*$  with the

distribution  $\mu$  and respectively  $\mu^*$ ). That means that  $\mu$  and  $\mu^*$  are close if  $\int f(x)\mu(dx)$  and  $\int f(x)\mu^*(dx)$  are close as long as  $f$  is a function which doesn't vary too fast.

If  $\mu$  is a probability of the distribution on  $[0, +\infty)$ ,  $\sigma$  a positive constant and  $b$  a function from  $v_{\sigma,b}(\mu)$  which shows time distribution when the Brawnian movement begun in distribution  $\mu$ , with deviation  $b$  and constant diffusion  $\sigma$ , reaches value 0 for the first time. We will write  $v_{\sigma,b}(g)$  where  $g$  is a probability density. When  $\sigma$  is not included in notation, it receives value 1. We will call it a distribution on  $R^+$ ,  $b$ -accessible if there is a distribution  $\mu$  such as  $d(v, v_b(\mu)) < \epsilon$ .

We have to keep in mind that the dead time in 0 is unchanged by a linearly rescaling of space. This explains  $v_{\sigma,b}(\mu) = v_{b/\sigma}(\mu)$ .

The first result shows that any distribution  $v$  with target – mortality time is  $\epsilon$  – approximately  $\frac{b}{\sigma}$  – accessible when  $\sigma$  is a small enough rescaling factor.

*Theorem 1.* Let us suppose that  $\infty$  is a natural limit for the process,  $b$  is Lipschitz function, far from 0 and there is  $\alpha_1$  and  $\alpha_2$  positive constants, so that:

$$\alpha_1 \leq -b(x) \leq \alpha_2(1+x)$$

and a constant  $L$  so that

$$|b(x) - b(y)| \leq L|x - y| \quad \forall x, y \in \mathbf{R}^+. \quad (16)$$

Therefore there is a distribution  $\mu$  on  $\mathbf{R}^*$  so that  $d(v, v_{b/\sigma}(\mu)) < \epsilon$  for any distribution probability  $v$  on  $\mathbf{R}^*$ :

$$\int_0^\infty e^{-\alpha_2 z} \sqrt{z} v dz < \infty \quad (17)$$

for any  $\epsilon > 0$  and for any  $\sigma$  small enough.

Any exponential exit-time distribution can be approximated from an initial distribution, as long as the deviation constant is big enough. The rest of the result depends on the deviation constant.

To prove that a distribution is not  $b$  – accessible we use Laplace transform.

If  $\mu$  is a probability of distribution on  $\mathbf{R}^*$ , the Laplace transform is the function:

$$f(s) = \int_0^\infty e^{-sz} \mu(dz) \quad (18)$$

*Theorem 2:* May it be  $b$  a negative constant and  $v$  a probability of distribution in  $\mathbf{R}^+$ , with Laplace transform  $f$ . Then there is  $v$  – representable if and only if

$$\Phi(S) := f\left(\frac{s^2}{2} - bs\right) \quad \text{is the Laplace}$$

transform of a distribution  $\mu$ . This is equivalent to:

$$\sum_{j=0}^{\lfloor \frac{n}{2} \rfloor} (-1)^j \binom{n-j}{j} 4^{-j} \left(1 - \frac{b^2 - 2r}{(-b+s)^2}\right)^j \epsilon_{n-j}\left(\frac{s^2}{2} - bs\right) > 0 \quad (19)$$

$(\forall) s \in \mathbf{R}^+, n \in \mathbf{Z}^+$ , where

$$\epsilon_k(s) := (-1)^k \frac{(s+r)^k}{k!} f^{(k)}(s) > 0$$

In this case,  $\mu$  is the beginning distribution. This fact gives us the possibility of showing that a given distribution is not  $b$  – accessible.

If we consider a logistic Gompertz distribution with  $\theta = r = a = 1$  as long as the asymptotic hazard rate is 1, theoretically could be,  $b$ -accessible, for  $(\forall) b \leq -\sqrt{2}$ .

It is simple to prove that (19) is negative for  $b = -\sqrt{2}, s = 0, n = 3$ . If  $b = 2$  we obtain a negative sum for  $s = 0$  when  $n = 19$ .

Theorem (2) allows us to show that a wide class of distributions are  $b$  – accessible.

### Demonstration of theorem 1

May it be  $P(x) = \int_0^x \frac{dy}{b(y)}$ ,  $\mu^*$  convergent

in an increasing way towards  $v$  via  $P$ , for  $(\forall) A \subset \mathbf{R}^+ \mu^*(A) = v(P^{-1}(A))$ .

May it be  $W_t$  a single Brownian movement and  $X_t^{(\sigma)}$  defined as a strong solution of SDE:

$$dX_t = \sigma dW_t + b(X_t)dt \quad \text{in distribution } \mu^*.$$

We assume that  $\infty$  is a natural limit which guarantees the existence of a strong solution.

May  $\tau^{(\sigma)}$  the first time when  $X_t^{(\sigma)}$  reaches 0.

For  $\sigma > 0$  the distribution of  $\tau^{(\sigma)}$  is the same with the one noted as  $v_{\mu/\sigma}(\mu^\bullet)$ .

The only aleatory thing in  $X^{(0)}$  is the beginning point and it is easy to notice that  $\tau^{(0)}$  has a distribution on  $v$ .

We only have to show that:  $\lim_{\sigma \rightarrow 0} d(\tau^{(\sigma)}, \tau^{(0)}) = 0$ , where the distance between the aleatory variables is the distance between their distributions. But in this case it is enough to show that :

$$\lim_{\sigma \rightarrow 0} E(\tau^{(\sigma)}, \tau^{(0)}) = 0.$$

May it be  $\sigma > 0$  and may it be  $Z_t = X_t^{(\sigma)} - X_t^{(0)}$ . May it also be  $Z_t^*$  the strong solution of

$$dZ_t^* = \sigma dW_t + \alpha_2 (|Z_t^*| + 1) dt,$$

with the initial condition  $Z_0^* = Z_0$ . Then  $Z^*$  and  $Z$  have the same diffusion term (and from Lipschitz condition) the fall of  $Z^*$  is bigger. Thus we notice that  $Z_t^* > Z_t$ , for all  $0 \leq t \leq T$ .

Therefore:

$$\zeta := \sup\{Z_t : 0 \leq t \leq \tau^{(0)}\} \leq \sigma e^{\alpha_2 \tau^{(0)}} \cdot \sup_{0 < t < \tau^{(0)}} |W_t|. \quad (20)$$

As  $X^{(\sigma)}$  is a diffusion with negative fall at least  $\alpha_1$  and because  $X_{\tau^{(\sigma)}}^{(\sigma)} \leq \varepsilon$ ,

$$E\left[\frac{\tau^{(\sigma)} - \tau^{(0)}}{\zeta}\right] \leq \frac{\zeta}{\alpha_1}. \quad (21)$$

That means that a diffusion with drift  $-\alpha$  has an expectancy time of reaching point 0, no longer than  $\alpha^{-1}$  times at the beginning point.

Thus, the expected rise of  $\tau^{(\sigma)}$  over  $\tau^{(0)}$  isn't bigger than  $\alpha_1^{-1}$  multiplied its distance from 0 when it reaches  $X^{(0)}$ . Similarly if  $\tau^{(\sigma)} \leq \tau^{(0)}$  must be  $X_{\tau^{(\sigma)}}^{(0)} \leq \varepsilon$ . The difference between the reaching times is limited by:

$$E\left|\tau^{(\sigma)} - \tau^{(0)}\right| \leq \frac{2E\varepsilon}{\alpha_1} \quad (22)$$

Thus it results that:

$$\sup_{0 \leq t \leq s} |W_t| = 2E[|W_s|] = 4 \frac{\sqrt{s}}{\sqrt{2\pi}} \quad (23)$$

from where we have:

$$E\left|\tau^{(\sigma)} - \tau^{(0)}\right| \leq \frac{4\sigma}{\alpha_1} E\left[\sqrt{\tau^{(0)}} e^{\alpha_2 \tau^{(0)}}\right] \quad (24)$$

This is finite and tends to 0 via  $\sigma$ .

### Demonstration of theorem 2

We assume that  $\mu$  is a beginning distribution, so that  $v_b(\mu) = v$  and we call its Laplace transform  $g$ . For  $x$  positive, may it be  $\tau_x$  the time when Browniană movement with drift  $b < 0$ , begun in  $x_0$ , reaches 0 for the first time. We define for  $\alpha$  positive:

$$\zeta_\alpha(x) := E\left[e^{-\alpha \tau_x}\right]$$

From the Feynman-Kac formula  $\zeta$  verifies  $\frac{1}{2}\zeta'' + b\zeta' = \alpha\zeta$ , with conditions at the limit  $\zeta_\alpha(0) = 1$  and  $\zeta_\alpha(\infty) = 0$ .

This leads to :

$$\zeta_\alpha(x) = \exp\left\{\left(-b - \sqrt{b^2 + 2\alpha}\right)x\right\} \quad (25)$$

As the touching time from the beginning in a distribution  $\mu$  has the distribution  $v$ , we have:

$$f(\alpha) = \int_0^\infty \zeta_\alpha(x) \mu(dx) = g\left(b + \sqrt{b^2 + 2\alpha}\right) \quad (26)$$

Therefore for  $s$  positive:

$$\Phi(s) = f\left(\frac{s^2}{2} - bs\right) = g(s) \quad (27)$$

which is the Laplace transform of  $\mu$ .

Now we assume that  $\emptyset$  is the Laplace transform of a distribution  $\mu$ . From calculations, if  $\mu$  is the initial distribution and  $\Psi(\alpha)$ - the Laplace transform of the first time when 0 is reached, we have:

$$\Psi(\alpha) = \Phi\left(b + \sqrt{b^2 + 2\alpha}\right) = f(\alpha) \quad (28)$$

As the reaching time has the same Laplace transformer as  $v$  they are the same distribution.

$\emptyset$  is the Laplace transform of a distribution probability if and only if

$\lim_{z \rightarrow 0} \Phi(z) = 1$  and  $\Phi$  is totally monotonous

(that is  $(-1)^n \Phi^{(n)}(s)$  is positive for all  $n$  and  $s$ ), then  $\Phi^{(n)}$  is the derivative of order  $n$  of  $\Phi$ .

It can be shown inductively that:

$$\Phi^{(n)}(s) = \sum_{k=\lfloor \frac{n}{2} \rfloor}^n \frac{n!}{2^{n-k} (2k-n)! (n-k)!} A, \quad (29)$$

where

$$A = (s-b)^{2k-n} f^{(k)}\left(\frac{s^2}{2} - bs\right)$$

A change of variable  $j = n - k$  shows that the sum from rel (19) is:

$$(-1)^k (n!)^{-1} \left(\frac{s^2}{2} - bs + r\right)^n (-b+s)^{-n} \Phi^{(n)}(s) \quad (30)$$

whose positivity for all  $s$  and  $n$  is the definition of  $\Phi$  as being totally monotonous, which is equivalent to  $\Phi$  as being the Laplace transform of a distribution.

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# COMPLEX TELETRAFFIC ANALYSIS AND OPTIMIZATION SYSTEM FOR COMMUNICATION NETWORKS BASED ON TECHNOLOGICAL DIVERSITY AND SERVICE CONVERGENCE

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*Abstract:* The project is meant to serve the administrators of public and private communication systems whose networks must react promptly and at low costs to the ever growing services demand. The project progress will focus on the existent diversity of technologies underlying the communication and the need for convergence of the services offered to the clients.

*Keywords:* traffic analysis and optimization, technological diversity, convergence of service.

## 1. INTRODUCTION

This paper work will focus on the existent diversity of technologies underlying the communication and the need for convergence of the services offered to the clients.

At this time, we witness an undergoing analysis regarding the opportunity of steering the services supported by communication networks towards convergence. An example in this view is the soon to come implementation of a unified mobile digital telecommunications platform at national scale. Inside it, all services users, regardless of the structure they belong to, must be able to access any of the network resources, based on a prior authorization and using the national common infrastructure.

Relevance of the project is in the objectives of the 4<sup>th</sup> Program - Partnerships in priority domains, coordinated by the National Center for the Programs Management (CNMP), 2007 [1] (\* see the note from the end of the paper work).

So, the project will be developed by a consortium consisting of two high education institutions (the Technical Military Academy and „Politehnica” University of Bucharest),

one research and development institute (the Military Equipment and Tehnologies Research Agency) and one privately held company with R&D activities (S.C. MarcTel SIT SRL); in this way, cooperation between academia, R&D and commercial companies is stimulated.

The project also complies to the derivative objectives of the 4<sup>th</sup> Program concerning research [2], due to the fact that one of its ends is the development of a centre for telecommunication networks modelling, a centre that will acquire high added value technologies, will create conditions for the training of young researchers in the field and will contribute to raising the competitiveness of Romanian R&D up to the level existent in the European Union.

The project is compliant to the specific goals of the 1<sup>st</sup> research direction (The Information Technology and Communications) and subdirection (Communication technologies, systems and infrastructures) due to the following elements:

- the inner working of networks with communication services convergence is analysed, subdirection: convergent architectures and infrastructures (networks)

convergent by view-point of high level communication services, likely to, in same time, technological diversity of solutions for communications;

- methods for communication networks simulation will be employed, in order to assess the performance and to provide efficient solutions for resource planning, subdirection: algorithms, methods of simulation for telecommunication complex systems for the evaluating the performances and for networks planning;

- a set of methods and software products used in resource and services management for complex communication systems will be developed, subdirection: Methods and software for the management of the services and resources in communication complex systems;

- an integrated modelling platform for functional assessment of performance in communication systems will be created, subdirection: technologies, functionality and performances testing systems.

Long term goal, lesser operational costs in public and private telecommunication networks, we can notice that the average traffic figures centered on different network resources are widely scattered. Thus, large subnetworks where needed traffic values surpass the network processing and transport capabilities coexist with other areas where loading often runs below 10% of the installed network capacity, a reality that affects operation costs.

For the realisation of this desideratum, in paper work we present the develop a novel technology (centralized management of networks with diverse underlying technologies) and will solve a complex problem (convergent services administration); at the same time, it will provide mechanisms for practical implementing of the new technology (administrative and technical implementation procedures) and will end with the implementation of an integrated platform for traffic modelling, a product with high added value.

The project will yield an analysis regarding resources and services allocation in public and private telecommunication networks.

The most relevant technical aspects to be considered are those related to the diversity of underlying technologies for these networks. The aspects pertaining to technological diversity and differences in administrative procedures are taken into consideration in order to establish the most efficient way to optimize centralized access to the said resources. In the wake of this analysis, administrative and technical procedures will be established, in order to allow the telecommunication networks managers to cooperate in view to achieve logistical support at up to government level.

In finally, the main goal is the creation of a centre for traffic modelling in networks with diverse underlying technologies.

## **2. SYSTEM DESCRIPTION**

In view of this objective, we propose to run the follow certain stages which will lead to a system that will:

- allow for a sizeable reduction of effort implied by networks operation, administration and maintenance

- make easier network architecture optimization, due to the possibility to predict the network reaction in different working scenarios

- facilitate the augmentation of resource usage level and possibilities of restore after failures, with direct benefits towards the above mentioned aspects, enhancing investment efficiency and lowering maintenance costs

- Provide the necessary flexibility needed for the present trend of technological convergence, while the services and network applications tend to diversify.

The project's main goal is the creation of a centre for traffic modelling in networks with diverse underlying technologies. The derivative goals are for the project to contribute to:



• higher performance of the RDI system by:

- placing patent claims for the appropriate solutions developed within the modeling centre;

- reaching scientific results of excellence grade through the development of new mathematical models able to evaluate more efficiently the networks with diverse underlying technologies and of an operational model for optimization of resource allocation, a model that can be implemented in network management centers;

- development of procedures for establishing optimum network topologies required by the technologies and types of services;

- creation of a data base for simulation scenarios and corresponding results, useful in:

- comparative evaluation procedures for communication networks performances;

- scientific papers in ISI graded publications;

- development of RDI system resources by:

- better access to the research infrastructure. The modeling platform will be designed as an open system that can be accessed remotely via Internet;

- development of research facilities of national interest;

- PhD candidates and graduate students training for the domains of expertise available in the modeling centre.

- involvement of the private sector by:

- Stimulating RDI activity in the private sector, because the consortium includes a commercial company with R&D activities;

- Creation of a technological platform and a competence center through a public-private partnership;

- Raising the technological expertise level of the research team.

- Enhanced international cooperation by:

- Connecting the modeling platform to the European research structure;

- Participation in scientific workshops, fairs and international exhibitions in order to disseminate and promote the research results.

### **3. THE SCHEME OF EXECUTION**

The requirements for the proposed theme can be realized in 4 stages.

The first stage begins with a study necessary for establishing the technical and administrative aspects of the different targeted communication networks that have to be taken into consideration in order to describe, specify and successfully implement the hardware and software platforms. For these purposes, it will be paid attention, on one hand, to the capabilities provided by the used technologies and the features of the services available in the respective communication networks, to which the traffic descriptors in correspondence with the sources and streams aggregated in the carriers will be added and, on the other hand, to the available means of administration of the concerned configurations. Precisely, the two activities scheduled to be performed in this stage are: data acquisition and analysis in order to extract the necessary information needed to conduct the following stages.

The second stage regards, as a first activity, defining functional components and interfaces through which the traffic analysis and optimization system will connect to the communication networks that, in this way, can be managed unitary and coherently. This will be followed by the global and detailed description of the system architecture and functioning, under the terms of ensuring a complete availability. The second stage concludes with the preparation of the specification, both hardware and software, based on which the next stage can be achieved, the implementing one:

In this time, the first two stages it also accomplished, again the last two stages it will be realized in the near future.

The third stage consists in implementing the traffic analysis and optimization system

according to the specifications. For these purposes, as a first activity, algorithms will be implemented, on which the activities in each basic functional block are based, as well as the communication protocols, both through the external interfaces and through the internal interfaces interconnecting the functional block according to the designed architecture. Mathematical pattern will provide flexibility in choosing the analysed working scenarios. The hardware platform, as a result of the second activity, incorporates various technologies used today in the networking field.

The target of the fourth stage consists in performing two activities necessary for completing this project. It is about testing and validating the solution accompanied by preparing the system's technical documentation. The validation of the solution will be made by the tests performed in different working scenarios, by confronting it with the necessities of independent users.

#### **4. CONCLUSIONS**

The new elements brought by the project are:

- contributions to the development of mathematical models aimed for traffic simulation and analysis in networks with diverse technologies;
- contributions to the development of optimisation methods regarding network resources allocation;
- by design, the hardware and software platforms will allow for online data acquisition and real time processing

*\*Note:*

*This paper work it was realized and financial favoured through contract No. 11-029/2007 of CNMP.*

- possibilities for local and remote training regarding different technologies that support a range of services

- the network management solutions will be assessed by direct testing

- modular structure for the hardware and software platforms, that allow for further developments regarding new technologies and services.

The project complexity level is given by the following elements:

- the simulation platform will be able to model the traffic in networks with diverse technologies;

- by design, the hardware and software platforms will offer remote user access, regarding traffic scenarios testing and resource allocation. Thus, the platform will be seen by the users as a virtual laboratory for model testing. The users will be granted access after an authorization procedure is completed;

- orientation towards wide band services, especially the video streaming.

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## ON INDUCED COMPLEX VECTOR PSEUDO-FIELDS ON AFFINE FIBERED MANIFOLDS

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**Abstract.** In this paper we define the complex affine fibered manifold and the complex vector pseudo-field notions. Using the local calculus we construct a complex affine bundle associated with a given complex vector pseudo-field. The notions are introduced by analogy with the real case following [Po], but with some specific particularities.

**2000 Mathematics Subject Classification:** 53B40, 53C12.

**Key Words:** Affine fibered manifolds, complex vector pseudo-fields.

### 1. AFFINE COMPLEX FIBERED MANIFOLDS

Let be  $M$  and  $N$  two complex manifolds, where  $\dim_C M = p + q$  and  $\dim_C N = p$ .

**Definition 1** ([Va 1]) A complex surjective submersion  $\pi : M \rightarrow N$  is usually called a complex fibered manifold.

A morphism of the complex fibered manifolds  $\pi' : M' \rightarrow N'$  and  $\pi : M \rightarrow N$  is a couple  $(f_0, f_1)$  where  $f_0 : N' \rightarrow N$  and

$$f_1 : M' \rightarrow M \text{ satisfying the condition:} \\ \pi \circ f_1 = f_0 \circ \pi' \quad (1)$$

(i.e.  $f_1$  sends the fibers to fibers). Also we said that  $f_1$  is a  $f_0$ -morphism of complex fibered manifolds.

Using the local calculus, if  $(z_\alpha^k)_{k=1, \dots, p}$  are the local complex coordinates in a local chart  $(U_\alpha, \varphi_\alpha)$  of  $N$  and  $u_\alpha = (z_\alpha^k, \eta_\alpha^a)_{k=1, p; a=p+1, p+q}$  are the local complex coordinates in a local chart  $(V_\alpha, \psi_\alpha)$  of  $M$  with  $\pi(V_\alpha) = U_\alpha$ , then at local changes maps  $(V_\alpha, \psi_\alpha) \rightarrow (V_\beta, \psi_\beta)$  on  $M$  we have,

$$z_\beta^k = z_\beta^k(z_\alpha^j); \eta_\beta^a = \eta_\beta^a(z_\alpha^j, \eta_\alpha^b) \quad (2)$$

**Definition 2** An affine complex fibered manifold (or affine complex bundle) is a complex fibered manifold  $\pi : M \rightarrow N$  for which the change rules of the local coordinates on  $M$  have the form  $z_\beta^k = z_\beta^k(z_\alpha^j); \eta_\beta^a = M_{\alpha\beta, b}^a(z) \eta_\alpha^b + B_{\alpha\beta}^a(z_\alpha^j)$  (3)

where  $i, j, \dots = 1, 2, \dots, p; a, b, \dots = p + 1, \dots, p + q$  and  $z_\beta^k, M_{\alpha\beta, b}^a, B_{\alpha\beta}^a$  are holomorphic functions on variables  $z_\alpha^j$  and  $\det(M_{\alpha\beta, b}^a) \neq 0$ .

**Definition 3** An affine local section in the complex affine bundle  $\pi : M \rightarrow N$  is a differentiable map  $s : U_\alpha \rightarrow M$  such that  $\pi \circ s = id U_\alpha$  and its local components change according to the rule  $s_\beta^a(z_\beta^k) = M_{\alpha\beta, b}^a(z_\alpha^j) s_\alpha^j(z_\alpha^j) + B_{\alpha\beta}^a(z_\alpha^j)$  (4)

The set of complex affine sections on  $M$  is denoted by  $\Gamma(M)$  and it is an affine module over  $F(M)$ , i.e. for every differentiable functions on  $M$ ,  $f_1, \dots, f_p \in F(M)$  such that  $f_1 + \dots + f_p = 1$  and  $s_1, \dots, s_p \in \Gamma(M)$ , then  $f_1 s_1 + \dots + f_p s_p \in \Gamma(M)$ , where the affine combination is taken at every point  $z \in N$ . Using a partition of the unity on the base  $N$ , it

can be easily proved that every complex affine bundle allows an affine section.

A holomorphic vector bundle  $\pi : E \rightarrow N$  can be canonically associated with a complex affine bundle  $\pi : M \rightarrow N$ . More precisely, using local coordinates, the complex affine bundle  $\pi : M \rightarrow N$  reduces at a holomorphic vector bundle if  $B_{\alpha\beta}^a = 0$ . In this case, we say that  $M$  is of *holomorphic vector type* or according to [Po],  $E$  is called a *central affine holomorphic bundle*.

Let  $\ker \pi_* = V'(M) \rightarrow M$  be the holomorphic vertical bundle of  $M$  and  $\Gamma(V'(M))$  be the module of holomorphic vertical sections. According to [Mu], the local complex coordinates on  $V'(M)$  have the form  $(z^k, \eta^a, \zeta^b)$  and the transformation rules at local charts changes are of the form,

$$\begin{aligned} z_\beta^k &= z_\alpha^k(z_\alpha^j); \eta_\beta^a \\ &= M_{\alpha\beta,b}^a(z_\alpha^j)\eta_\alpha^b + B_{\alpha\beta}^a(z_\alpha^j); \zeta_\beta^a = \\ &= M_{\alpha\beta,b}^a(z_\alpha^j)\zeta_\alpha^b \end{aligned} \quad (5)$$

**Definition 4** A Liouville type complex section is a vertical complex section  $S \in \Gamma(V'(M))$  which has the local form  $S_\alpha^b(z_\alpha^j, \eta_\alpha^b) = \eta_\alpha^b + C_\alpha^b(z_\alpha^j)$  (6)

**Proposition 1** Every Liouville type complex section in  $\Gamma(V'(M))$  defines a complex affine section in  $\Gamma(M)$ , and conversely.

**Proof:** According to (5) at local charts changes, we have  $S_\beta^a = M_{\alpha\beta,b}^a S_\alpha^b$ . Taking into account the local forms of  $S_\beta^a$  and  $S_\alpha^b$  follows that  $\eta_\beta^a + C_\beta^a = M_{\alpha\beta,b}^a(\eta_\alpha^b + C_\alpha^b)$ . Using (3) follows that

$$C_\beta^a(z_\beta^k) = M_{\alpha\beta,b}^a(z_\alpha^j)C_\alpha^b(z_\alpha^j) - B_{\alpha\beta}^a(z_\alpha^j)$$

Thus, the local functions  $\{-C_\alpha^b(z_\alpha^j)\}$  are the local components of a global affine complex section from  $\Gamma(M)$ . Conversely, for a global affine complex section  $s \in \Gamma(M)$  having the local components  $s_\alpha^b(z_\alpha^j)$ , the local functions  $\eta_\alpha^b - s_\alpha^b$  on  $M$  verify at local charts changes

the rule (6) from definition of Liouville section. *Q.e.d.*

## 2. COMPLEX VECTOR PSEUDO-FIELDS

By analogy with the real case (see [Po]), we define the complex vector pseudo-field notion on a complex affine fibered manifold. Let  $U_\alpha = \pi(V_\alpha)$ ,

**Definition 5** We call a complex vector pseudo-field on  $M$  an association of a local complex vector field  $\Gamma_\alpha \in X(V_\alpha)$  with every domain  $V_\alpha$  of a given atlas on  $M$ , such that  $\Gamma_\alpha(\eta_\alpha^b) = 0$  and for every two domains  $V_\alpha$  and  $V_\beta$ , which have the local coordinates  $(z_\alpha^j, \eta_\alpha^a)$  and  $(z_\beta^k, \eta_\beta^a)$ , then on  $V_\alpha \cap V_\beta$  we have  $\Gamma_\alpha(z_\alpha^j) = \Gamma_\beta(z_\alpha^j)$  and  $\Gamma_\alpha(z_\beta^k) = \Gamma_\beta(z_\beta^k)$ .

From Definition 5 a straightforward calculus leads to the following transformation rule on  $V_\alpha \cap V_\beta$  for  $\Gamma$ ,

$$\Gamma_\beta = \Gamma_\alpha - \Gamma_\alpha(\eta_\beta^a) \frac{\partial}{\partial \eta_\beta^a} \quad (7)$$

In the sequel, we present some examples of complex vector pseudo-fields.

1) Let  $\pi : M \rightarrow N$  be a complex affine fibered manifold and  $Z \in X(N)$  a

holomorphic vector field on the base  $N$ . If the vector field  $Z$  has the local form  $Z = Z_\alpha^j(z_\alpha^j) \frac{\partial}{\partial z_\alpha^j} \in X(U_\alpha)$ , then

$\Gamma_\alpha = Z_\alpha^j(z_\alpha^j) \frac{\partial}{\partial z_\alpha^j}$  is a complex vector pseudo-field on  $V_\alpha = \pi^{-1}(U_\alpha)$ .

2) Let  $\pi : M \rightarrow N$  be a complex affine fibered manifold and  $D : V'(M) \rightarrow T'N$  a

$\pi$ - morphism of holomorphic vector bundles, where  $T'N$  is the holomorphic tangent bundle of the complex manifold  $N$  and  $V \in X(V'(M))$  be a holomorphic vertical vector field. Using the local complex

coordinates,

$$V = V_\alpha^b(z_\alpha^j, \eta_\alpha^b) \frac{\partial}{\partial \eta_\alpha^b} \in X(V'(M)) \text{ and}$$

$$V = V_\alpha^b(z_\alpha^j, \eta_\alpha^b) \xrightarrow{D} \frac{\partial}{\partial \eta_\alpha^b}$$

$$\xrightarrow{D} D_a^k(z_\alpha^j, \eta_\alpha^b) V_\alpha^a(z_\alpha^j, \eta_\alpha^b) \frac{\partial}{\partial z_\alpha^k}$$

( $Z^k = D_a^k V^a$  are the complex function on  $V'(M)$  and  $\{\frac{\partial}{\partial z^k}\}$  are the complex vector fields on  $N$ ), then

$$\Gamma_\alpha = D_a^k(z_\alpha^j, \eta_\alpha^b) V_\alpha^a(z_\alpha^j, \eta_\alpha^b) \frac{\partial}{\partial z_\alpha^k} \in X(V_\alpha)$$

defines a complex vector pseudo-field on  $M$ .

**Remark 1** In the second example, we can consider the particular case when

$$V = \eta_\alpha^b \frac{\partial}{\partial \eta_\alpha^b}$$

is the Liouville complex vector field (or radial complex vector field). Then, the complex vector pseudo-field associated is

$$\text{of form } \Gamma_\alpha = D_a^k(z_\alpha^j, \eta_\alpha^b) \eta_\alpha^a \frac{\partial}{\partial z_\alpha^k}.$$

3) We consider  $H'(M)$  be a supplementary (transversal) distribution of  $V'(M)$  in  $T'M$ , namely  $T'M = H'M \oplus V'M$  i.e., according to [Mu] a complex nonlinear connection, briefly (c.n.c) on  $M$ , with

$$H'M = \text{span}\left\{ \frac{\delta}{\delta z^k} = \frac{\partial}{\partial z^k} - N_k^a(z, \eta) \frac{\partial}{\partial \eta^a} \right\}. \text{ Let}$$

$$\tilde{Z} = Z_\alpha^j(z_\alpha^j, \eta_\alpha^b) \frac{\delta}{\delta z_\alpha^j}$$

be a complex horizontal vector field, then

$$\Gamma_\alpha = Z_\alpha^j(z_\alpha^j, \eta_\alpha^b) \frac{\partial}{\partial z_\alpha^j} \in X(V_\alpha)$$

defines a complex vector pseudo-field on  $M$ .

**Proposition 2** If  $\pi : M \rightarrow N$  is a complex affine bundle and  $\Gamma$  is a complex vector pseudo-field on  $M$ , there is a complex affine bundle  $\pi' : M' \rightarrow M$  and a complex vector pseudo-field  $\Gamma'$  on  $M'$  which is natural induced by  $\Gamma$ .

if **Proof:** We assume that the change of the local complex coordinates on  $M$  is made after the formulas (3) and we define the change rule of the coordinates on  $\pi'^{-1}(V_\alpha) \cap \pi'^{-1}(V_\beta)$  of  $M'$  by

$$\zeta_\beta^a(z_\alpha^j, \eta_\alpha^b, \zeta_\alpha^b) = M_{\alpha\beta,b}^a(z_\alpha^j) \zeta_\alpha^b + \Gamma_\alpha(\eta_\beta^a) \quad (8)$$

In the sequel, we prove that  $\pi' : M' \rightarrow M$  is a complex affine bundle over base  $M$ . We consider  $(z_\gamma^l, \eta_\gamma^c, \zeta_\gamma^c)$  the local coordinates in another local chart  $\pi'^{-1}(V_\gamma)$  of  $M'$  which changes after the rule

$$\begin{aligned} z_\gamma^l &= z_\gamma^l(z_\beta^k); \eta_\gamma^c = \\ &= M_{\beta\gamma,a}^c(z_\beta^k) \eta_\beta^a + B_{\beta\gamma}^c(z_\beta^k); \zeta_\gamma^c \quad (9) \\ &= M_{\beta\gamma,a}^c(z_\beta^k) \zeta_\beta^a + \Gamma_\beta(\eta_\gamma^c) \end{aligned}$$

To prove that (9) is invariant must be express the link between the local coordinates  $(z_\alpha^j, \eta_\alpha^b, \zeta_\alpha^b)$  and  $(z_\gamma^l, \eta_\gamma^c, \zeta_\gamma^c)$ . We have,  $z_\gamma^l = z_\gamma^l(z_\alpha^j);$

$$\eta_\gamma^c = M_{\beta\gamma,a}^c(z_\beta^k) \eta_\beta^a + B_{\beta\gamma}^c(z_\beta^k) =$$

$$M_{\beta\gamma,a}^c(z_\beta^k) [M_{\alpha\beta,b}^a(z_\alpha^j) \eta_\alpha^b + B_{\alpha\beta}^a(z_\alpha^j)] + B_{\beta\gamma}^c(z_\beta^k) = M_{\alpha\gamma,b}^c(z_\alpha^j) \eta_\alpha^b + B_{\alpha\gamma}^c(z_\alpha^j)$$

where

$$B_{\alpha\gamma}^c(z_\alpha^j) = M_{\beta\gamma,a}^c(z_\beta^k) B_{\alpha\beta}^a(z_\alpha^j) + B_{\beta\gamma}^c(z_\beta^k(z_\alpha^j))$$

, and

$$\zeta_\gamma^c = M_{\beta\gamma,a}^c(z_\beta^k) \zeta_\beta^a + \Gamma_\beta(\eta_\gamma^c)$$

$$= M_{\beta\gamma,a}^c(z_\beta^k) [M_{\alpha\beta,b}^a(z_\alpha^j) \zeta_\alpha^b +$$

$$+ \Gamma_\alpha(\eta_\beta^a)] + \Gamma_\beta(\eta_\gamma^c)$$

$$= M_{\alpha\gamma,b}^c(z_\alpha^j) \zeta_\alpha^b + M_{\beta\gamma,a}^c(z_\beta^k) \Gamma_\alpha(\eta_\beta^a) +$$

$$+ \Gamma_\beta(\eta_\gamma^c)$$

$$= M_{\alpha\gamma,b}^c(z_\alpha^j) \zeta_\alpha^b + M_{\beta\gamma,a}^c(z_\beta^k) \Gamma_\alpha(\eta_\beta^a) +$$

$$+ \Gamma_\alpha(\eta_\gamma^c) - \Gamma_\alpha(\eta_\beta^a) \frac{\partial \eta_\gamma^c}{\partial \eta_\beta^a}$$

$$= M_{\alpha\gamma,b}^c(z_\alpha^j) \zeta_\alpha^b + \Gamma_\alpha(\eta_\gamma^c)$$

Thus,  $\pi' : M' \rightarrow M$  is a complex affine bundle. We define,

$$\Gamma'_\alpha = \Gamma_\alpha + \zeta_\alpha^b \frac{\partial}{\partial \eta_\alpha^b} \text{ on } \pi'^{-1}(V_\alpha)$$

For the finish of prove we will show that  $\Gamma'$  defines a complex vector pseudo-field on  $M'$ . Indeed, is evident that  $\Gamma'_\alpha(\zeta_\alpha^b) = 0$  and on the intersection of two domains  $\pi'^{-1}(V_\alpha) \cap \pi'^{-1}(V_\beta)$  on  $M'$  we have,

$$\Gamma'_\alpha(z_\alpha^j) = \Gamma_\alpha(z_\alpha^j) = \Gamma_\beta(z_\alpha^j) = \Gamma'_\beta(z_\alpha^j);$$

$$\begin{aligned} \Gamma'_\alpha(z_\beta^k) &= \Gamma_\alpha(z_\beta^k) + \zeta_\alpha^b \frac{\partial z_\beta^k}{\partial \eta_\alpha^b} \\ &= \Gamma_\alpha(z_\beta^k) = \Gamma_\beta(z_\beta^k) = \Gamma'_\beta(z_\beta^k); \end{aligned}$$

$$\Gamma'_\alpha(\eta_\alpha^b) = \Gamma_\alpha(\eta_\alpha^b) + \zeta_\alpha^b \frac{\partial \eta_\alpha^b}{\partial \eta_\alpha^b} = \zeta_\alpha^b$$

and

$$\begin{aligned} \Gamma'_\beta(\eta_\alpha^b) &= \Gamma_\beta(\eta_\alpha^b) + \zeta_\beta^a \frac{\partial \eta_\alpha^b}{\partial \eta_\beta^a} = \\ &= \Gamma_\beta(\eta_\alpha^b) + \zeta_\beta^a M_{\alpha\beta,a}^b = \zeta_\alpha^b = \Gamma'_\alpha(\eta_\alpha^b); \end{aligned}$$

$$\Gamma'_\beta(\eta_\beta^a) = \Gamma_\beta(\eta_\beta^a) + \zeta_\beta^a \frac{\partial \eta_\beta^a}{\partial \eta_\beta^a} = \zeta_\beta^a =$$

$$= \Gamma_\alpha(\eta_\beta^a) + M_{\alpha\beta,b}^a \zeta_\alpha^b =$$

$$= \Gamma_\alpha(\eta_\beta^a) + \zeta_\alpha^b \frac{\partial \eta_\beta^a}{\partial \eta_\alpha^b} = \Gamma'_\alpha(\eta_\beta^a)$$

and this finish the proof. *O.e.d.*

Finally, we remark that in a future paper we purpose to investigate the globalization of the complex vector pseudo-fields and to find the obstructions for globalization.

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# IMPLEMENTING SIMULATED ANNEALING ON GPU FOR IMAGE PROCESSING TASKS

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**Abstract:** An implementation on GPU (Graphic Processing Unit) of the Simulated Annealing Algorithm, for image deconvolution, (both known filter case and blind deconvolution case). The advantage of the method is that it is also reliable in ill-posed problems, but this advantage comes at high computation cost. However, with the use of high performance graphical processors, annealing could be a considerable generic method of image restoration..

**Key words:** Image Processing, Simulated Annealing, Deconvolution, Deblurring, GPU, CUDA

## 1. INTRODUCTION

Simulated annealing is a technique to solve complex optimization problems [1]. It is a generic method, in which a given cost function  $J(x)$  needs to be minimized, where  $x$  is the parameter vector, which is often large dimensional. In physics, annealing is the process of slowly cooling a physical system in order to obtain a state with globally minimum energy. By analogy, the simulated annealing algorithm tries to minimize  $J(x)$  by perturbing randomly the  $x$  parameter vector by  $dx$ , a “perturbation” vector of random variables. The properties of the perturbation are problem dependent

$$x' = x + \Delta x \quad (1)$$

The perturbation in the parameter space causes a change of the cost function (analogous to the energy of the physic system)

$$\Delta J = J(x + \Delta x) - J(x) \quad (2)$$

If  $\Delta J < 0$  (the system entered a favorable state), the new parameter vector  $x + \Delta x$  is accepted and will replace the current parameter.

If, however, the cost did not decrease, the new state will be accepted with a given probability.

$$p(\text{accept} | \Delta J) = \begin{cases} 1, & \Delta J \leq 0 \\ e^{-\frac{\Delta J}{T}}, & \Delta J > 0 \end{cases} \quad (3)$$

This equation represents the Metropolis method [2] to sample states of systems with Boltzmann distribution.

To ‘anneal’ the system, the temperature is successively, slowly reduced, and the perturbation steps are repeated until an acceptable minimal cost function  $\hat{x} = \arg \min J(x)$  is found or other constrain (time limit) fail. The required number of iterations depends on the problem.

## 2. IMAGE DECONVOLUTION

Image capturing devices or environmental effects often distort, due to lens characteristics, environmental effects, prolonged exposure and device non-linearities [4].

By considering only the linear effects, the observed image  $g(x, y)$  can be estimated to be the two-dimensional discrete convolution of the true image  $f(x, y)$  with a linear shift-invariant blur, also known as the point-spread function (PSF),  $h(x, y)$ .

$$g_{(x,y)} = f * h = \sum_i \sum_j f_{(x-j, y-i)} h_{(j,i)} \quad (4)$$

The  $h$  function has finite support, that is nonzero only for a range of  $|i| < N$  and  $|j| < N$ . In presence of additive noise, the model becomes:

$$g_{(x,y)} = (f * h)_{(x,y)} + \eta_{(x,y)} \quad (5)$$

The image deconvolution is the inverse problem: given the observed image  $g$ , compute an  $\hat{f}$  estimate of the original image. If we use the L2 norm for images, the best estimate minimizes

$$J = \|g - \hat{g}\| = \sqrt{\sum_i (g(x_i) - \hat{g}(x_i))^2} \quad (6)$$

where  $\hat{g} = \hat{f} * \hat{h}$ ,  $\mathbf{x}$  the two dimensional parameter.

In some cases, the  $\hat{h}$  estimate of PSF is known a-priori, which makes the task of finding  $\hat{f}$  easier. There are well established numerical methods as inverse filtering, Wiener filtering [3].

By the contrary, if  $\hat{h}$  is not known, we are faced with the problem of *blind deconvolution*. Several techniques exist also for this field [4].

### 3. SIMULATED ANNEALING FOR IMAGE RESTORATION

Simulated annealing can be used in both cases, with a-priori known PSF and with unknown PSF, in the later case, however, constrains needs to be given. Typical constrains are the finite support size of the PSF, it's normalization and non-negativity.

In addition to the equation (6), we incorporate in the function a Laplacian smoothing term [6] to be minimized.

$$J(\hat{f}, \hat{h}) = \frac{\|g - \hat{f} * \hat{h}\|}{\|g\|} + \lambda \|\nabla^2 \hat{f}\| \quad (7)$$

The Laplacian term imposes a smoothing constraint on  $\hat{f}$  weighted by scalar  $\lambda$ . In the denominator, the  $\|g\|$  term is given to normalize the error. By adding the smoothing term, the algorithm will be more robust in the presence of noise.

**Simulated Annealing algorithm for image restoration [7]:**

- Input: image  $g, h$  (in case of non-blind convolution)

- initialization, choose:

$T$  = initial temperature,

$a$  = perturbation amplitude

normalize  $g, h$ , so that  $\|g\|=1$  and  $\|h\|=1$

$S$  = 'scan count' = number of successive iterations at the same temperature

$I$  = iteration count

for  $i=1$  to  $I$  ('cycles')

for  $s=1$  to  $S$  ('scans')

for each pixel  $(x,y)$  ('Metropolis cycle')

$$\hat{f}_p(x, y) = \hat{f}(x, y) + a \text{Rand}[-1, 1] \quad (8)$$

Compute  $J(\hat{f}, \hat{h})$  using (7), and

$$\Delta J = J(\hat{f}_p, \hat{h}) - J(\hat{f}, \hat{h})$$

if  $(\Delta J < 0)$  or

$$(e^{\frac{-\Delta J}{T}} > \text{Rand}[0, 1]) \text{ then } \text{accept } f^p$$

(In case of blind deconvolution, where also  $\hat{h}$  needs to be estimated, repeat the "Metropolis cycle" by perturbing the values of  $\hat{h}$  and keeping  $f$  constant).

end for  $s$

lower temperature:

$$T_{i+1} = T_i * W \quad (9)$$

end for  $i$

**end of the algorithm.**

### 4. IMPLEMENTATION ON GPU

The Graphical Processing Unit contains several multiprocessor cores, which can perform per-pixel tasks. To efficiently parallelize the simulated annealing, we were facing the following issues:

- global re-computation of cost function is not efficient

- need parallel, uncorrelated pseudo random number generator

We modified the SA algorithm in a similar way as described in [9]:

**Parallel algorithm:**

for  $i$  from 1 to  $I$  sequentially

for  $s$  from 1 to  $S$  sequentially

compute convolution

$$c = \hat{f} * \hat{h}$$



for each pixel  $f(x,y)$ , compute in parallel:  
 $\alpha = T$  (perturbation amplitude)  
 $\Delta f_{(x,y)} = \alpha \text{Rand}[-1,1]$ ; saturate as (10)  
 $c'_{(x,y,j,i)} = c_{(x+j,y+i)} + \Delta f_{(x,y)} h_{(j,i)}$   
 $0 \leq (f + \Delta f) \leq 1$  range constraint  
 $e'_{(x,y)} = \sum_{i=-N/2}^{N/2} \sum_{j=-N/2}^{N/2} \|g_{(x+j,y+i)} - c'_{(x,y,j,i)}\|$   
 $\Delta e_{(x,y)} = e'_{(x,y)} - e_{(x,y)}$   
**if**  $(\Delta e_{(x,y)} < 0) \vee \text{accept}(\Delta e_{(x,y)}, T)$  **then**  
 $\hat{f}_{(x,y)} = \hat{f}_{(x,y)} + \Delta f_{(x,y)}$   
 $e_{(x,y)} = e'_{(x,y)}$   
 end for s loop  
 decrease temperature and repeat iterations  
 end for i loop  
**end of the algorithm.**

where  $N*N$  is the size of pixel neighborhood around  $(x,y)$ . Local cost functions are computed for every pixel-neighborhood of size  $N*N$ , which is the support size of  $h(j,i)$ . To compute the effect on global  $J$  of perturbing a single  $f(x,y)$  pixel, is sufficient to re-convolve only in the neighborhood of  $f(x,y)$ . The  $\text{accept}(d,T)$  function is the Metropolis acceptance criteria from eq.(3).

We implemented the above algorithm in the CUDA environment (a parallel extension of the C language).

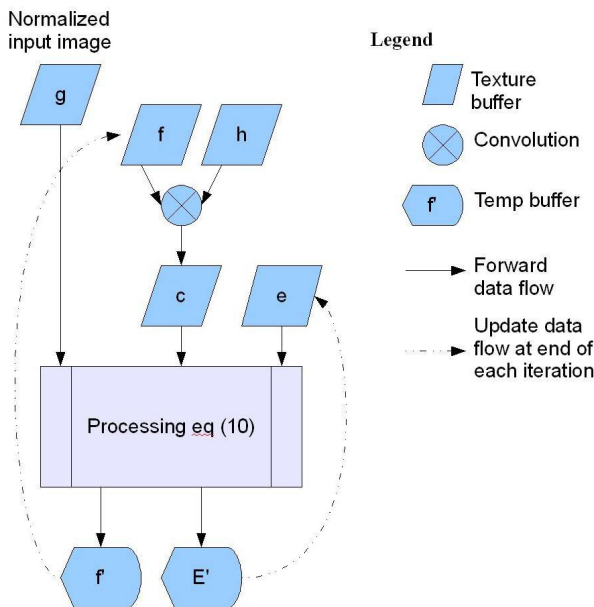


Fig. 1: GPU Annealing iteration flowchart

The processing is controlled by the Host CPU, which iteratively invokes the GPU kernels (convolution followed by annealing), then updates the texture buffers containing for  $f$  and  $e$  and reduces temperature parameter  $T$ .

Texture buffer  $g$  remains constant during the operation.

In case of non-blind restoration,  $h$  is given a-priori and remains constant during the annealing cycles, otherwise it is perturbed in a similar manner as  $f$  and cost re-computed.

### The Pseudo-Random number generator

To achieve highly uncorrelated parallel pseudo random sequences is a non-trivial task. We employed the Mersenne Twister (MT) Pseudorandom generator [10] only to create initial seeds for every pixel coordinate. These seeds are generated by the host CPU at the initialisation phase of the algorithm and copied to GPU memory. Each GPU updates the pixel seed by a much simpler multiply-modular pseudorandom generator with seed  $r$ :

$$r' = (ra + b) \bmod m \quad (11)$$

With  $a=1664525$ ,  $b=1013904223$ ,  $m=2^{32}$  (constants from Numerical Recipes)

This later generator, although fast, has a much lower period than the MT, so we reset the seeds periodically, after every 1000 annealing iterations to another sets of random numbers generated on the host by MT.

## 4. RESULTS

As noted in the literature, the convergence speed highly depends on choosing the initial temperature and the temperature decreasing schedule. Based on heuristics, we have chosen  $T_0=0.01$  (using normalized images), and  $T'=0.9999T$

In the example below, we artificially blurred a 128x128 grayscale image with a motion-blur PSF of length  $N=13$  pixels. We annealed the image for 40,000 iterations. In figure 4. it can be seen that the cost function dropped fast in the first 5000 iterations, then the subsequent processing had less improvements.



Fig. 2: Blurred image



Fig. 3: Deblurred

The noise in the images is due to the lack of smoothing constrains in the cost functions ( $\lambda=0$ ) in eq.(7). The figure below shows the decrease of the cost function:

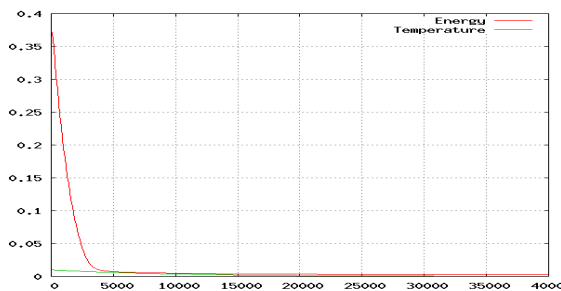


Fig. 4: Energy, Temperature vs Iterations

Table 1. shows execution performance on a GPU: NVIDIA GeForce 8600 card (32 multiprocessors) vs a CPU Intel Core2Duo, running at 2.6GHZ.

Note, that on the CPU a single core was used, no SSE, floating-point instructions, generated by compiler with full optimizations turned on, meaning that this is not the maximum achievable performance on the Intel CPU. The computing was done on 32 bit floating point in both cases, and PSF (Convolution) kernel size was 11x11.

Image size	Time (in s) for 1000 iterations	
	NVIDIA GeForce 8600	Intel Core2Duo 2.6GHz
128 x 128	1.53	4.77
256 x 256	5.94	25.04
512 x 512	23.07	98.06
1024x1024	96.14	383.08

Table 1: Execution performance

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## STATISTICAL TESTING OF RANDOM NUMBER GENERATORS

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**Abstract:** Random numbers are crucial ingredients for a whole range of applications and their consumption is rapidly increasing. In this paper, after a briefly description of random numbers and their wide type of applications, we try to make a comparison between types of RNGs using a statistical test suites that are currently being used according to some issues that need to be considered before recommending a statistical test suite that detects non-randomness in sequences of number.

**Keywords:** Random number, statistical testing, cryptography, PRNG, TRNG, statistical test suite.

### 1. DEFINITION OF A RANDOM SEQUENCE

A random sequence could be interpreted as the result of the flips of an unbiased “fair” coin with sides that are labelled “0” and “1”, with each flip having the probability of exactly 0.5 of producing a “0” or “1”.

Furthermore, the flips are independent of each other; the results of any previous coin flips does not affect future coin flips”. There should be complete forward (and backward) unpredictability. The unbiased “fair” coin is thus the perfect random number generator, since the “0” and “1” values will be randomly distributed. All elements of the sequence are generated independently of each other, and the value of the next element in the sequence cannot be predicted, regardless of how many elements have already been produced.

Encompassing these ideas in a formal mathematical statement the following working definition is proposed:

Let  $n$   $X$  be a sequence of random variables, where  $e$   $n = 1,2,3...n$   $X$  is a binary random variable, meaning that the possible values of  $n$   $X$  are 0 and 1.

If  $P(X = 1 | \text{all others}) = 0.5$   $n$

Or equivalently, the joint distribution of all the sequences is  $0.5^N$  at every point of the sample  $N$  space, of which there are  $2^N$  points.

### 2. APPLICATIONS OF RANDOM NUMBERS

Random numbers are crucial ingredients for a whole range of usages, including cryptography, simulation, gaming, sampling, decision making and aesthetics. The main applications of random numbers are following one:

- Cryptography
- Simulation
- Gaming
- Sampling
- Aesthetics

Random numbers are an important building block in applications across various fields of work and play. The consumption or random numbers is undoubtedly increasing rapidly as is evident from the preceding discussions. The applications range from the critical to the trivial and in the former case great care has to be taken to choose the right type of random number generator as well a random number generator that generates numbers that are sufficiently random.

### 3. TYPES OF RANDOM NUMBER GENERATORS

There are two basic types of generators to produce random sequences – true (or physical) random number generators (TRNGs) and pseudorandom number generators (PRNGs). The essential difference between the two types is that TRNGs sample a source of entropy whereas PRNGs instead use a deterministic

algorithm to generate random numbers. A brief overview of TRNGs and PRNGs are detailed below.

### 3.1. TRUE RNGS

A true random number generator requires a naturally occurring source of randomness, i.e. entropy, to generate random numbers. It samples this source of entropy and processes it through a computer to produce a sequence of random numbers. True RNGs refer to physical RNGs and should not be taken as completely random because they are called “true”. True random numbers are by definition entirely unpredictable. The use of a distillation process is generally needed to overcome any weaknesses in the entropy source that results in the production of non-random numbers (e.g. the occurrence of long strings of zeroes or ones). The entropy source typically consists of some physical quantity, such as atmospheric noise from a radio the elapsed time between the emission of particles during radioactive decay the thermal noise from a semiconductor diode or the frequency instability of a free running oscillator. There are more novel sources of entropy used to generate random numbers such as the photographs of lavalamps.

### 3.2. PSEUDO-RNGS

Pseudo random numbers are not strictly random; their generation does not depend on a source of entropy. Rather they are deterministic, meaning that they are computed using a mathematical algorithm. If the algorithm and the seed are known then the numbers generated are predictable.

The main objective with PRNGs is to obtain sequences that behave as if they are random. The output sequences of many PRNGs are statistically indistinguishable from completely random sequences and ironically, PRNGs often appear to be more random than random numbers obtained from TRNGs

### 3.3. COMPARISON OF RNGS AND PRNGS

Both true random number generators and pseudorandom number generators have their advantages and disadvantages. Generally the limitation of one type is the merit of the other. Because of this only the advantages and disadvantages of TRNGs are listed in Table 1 (in considering PRNGs reverse the advantages and disadvantages of the TRNG). The table applies to true RNGs that are deemed to be completely random. This analysis perhaps sheds light on the suitability of particular RNGs to particular applications.

Tabel 1 Advantages and Disadvantages of TRNGs

<b>True RNGs</b>	
<b>Advantages</b>	<b>Disadvantages</b>
No periodicities	No predictability of random numbers based on
Slow and inefficient	knowledge of preceding sequences
	Cumbersome to install and run
Certainty that there are no dependencies	present
random number sequences are not	reproducible
High level of security	Conceptually nice – not based on algorithm
Costly	Possibility of manipulation

## 4. REVIEW OF TEST SUITE

### a. Crypt-X test suites [1]

The Crypt-X suite of statistical test was developed by researchers at the Information Security Research Centre at Queensland University of Technology in Australia and is a commercial software package

Crypt-X tests are applied based on the type of algorithm being tested and so is obviously geared towards the testing of pseudo random number generators. Crypt-X supports stream ciphers, block ciphers and keystream generators.

These tests are applied to the key generator blocks.

1. *Frequency* -tests the distribution of the the number of ones in the block, based on an equal proportion of ones and zeros.
2. *Binary Derivative* - tests the distribution of the number of bit changes in each block, based on a 1-bit *memoryless* source.
3. *Sub-blocks* - tests the uniformity of all 1-bit positions and pairwise independence of all 2-bit positions in the block. Tests the uniformity of sub-blocks for a chosen number of bit positions in the block.
4. *Entropy* – an estimate of the block *entropy* (number of independent bits in the block) is obtained on the whole block or by dividing the block into smaller sub-blocks.

b. NIST test suites [3]

Released in 2001, the NIST Statistical Test Suite is a statistical package consisting of 16 tests that were developed to test the randomness of arbitrary long binary sequences produced by either hardware or software based cryptographic random or pseudorandom number generators. The test suite is the result of collaborations between the Computer Security Division and the Statistical Engineering Division at NIST in response to a perceived need for a credible and comprehensive set of tests for binary (not uniform) random number generators. The test suite makes use of both existing algorithms culled from the literature and newly developed tests. NIST is now by and large the standard in the world of RNG testing.

1. *Frequency (Monobit) Test* - The focus of this test is the proportion of zeroes and ones for the entire sequence. The purpose of this test is to determine whether the number of ones and zeros in a sequence are approximately the same as would be expected for a truly random sequence. The test assesses the closeness of the fraction of ones to  $1/2$ , that is, the number of ones and zeros in a sequence should be about the same.
2. *Frequency Test within a Block* - The focus of this test is the proportion of ones within M-bit blocks. The purpose of this test is to determine whether the frequency of ones in an M-bit block is approximately  $M/2$ , as

would be expected under the assumption of randomness.

3. *Runs Test* - The focus of this test is the total number of runs in a sequence, where a run is an uninterrupted sequence of identical bits. A run length of k consists of exactly k identical bits and is bounded before and after with a bit of opposite value. The purpose of the runs test is to determines whether the number of runs of ones and zeros of various lengths is ass expected for a random sequence. In particular, this test determines whether the oscillation<sup>14</sup> between such zeroes and ones is too fast or too slow.
4. *Test for the Longest Run of Ones in a Block* – The focus of the test is the longest run of ones within M-bit blocks. The purpose of this test is to determine whether the length of the longest run of ones within the tested sequence is consistent with the length of the longest run of ones that would be expected in a random sequence. Note that an irregularity in the expected length of the longest run of ones implies that there is also an irregularity in the expected length of the longest run of zeroes. Therefore, only a test for ones is necessary.
5. *Binary Matrix Rank Test* - The focus of the test is the rank of the disjoint sub-matrices of the entire sequence. The purpose is to check for linear dependence among fixed length substrings of the original sequence. This test also appears in the DIEHARD battery of tests.
6. *Discrete Fourier Transform (Spectral Test)* - The focus of this test is the peak heights in the Discrete Fourier Transform of the sequence. The purpose of this test is to detect periodic features (i.e., repetitive patterns that are near each other) in the tested sequence that would indicate a deviation from the assumption of randomness. The intention is to detect whether the number of peaks exceeding the 95 % threshold is significantly different than 5 %.
7. *Non-overlapping Template Matching Test* - The focus of this test is the number of occurrences of pre-specified target strings. The purpose of this test is to detect generators that produce too many occurrences of a given non-periodic (aperiodic) pattern. For this test and the Overlapping Template Matching Test of

Section X), an m-bit window is used to search for a specific m-bit pattern. If the pattern is not found, the window slides one bit position. If a pattern is found, the window is reset to the bit after the found pattern, and the search resumes.

8. *Overlapping Template Matching Test* - The focus of the Overlapping Template Matching test is the number of occurrences of prespecified target strings. Like the Non-overlapping Template Matching test, this test uses an m-bit window to search for a specific m-bit pattern. In this test also the window slides one bit position if the pattern is *not* found. However, if the pattern *is* found then the window slides only one bit before resuming the search as opposed to sliding the m-bits.
9. *Maurer's "Universal Statistical" Test* - The focus of this test is the number of bits between matching patterns (a measure that is related to the length of a compressed sequence). The purpose of the test is to detect whether or not the sequence can be significantly compressed without loss of information. A significantly compressible sequence is considered to be non-random.
10. *Linear Complexity Test* - The focus of this test is the length of a linear feedback shift generator (LFSR). The purpose of this test is to determine whether or not the sequence is complex enough to be considered random. Random sequences are characterised by longer LFSRs. A LFSR that is too short implies nonrandomness.
11. *Serial Test* - The focus of this test is the frequency of all possible overlapping m-bit patterns across the entire sequence. The purpose of this test is to determine whether the number of occurrences of the  $2^m$  m-bit overlapping patterns is approximately the same as would be expected for a random sequence. Random sequences have uniformity; that is, every m-bit pattern has the same chance of appearing as every other m-bit pattern. Note that for  $m=1$ , the serial test is equivalent to the frequency test.
12. *Approximate Entropy Test* - As with the Serial test, the focus of this test is the frequency of all possible overlapping m-bit patterns across the entire sequence. The purpose of the test is to compare that frequency of

overlapping blocks of two consecutive/adjacent lengths ( $m$  and  $m+1$ ) against the expected result for a random sequence

13. *Cumulative Sums (Cusum) Test* - The focus of this test is the maximal excursion (from zero) of the random walk defined by the cumulative sum of adjusted (-1,+1) digits in the sequence. The purpose of the test is to determine whether the cumulative sum of the partial sequences occurring in the tested sequence is too large or too small relative to the expected behaviour of that cumulative sum for random sequences. This cumulative sum may be considered as a random walk. For a random sequence, the excursions of the random walk should be near zero. For certain types of non-random sequences, the excursions of this random walk from zero will be large.
14. *Random Excursions Test* - The focus of this test is the number of cycles having exactly  $K$  visits in a cumulative sum random walk. The cumulative sum random walk is derived from partial sums after the (0,1) sequence is transferred to the appropriate (-1,1) sequence. A cycle of a random walk consists of a sequence of steps of unit length taken at random that begin at and return to the origin. The purpose of this test is to determine if the number of visits to a particular state within a cycle deviates from what one would expect for a random sequence. This test is actually a series of eight tests (and eight conclusions), one test and one conclusion for each of the states: -4, -3, -2, -1 and +1, +2, +3, +4.
15. *Random Excursions Variant Test* - The focus of this test is the total number of times that a particular state is visited (i.e., occurs) in a cumulative sum random walk. The purpose of this test is to detect deviations from the expected number of visits to various states in the random walk. This test is actually a series of eighteen tests (and conclusions), one test and conclusion for each of the states: -9, -8, ..., -1 and +1, +2, ..., +9.

c. FIPS Test suites [2]

1. *Monobit test* – Count the number of ones in the 20,000 bit stream.
2. *Poker test* – Divide the 20,000 bit stream into 5,000 consecutive 4 bit segments. Count and store the number of occurrences of the 16 possible 4 bit values.
3. *Runs test* – A run is defined as a maximal sequence of consecutive bits of either all ones or all zeros that is part of the 20,000 bit sample stream. The incidences of runs (for both consecutive zeros and consecutive ones) of all lengths ( $\geq 1$ ) in the sample stream should be counted and stored
4. *Long run test* – A long run is defined to be of length 26 or more (of either zeros or ones). On the sample of 20,000 bits, the test is passed if there are no long runs.

### 5. RESULTS AND CONCLUSIONS

Two comparative true random number generators, Hotbits and Randomnumbers.info were subjected to the NIST suite of tests once. Hotbits passed all tests while Randomnumbers.info failed two tests.

Table 2 P-values for TRNG comparative

P-Values			
		RN.info	Hotbits
1	Frequency (monobit)	1.0000	0.8415
2	Frequency (block)	0.3970	0.0914
3	Runs test	0.1096	0.6920
4	Longest run of ones in a block	0.9436	0.1654
5	Binary matrix rank	0.0732	0.2866
6	Discrete fourier transform (spectral)	0.9750	0.3178

7	Non-overlapping template matching	0.0000	0.2860
8	Overlapping template matching	0.0000	0.0868
9	Maurer's universal statistical	0.6498	0.8207
10	Linear complexity	0.8347	0.1624
11	Serial	0.7678	0.8010
12	Approximate entropy	0.3818	0.9310
13	Cumulative sums	0.2192	0.3230
14	Random excursions	0.9920	0.3264
15	Random excursions variants	0.2716	0.6480

Table 2 shows the p-value results of the two true random number generators – Randomnumbers.info and Hotbits. Both were subjected to suite of tests once. Hotbits passed all the tests in the suite (all p-values are greater than 0.01). Randomnumbers.info failed both the Non-overlapping and Overlapping Template Matching test. The generator should not be deemed non-random because of these failures. Rather, these failures are evidence of non-randomness. Further testing should be done before any definitive conclusion is made.

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2. <http://www.isi.qut.edu.au/resources/cryptx/tests.php>
3. NIST Special Publication 800-22 – A Statistical Test Suite For Random And Pseudorandom Number Generators For Cryptographic Applications

## ANALYTICAL MODEL OF A QUANTIFYING AND ASSESSING THE COUNTRY RISK

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### Abstract

*This type is meant to facilitate the quantification and assessment of the severance risk factors and also the drafting, drawing up of a chart risk. Depending on this, some international comparisons might be achieved for the use of the export the country.*

*Five groups of relevant indicators are used. The sum of the indicators may be situated between zero, that has maximum risk and 100 for a minimum risk*

*The method through which this potential is materialized depends on the specific characteristic of each transaction.*

Model risk assessment for the country aims to facilitate quantification and evaluation of risk factors for the country and prepare a risk rating of the country, which constitutes an optimal international comparisons, required for a policy of export orientation. The model uses five groups of indicators relevant to the risk of the country, each indicator being associated with a given and the scoring, after a pre-scale. Sum scores are associated with indicators of the country's total score, which can be between 0, corresponding to a maximum risk, and 100 corresponding to a minimum risk.

The five groups of indicators are to:

- economic and social performance, with a share of 25%
- economic policy, with a share of 10%
- external balance situation, with a share of 20%
- external debt situation, with a share of 25%

- juncture social policy, with a share of 20%

Technical granting real scores associated to the indicators is the following:

A. **ECONOMIC AND SOCIAL PERFORMANCE** is ranked with maximum of 25 points and is assessed according to:

**A1. a. international financial situation, which is awarded to:**

- one point if a budget deficit \ GDP is less than or equal to 3%
- zero points if the budget deficit \ GDP is less than 3%

**A1. b. sectorial situation, which is granted:**

- a point, if the agricultural gross domestic product is lower than the gross domestic product industry,
- zero points if the agricultural gross domestic product is



greater than or equal to gross domestic product industry

**A1. c. unemployment level, which provide:**

- one point if unemployment is less than 10%
- zero points if unemployment is greater than or equal to 10%

**A1. d. monetary stability which is given:**

- two points if the exchange rate stability is a good point if monetary depreciation is slow or the exchange rate is very high
- zero points if the depreciation is rapid monetary

**A2. Gross domestic product per capita (USD) in the calculation, measured as follows:**

- five points for values greater than or equal to 8001
- four points for values between 5001-8000
- three points for values between 3001-5000
- two points for values between 2001-3000
- one point for values between 1001-2000
- zero points for values less than or equal to 1000

**A3. Evolution of gross domestic product per capita (0%), which measure as follows:**

- five points for values greater than or equal to 6.01
- four points for values between 4.01 and 6.00
- three points for values between 2.51 and 4.00
- two points for values between 1.51 and 2.50

- one point for values between 0.51 and 1.50
- zero points for values less than or equal to 0.50

**A4. Inflation rate (%) that measure as follows:**

- five points for values less than or equal to 10
- four points for values between 10-20
- three points for values between 20-30
- two points for values between 30-40
- one point for values between 40-50
- zero points for more than 50

**A5. Business climate, evaluated according to:**

**A5 a. the inflow of foreign capital, measured as follows:**

- 2 points for large foreign investments, funding for projects in the long term,
- 1 point for large foreign investments, but intended for speculative purposes,
- zero points for foreign investment reduced

**A5 b. level of corruption, measured as follows:**

- two points for corruption reduced corruption ,
- one point for extensive corruption,
- zero points for extensive corruption that affects the scope and high-level decisional

**A5 c. judicial efficiency, measured as follows:**

- one point for a good efficiency,
- zero points for low efficiency.

**B. ECONOMIC POLICY** is rated with a maximum of 10 points and is evaluated according to:

**B1. the report domestic investment / GDP (%), which measure as follows:**

- five points for values greater than or equal to 30.1,
- four points for values between 24.1 and 30.0,
- three points for values between 19.1 and 24.0,
- two points for values between 15.1 and 19.0,
- one point for values between 12.1 and 15.0 ,
- zero points for values less than or equal to 12.0.

**B2. Evaluated the adequacy of economic policy according to:**

**B2 a. the economic policy, which measure as follows:**

- two points for good coherence and durability,
- one point for good coherence,
- zero points for coherence light.

**B2 b. economic opening, evaluated according to the law on foreign investment, non-tariff trade barriers and fiscal policy, measured as:**

- One point for a high opening (low restrictions),
- zero points for a low opening (high restrictions).

**B2 c. economic freedom, which measure as follows:**

- two points to the existence of a functioning market economy,
- one point to the existence of strong elements of market economy.
- zero points if the property is mainly state.

**C. SITUATON EXTERNAL BALANCE OF PAYMENTS** is rated

with a maximum of 20 points and is evaluated based on:

C1. external financial balance, measure as follows:

- Two points to the existence of equilibrium persistent balance of payments.
- one point to the existence of a fluctuating balance of balance of payments.
- zero points for the existence of a considerable deficit and persistent balance of payments or current account.

**C2. The degree of coverage of imports by exports, illustrated by the percentage of the value of exports of goods and services / import of goods and services, which measure as follows:**

- five points for values greater than or equal to 130.1.
- four points for values between 120.1 and 130.0.
- three points for values between 110.1 and 120.0.
- Two points for values between 100.1 and 110.0.
- zero points for a lower amount or equal to 90.0.

**C3. The external resources, excluding gold (expressed in months of imports), measure as follows:**

- Five points for values greater than or equal to 12.1.
- Four points for values between 9.1 and 12.0.
- Three points for values between 6.1 and 9.0.
- Two points for values between 6.1 and 9.0.

- One point for values between 2.1 and 4.0.
- zero points for values less than or equal to 2.0.

**C4. Dependent on exports, the share of exports reflected properly first or the first maximum of three products in total exports achieved, which measure as follows:**

- five points for values greater than or equal to 15.0.
- Four points for values between 15.1 and 25.0
- three points for values between 25.1 and 35.0
- two points for values between 35.1 and 45.0
- one point for values between 45.1 and 55.0
- zero points for values less than or equal to 55.1.

**D. EXTERNAL DEBT SITUATIONE**, with a maximum rated 25 points, which is assessed according to:

**D1. Debt service-export of goods and services (%), measured as:**

- Ten points for values less than or equal to 5.0.
- Nine points for values between 5.1 and 10.0.
- Eight points for values between 10.1 and 15.0.
- Seven points for values between 15.1 and 20.0.
- six points for values between 20.1 and 25.0.
- five points for values between 25.1 and 30.0.
- four points for values between 30.1 and 35.0
- three points for values between 35.1 and 40.0.

- Two points for values between 40.1 and 45.0 .
- one point for values between 45.1 and 50.0.
- zero points for values greater than or equal to 50.1.

**D2. Total external debt to export goods and services (%), which measure as follows:**

- five points for values less than or equal to 100.0.
- Four points for values between 100.1 and 150.0.
- Three points for values between 150.1 and 200.0
- Two points for values between 200.1 and 250.0.
- one point the values contained 250.1 and 300.0.
- zero points for values less than or equal to 300.1.

**D3. Structure of external debt (%) reflected the value of external debt in the short term / Total external debt, which measure as follows:**

- five points for values less than or equal to 5.0
- four points for values between 5.1 and 10.0
- three points for values between 10.1 and 15.0
- two points for values between 15.1 and 20.0
- one point for values between 20.1 and 25.0
- zero points for values greater than or equal to 25.1.

**D4. The external debt management, reflected as:**

**D4 a. relations with the IMF, which quantifies this:**

- one point for a normal relationship.

- Zero points for difficult relationships.

**D4 b. access to international capital markets, measured as:**

- one point for easy access .
- zero points for difficult access, or nonexistent.

**D4 c. relations with creditors, quantified as follows:**

- two points for preferential relationships.
- for a normal relationship.
- zero points for difficult relationships.

**D4 d. experience bilateral relations (between the partners), such quantified as:**

- one point a good relationship
- zero points for problematic relationships.

**E. CONJUNCTURE SOCIAL POLICY** , rated with a maximum 20 points, which is calculated according to:

**E1. The social tensions, such quantified.**

- Ten-point for social stability, tolerance, high civism.
- Nine points for low voltages, without destabilizing potential.
- Eight points for the significant political tensions.
- Seven points for political and economic tensions high (unequal distribution of national income, large disparity of living standards of different social groups, etc.)..
- six points for the political tensions, economic and social high.
- five points to political tensions, economic, social and religious high.
- four points to political tensions, economic, social, and irreligious Ethnic large.

- Three points for political tensions, economic, social, religious, ethnic and large ethnic.

- Two points for repression extended or serious violations of human rights.

- One point for uprising for an insurgent movements or large.

- zero points for civil war.

**E2. The political system, which measure as follows:**

- five points for the democratic political system, with regular changes of government, without diverging from the big parties.

- Four points for the democratic political system, with regular changes of government, parties that alternate in government but with orientation very different policy.

- three points for democratic political system, with high instability (frequent changes of government and / or weak governments).

- two points for the political system of democratic orientation.

- one point for undemocratic political system, with authoritarian or dictatorial government.

- zero points the undemocratic political system with totalitarian government, incompetent or irresponsible.

**E3. international position, measured as follows:**

- five points for good relations with neighbors and direct preferential great powers.

- four points for good relations with neighbors and direct large powers.

- three points for cold relations with neighbors.

- two points to strong tensions with its neighbors.

- one point for local confrontations or limited war.

- zero points for war large and / or international isolation.

The model presented above treats the analysis of country risk in the sense or the more general and can consider what is actually a tool for assessing the potential risk of the country. The way in which this potential is materializing depends, sometimes decided by the specific characteristics of each part in economic transactions. Depending on the potential risk of a country and the business at risk, can materialize in various forms of country risk and can cause damage to various extensions. Using an analytical model to quantify the risk of leading the country, finally, to characterize the level of risk specific to each country by a number representing a point located in the interval between 0 points and 100 points. Risk Rating is a ranking of countries according to level of country risk and constitutes an effective tool for tracking the evolution of comparative countries monitored to substantiate the strategic decisions.

A division of classes in the classification of risk, depending on the hierarchy level possible losses for each class giving some recommendations for addressing economic transactions, it could be as follows:

- 1) **Class A** (81-100 points) corresponds to a minimal level of potential risk of the country. Protection is not required.
- 2) **Class B** (66-80 points) corresponds to a good level of potential

risk country. Protection is optional. Possible losses are reduced.

- 3) **Class C** (45-65 points) corresponds to a critical level of potential country risk. In operations where short-term commercial use is recommended irrevocable letter of credit. For long-term projects, from case to case, may consider the need for government guarantees. The losses may be total.

- 4) **Class D** (35-44 points) corresponds to a high level of potential risk country. It is recommended to deal with large commercial operations caution in the short term. For long-term projects is recommended a waiting period. Losses may be total.

- 5) **Class E** (0-34 points) corresponds to a potential high risk country. Because insolvency market, it is recommended, at least in the short term, avoiding any economic transaction.

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## EVALUATING THE PERFORMANCE OF PARALLEL SYSTEMS

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**Abstract.** *The execution time of a parallel algorithm depends not only on input size but also on the number of processing elements used and their relative computation and interprocess communication speeds. Hence, a parallel algorithm cannot be evaluated in isolation from a parallel architecture without some loss in accuracy. A parallel system is the combination of an algorithm and the parallel architecture on which it is implemented.*

*A number of measures of performance are intuitive yet not definitive. Due to the complexity of defining the performance gains of parallel computing it must be assessed through various methods. Some measures quantify the benefit of parallelism, i.e. how much faster the parallel program runs with respect to the serial program. However, this characterization suffers several drawbacks. With this in mind, this article focuses on metrics for quantifying the performance of parallel programs and we will show the various metrics for evaluating the performance of parallel systems.*

**Keywords.** *Accuracy, quantify, parallel system, performance.*

### 1. SPEED-UP

In case of a sequential algorithm, the computing time ( $t_s$ ) is calculated with respect to the entering data dimension, on the other hand, a parallel algorithm is evaluated on the basis of the computing which does not depend only on the dimension of the inputs but also on the parallel architecture of the computer as well as on the number of processors existing in the system. The parallel computing time ( $t_p$ ) represents the time passed since the moment in which the parallel programme is launched into computing till the last processor ends its computing.

The test applications were rolled on an experimental system grid and achieved on the basis of the algorithms detailed as follows. This system is made up of computers linked together, using an Ethernet web of 100Mbit and one of 1Gbit. As a software we use the Globus Toolkit [7], and to develop the parallel applications on the GRID we installed an implementation (Open MPI) of the MPI standard (Message Passing Interface, [5]). All these were elaborated

after studying the parallel programming concepts [6]. The programs are achieved using the Open MPI implementation [3, 4] of the MPI standard and are rolled on the experimental grid made up of seven computers out of which one represents the server and the other six the calculation knot.

To measure the parallel computing time, necessary to determine the standard parameters in an MPI application, we use the MPI Wtime function. This function returns a double value, value that represents the time passed from a past arbitrary moment. Implicitly, from this point, one may calculate all the parameters and, as such, test the performance of the parallel algorithms [1, 2, 8].

To compare different algorithms, for the addition of n numbers on p processors, we use some sets of standard parameters. One of these is the speed which indicates the reduction of the computing time when one passes from the serial computing to the parallel one. This indicator is expressed as the ratio between the computing time in the most unfavourable case of the most rapid sequential algorithm which solves a certain problem and the computing time necessary to a parallel algorithm to solve the same problem on

a system with  $p$  processors identical to the one of the sequential computer.

$$S_p = \frac{t_s}{t_p}$$

When the calculations are equally distributed to the  $p$  processors and there are no communication and synchronizing operations, it results that:

$$t_p = \frac{t_s}{p}, \text{ and}$$

$$S_p = p.$$

The algorithm to add  $n$  numbers on  $n$  processors, ( $n$  is a power of 2, the processors and the numbers that must be added are numbered from 0 to  $n-1$ ), has the following steps: initially, each processor has in its local memory one of the values that must be summed up and each processor of odd order transfers the value it contains to the processor to his left which achieves the partial sum. After the first step, there remain  $\frac{n}{2}$  values (partial sums) to be added on  $\frac{n}{2}$  processors. The procedure is repeated, after a number of  $\log n$  steps, the final sum is to be found in the first processor. The estimation of the speed for the adding algorithm of  $n$  values using  $n$  processors is  $S_p = O\left(\frac{n}{\log n}\right)$ .

Appealing to the MPI\_Wtime function before and after calculating the sum and making the difference between the two values ( $t_2 - t_1$ ), we obtained the computing time in seconds.

```
t1 = MPI_Wtime();
for(int i = 1; i < p; i = i*2)
{ if(my_rank % (i*2) == i)
{ MPI_Send( &value,1, MPI_INT,
my_rank - i, 0, MPI_COMM_WORLD );}
if(my_rank % (i*2) == 0)
{MPI_Recv( &value_rec, 1, MPI_INT,
my_rank + i, 0, MPI_COMM_WORLD,
&status);
value = value + value_rec;}}
t2 = MPI_Wtime();
```

```
if(my_rank == 0)
{ printf("The numbers from 0...p were
added");
printf("\The n total value is %d\n", value);
printf("The computing time is: %f seconds",
t2-t1);
fflush( stdout );
}
```

The following table presents the result displayed by this application, for different values of  $p$ .

n=p	We added the numbers from 0 to p	Total value	The computing time is in seconds	Speed
16	0 – 15	120	0.024026	665.945226
32	0 – 31	496	0.038302	835.465511
64	0 – 63	2016	1.355970	47.198684

We notice that the computing time increases when  $n$  increases, thus, speed is lowering.

## 2. EFFICIENCY, COST AND OPTIMUM COST

Evaluating the way the processors are used in the system is done with another parameter, namely efficiency (see [8]), speed divided to  $p$ , the value of which is always subunitary, only in the ideal case its value being 1.

$$E_p = \frac{S_p}{p}$$

For the addition of  $n$  numbers on  $n$  processors the efficiency is:

$$E_p = \frac{S_p}{n} = O\left(\frac{1}{\log n}\right).$$

The product between the calculation time and the number of processors would be another parameter, namely the cost [8]:

$$C_p = t_p \cdot p.$$

The cost obtained for the addition of  $n$  numbers on  $n$  processors will be:

$$C_p = t_p \cdot n = O(n \log n) > O(t_s).$$

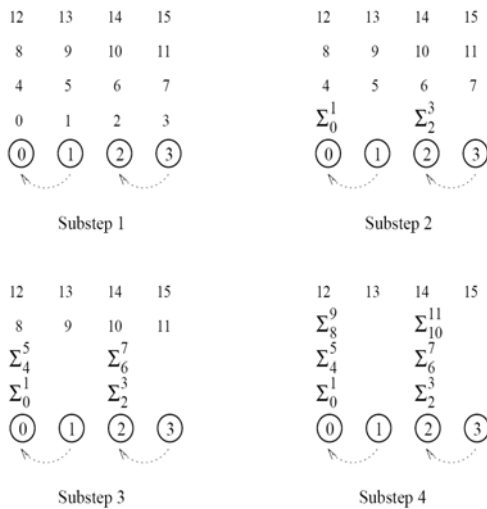
n=p	The computing time is in seconds	Speed	Efficiency	Cost
16	0.259744	61.599112	3,8499446	4,155904
32	0.766888	41.727084	1,3039714	24,540416
64	1.363303	46.944809	0,7335127	87,251392

In the following table we present the calculation of efficiency and cost, for different values of  $p$ , using the computing time calculated with the previous algorithm.

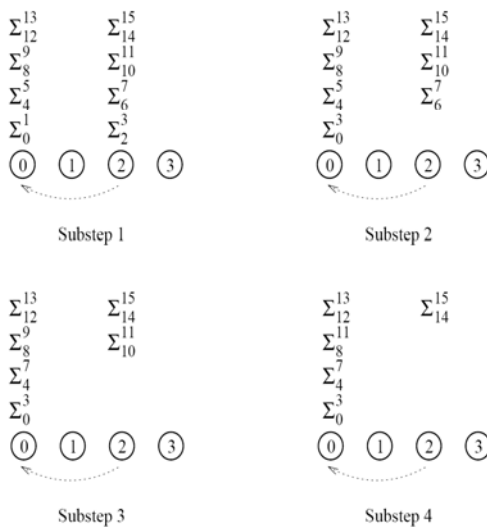
From the table we notice that the algorithm of adding  $n$  numbers ( $n = p$ ) from above is not the optimum cost, as it increases.

A parallel algorithm is considered to be the optimum cost if its parallel cost is related to the computing time of the most rapid serial algorithm that solves the respective problem:

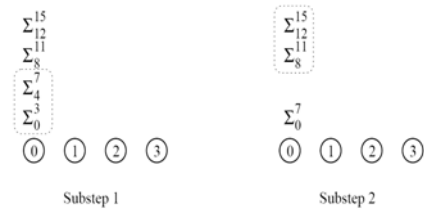
$$C_p = k \cdot t_s$$



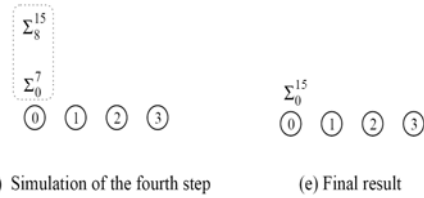
(a) Four processors simulating the first communication step of 16 processors



(b) Four processors simulating the second communication step of 16 processors



(c) Simulation of the third step in two substeps



(d) Simulation of the fourth step

(e) Final result

(continued) Four processing elements simulating 16 processing elements to compute the sum of 16 numbers (last three steps).

Using the previous relation, the parallel efficiency becomes:

$$E_p = \frac{C_s}{C_p} = \frac{t_s}{p \cdot t_p} = \frac{t_s}{k \cdot t_s} = \frac{1}{k} = O(1)$$

This equation shows that an algorithm of optimum cost has the efficiency of order  $O(1)$ , constant in the relation to the dimension of the problem and to the number of processors used for its solving.

### 3. GRANULARITY

A qualitative measure of the ratio between the calculation and communication is represented by the granulation capacity (see [8]).

The value of the parameters calculated previously, to add  $n$  numbers on  $n$  processors, indicates that the parallel variant is not the optimum cost, and if  $n$  increases, efficiency will decrease.

Then we can increase the granulation capacity using a smaller number of processors (e.g. for  $n = 16$  and  $p = 4$ ), so that every processor will receive  $\frac{n}{p}$  data which we shall add with the serial algorithm, and the final sum is obtained with the help of the same model of binary tree.

If at each level of the tree we use two time units, one for the sum and one to send the result away, then we obtain:



$$t_p = \frac{n}{p} + 2 \log p$$

$$S_p = \frac{np}{n + 2p \log p}$$

$$E_p = \frac{n}{n + 2p \log p}$$

$$C_p = n + 2p \log p$$

If  $n = W(p \log p)$ ,

then

$$C_p = O(n) = O(T_s),$$

it results that the algorithm is the optimum cost.

The following application will calculate the computing time when we use a smaller number of processors:

```

for( j = 0; j < p; j++)
    value[j] = j * p + my_rank;
//initialize the values that will add...
t1 = MPI_Wtime();
for(int i = 1; i < p; i = i*2)
{
    if(my_rank % (i*2) == i)
        for( j = 0; j < p; j++)
            {MPI_Send( &value[j], 1, MPI_INT,
my_rank - i, 0, MPI_COMM_WORLD );}
        if(my_rank % (i*2) == 0)
            for( j = 0; j < p; j++)
                {MPI_Recv( &value_rec, 1,
MPI_INT, my_rank + i, 0,
MPI_COMM_WORLD, &status);
                value[j] = value[j] + value_rec;}
}
if(my_rank == 0)
{ for( j = 0; j < p; j++)
    total_value += value[j];}
t2 = MPI_Wtime();
if(my_rank == 0)
{
    printf("We added the numbers from
0....%d", p*p - 1);
    printf("\nThe total nValue is %d\n",
total_value);
    printf("The computing time is: %f
seconds \n", t2-t1);
    fflush( stdout );
}
    
```

The following table presents the results displayed by this application, to add n numbers on p processors for different values of p.

p	We added the numbers from 0 to $p^*p-1$	Total value	The computing time is in seconds
4	0 - 15	120	0.004533
8	0 - 63	2016	0.008976
16	0 - 255	32640	0.034183
32	0 - 1023	523776	0.058168
64	0 - 4095	8386560	1.159968

Comparing the two tables, we notice that the computing time for this algorithm to add n numbers on p processors is more efficient than the one calculated with the previous algorithm.

An alternative method to add n numbers using p processors is illustrated in the nearby figure, also for  $n = 16$  and  $p = 4$ . In the first step of this algorithm every processor locally adds the

$\frac{n}{p}$  numbers in the time  $O\left(\frac{n}{p}\right)$ . Now the problem is reduced to the addition of the p partial sums on the p processors, which is executed in the time  $O(\log p)$ , the parallel computing time of this algorithm is given by the equation

$$T_p = O\left(\frac{n}{p} + \log p\right)$$

and of the cost

$$O(n + p \log p)$$

While

$$n = W(p \log p),$$

the cost is  $O(n)$ , which is similar to the serial computing time. Wherefrom this parallel algorithm is the optimum.

To prove this thing we achieved the following program which calculates the computing time to add n numbers on p processors.

```

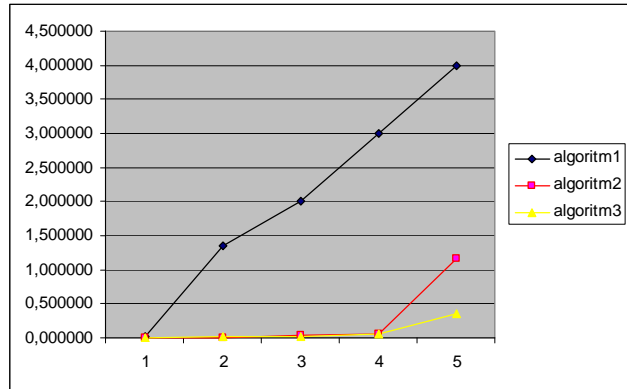
t1 = MPI_Wtime();
for( j = 0; j < p; j++)
    partial_value += value[j];
for(int i = 1; i < p; i = i*2)
{
    if(my_rank % (i*2) == i)
    
```

```

MPI_Send(&partial_value, 1,
MPI_INT, my_rank - i, 0,
MPI_COMM_WORLD);
    if(my_rank % (i*2) == 0)
    {
        MPI_Recv( &value_rec, 1, MPI_INT,
my_rank + i, 0, MPI_COMM_WORLD,
&status);
        partial_value = partial_value +
value_rec;}
    }
t2=MPI_Wtime();
if(my_rank == 0)
{
    printf("We added the numbers from
0....%d", p*p -1);
    printf("\The total nvalue is %d\n",
partial_value);
    printf("The computing time is: %f
seconds \n", t2-t1);
    fflush( stdout );
}
}
    
```

p	The numbers from 0 to p*p-1 were added	Total value	The computing time is in seconds
4	0 – 15	120	0.004528
8	0 – 63	2016	0.011058
16	0 – 255	32640	0.016496
32	0 - 1023	523776	0.054482
64	0 - 4095	8386560	0.362191

We present the computing time obtained with the three algorithms noticing that the third algorithm is the most efficient.

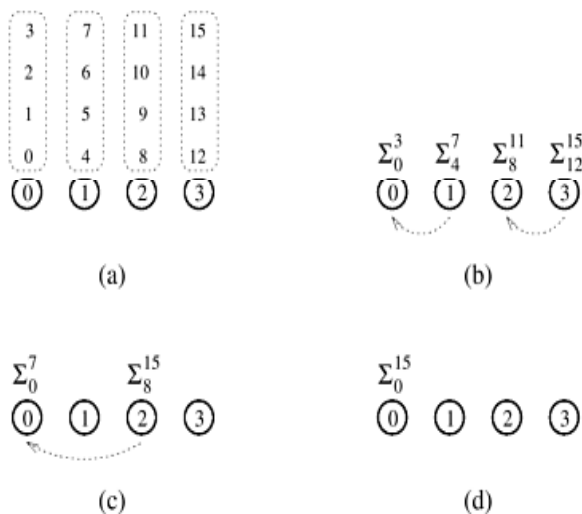


These simple examples show that the way of dividing the calculations on processors may determine if the parallel algorithm is optimum or not.

The possibility to assure the speed increase in the same time with the increase of the number of processors is given by another parameter, namely scalability ([8]), which could be defined also as maintaining a constant efficiency by the simultaneous growth of the problem dimension and the number of processors.

#### 4. CONCLUSIONS

Every process of projecting an algorithm aims to obtain a correct and performing result. In the case of the parallel algorithms, the performance cannot be characterized by a single figure. It depends on the category of applications in which the algorithm is used, many times the performance being a function of the characteristics of the product program achieved (computing time, occupied memory, number of used processes, scalability, efficiency, reliability, tolerance to breakdowns, portability), and of the costs implied by the different phases of the life cycle (projecting, implementation and maintenance). As in every situation in which there are several alternatives, the same in the case of parallel algorithms, the choice must be made on the condition of understanding the cost of the different variants. Estimating the costs asks for the use of some metrics and performing models. They allow the comparative evaluation of the solutions, the identification of the narrowing sections, the elimination of



inefficiencies, even before investing effort for their implementation.

Thus, projecting a parallel calculation system must be done by taking into account the performance parameters presented above and obeying Amdahl's law. Not obeying these, or their minimizing lead to unsatisfactory results that are arguments against parallel calculus.

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## ABOUT SIMULATION WITH FRACTAL INTERPOLATION USING LAGRANGIAN TRACKING OF PARTICLES

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**Abstract:** A closure model for Lagrangian tracking of particles, starting from LES flow data, is presented. The basic idea is to reconstruct the velocity field from the knowledge of its filtered values on a coarse grid, by means of fractal interpolation. Two different practical implementations of fractal interpolation are considered: in the first, the stretching parameters are assumed constant and a-priori assigned, while, in the second, they are computed by using DNS velocity fields. Validation is carried out by means of a-priori tests for turbulent channel flow. DNS data are filtered through either a cut-off or a top-hat filter; different filter widths are considered. Six different sets of particles are tracked, having characteristic relaxation times ranging over a huge interval. Particle statistics and concentration are computed, with and without fractal interpolation, and compared to those obtained starting from the DNS velocity fields.

**Key words:** Brownian motion, LES flow data, DNS velocity fields

### 1. INTRODUCTION

Fractals are shapes in which parts of the shape resemble the whole shape in some way. Brownian motion, a type of random walk, is a fractal. Fractional Brownian motion, a biased random walk in which the walker favors certain directions at each step, is also a fractal. Used to model a wide range of phenomena, from river levels and landscape topography to computer network traffic and stock market indicators, fractional Brownian motion is easy to find in natural processes but not as easy to simulate.

This paper introduces a new simulation algorithm called fracture-stretch and compares its effectiveness to existing simulation algorithms.

Direct Numerical Simulation (DNS) together with Lagrangian particle tracking has been quite extensively used to investigate and measure the mechanisms of particle transfer in a turbulent boundary layer. Clearly, DNS is limited to low Reynolds numbers, while the simulation of turbulent flows at higher Reynolds numbers can be tackled using Large-

Eddy Simulation (LES). As for the fluid dynamic part, the closure problem of LES equations has been deeply investigated and several Sub-Grid Scale (SGS) models have been proposed and tested. Let us assume, for the moment, one-way coupling between the two phases (i.e. the fluid dynamics governing equations are unchanged) [7].

Since only the filtered fluid velocity,  $\bar{u}$ , is available from LES, while the particle motion depends on the actual fluid velocity, a closure model should in principle be needed to reintroduce the SGS velocity fluctuations. However, this point has received little attention in the literature, especially if compared with the huge amount of work devoted to the closure problem for the fluid dynamic part.

The work by Armenio et al. [1] on dispersion statistics of tracer particles in LES of turbulent channel flow indicated that SGS effects may be neglected for well resolved LES and several simulations in the literature were carried out without any SGS model for the particle motion equations.

However, more recent a-priori and a-posteriori tests showed that LES is not able to

accurately predict the statistics and the concentration of particles of finite inertia if SGS effects in the particle equations are ignored. We proposed a closure model for the particle motion equations based on fractal interpolation, previously used by Scotti and Meneveau [6] to construct SGS models for the Navier-Stokes equations.

The aim of the present work is to provide further validation to this model through the Lagrangian tracking of 6 sets of particles, characterized by relaxation times spanning a huge interval, starting from filtered DNS or LES turbulent channel flow data. Furthermore, we improve upon the original formulation of the fractal interpolation by using an algorithm which allows the stretching parameters (free-parameters in the interpolation) to be computed from DNS data, without any a-priori knowledge of the fractal dimension of the velocity signal.

## 2. CHANNEL FLOW SIMULATION

Particles are introduced in a pressure driven incompressible turbulent channel flow. We assume that particle number density and particle size are both small, and that there is no feedback of the particles onto the gas flow.

The equations for the fluid phase are discretized through a pseudo-spectral method, using Fourier representations for the streamwise and spanwise directions and a Chebyshev representation for the wall-normal (non-homogeneous) direction.

A two-level explicit Adams-Bashforth scheme for the nonlinear terms and an implicit Crank-Nicolson method for the viscous terms were employed for time advancement. In the present study, the shear Reynolds number is equal to 150 and the Reynolds number based on mean velocity and half duct width is  $\cong 2066$ .

The computational domain is  $1885 \times 942 \times 300$  wall units in the streamwise, spanwise and normal directions;  $128 \times 128$  Fourier modes in the homogeneous directions and 129 Chebyshev polynomials in the normal one are used for DNS. Statistics of the flow field match closely with those of other DNS published in the literature.

## 3. PARTICLE TRACKING

Particles are injected into the flow at concentration low enough for particle-particle interaction due to their inertial force to be negligible and particles are assumed pointwise, rigid, spherical and obeying the following vectorial Lagrangian equation of motion:

$$\frac{dv}{dt} = \frac{1 + 0.15 \text{Re}_p^{0.687}}{\tau_p} (u - v) \quad (1)$$

in which “ $v$ ” is the particle velocity vector, “ $u$ ” is the fluid velocity vector at particle location, “ $\text{Re}_p$ ” is the particle Reynolds number, “ $\tau_p$ ” is the particle relaxation time. In the present simulations,  $10^5$  flyash particles, characterized by a particle to fluid density ratio equal to 769.23, have been released at randomly chosen locations within the computational box.

The Lagrangian particle tracking code integrates Eq. (1) by an explicit method, using the channel flow code to supply the fluid velocity field at each time step. The initial velocities of the particles were set equal to the interpolated fluid velocities at each particle location. Eq. (1) does not include wall effects: in our calculations, we simply considered that a particle is elastically reflected away from the wall when its center is at a distance from the boundary lower than half of the particle diameter.

The fluid forces acting on each single particle are calculated with a Lagrange interpolation of order three. Six different sets of particles have been tracked, characterized by different Stokes numbers (adimensionalized relaxation times), viz. 0.2, 1, 5, 10, 25 and 125.

The time step for the numerical simulation of the channel flow is equal to half the relaxation time of the smallest particles [7].

## 4. FRACTAL INTERPOLATION

The aim of fractal interpolation is to reconstruct the velocity field  $u(x_i, t)$  from the knowledge of its filtered value “ $u$ ”. This is

done by iteratively applying in each direction an affine mapping procedure to the filtered field. In this way, starting from a coarse grid on which “u” is defined, a signal can be reconstructed on a given finer grid.

The characteristics of the reconstructed signal depend on two stretching parameters. It can be shown that they are related to the fractal dimension of the signal. In [6] they are considered constant in time and space and the adopted values are obtained from experimental velocity signals of homogeneous and isotropic turbulence; in particular, these parameters are set to  $d_1 = 2^{-\frac{1}{3}}$  and  $d_2 = -2^{-\frac{1}{3}}$ , corresponding to a fractal dimension of the velocity signal of 1.7. As a first approach, the same constant values have been used in the present work.

Furthermore, we also apply an algorithm which allows the stretching parameters to be locally computed only using the discrete values on a fine grid (DNS data), without the a-priori knowledge of the fractal dimension of the velocity signal. However, the locally computed values show significant fluctuations which reflect the instantaneous fluctuations of

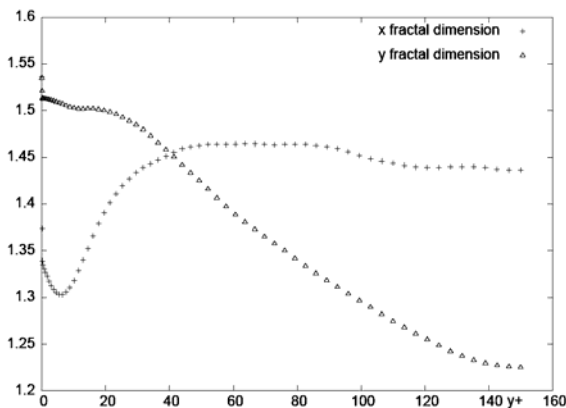


Fig. 1. Normal profiles of the averaged fractal dimension of the normal velocity component signal in the x and y directions.

the DNS velocity fields from which they have been derived.

Thus, to use these local values in the fractal interpolation procedure, a 3D distribution of the stretching parameters should be computed and stored for each velocity component at each time step. This renders the whole procedure much more

complex, but, most of all, this is impossible to be carried out in actual LES simulations for which the instantaneous DNS fields are obviously not available.

To overcome this problem, we adopted the following strategy: from the locally computed values of the stretching parameters we compute the fractal dimension (for each velocity component and at each time step) for fractal interpolation in the x direction, by considering the x distribution of the variable at each discrete y and z locations as a single signal.

Then, this is averaged over the homogeneous spanwise direction y and in time. The averaged fractal dimension for

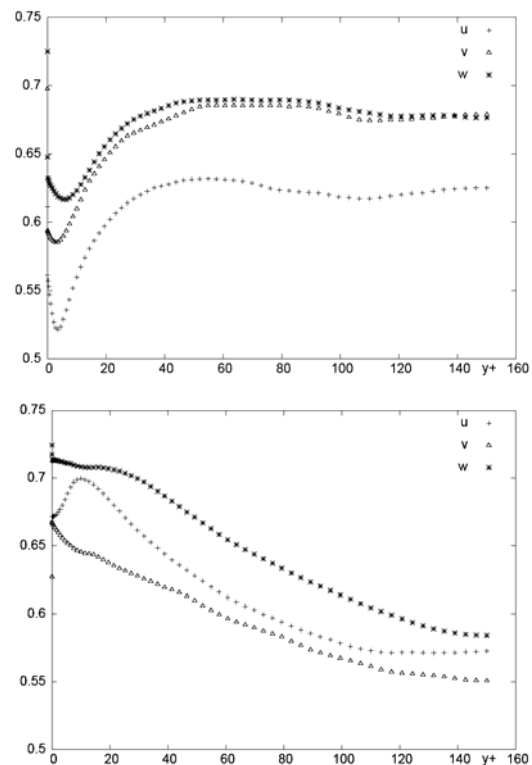


Fig. 2. Normal profiles of the averaged stretching parameters for the reconstruction of the velocity components in the x (a) and y (b) directions.

fractal interpolation in the y direction is computed analogously. The output of this computation is the averaged fractal dimension of each velocity component and for each horizontal plane (constant z), for reconstruction in the x and y directions respectively.

As an example Fig.1 shows the averaged fractal dimension of the normal velocity

component *signal* in the *x* and *y* directions as a function of the distance from the wall (in wall units).

Then, the stretching parameters for each velocity component and for each direction (*x* and *y*) are assumed constant in time and over the horizontal planes. These constant values can be easily derived from the previously computed fractal dimension, using the same relationship as in [6]. The computed values are shown in Fig. 2.

Note that in all cases the new stretching parameters show a noticeable variation in the wallnormal direction and they are significantly lower than the value experimentally obtained for homogeneous turbulence.

### 5. RESULTS

In the a-priori tests the DNS velocity fields are filtered to different resolutions in the streamwise and the spanwise directions only. In the normal direction the data are not filtered, since often in LES the normal

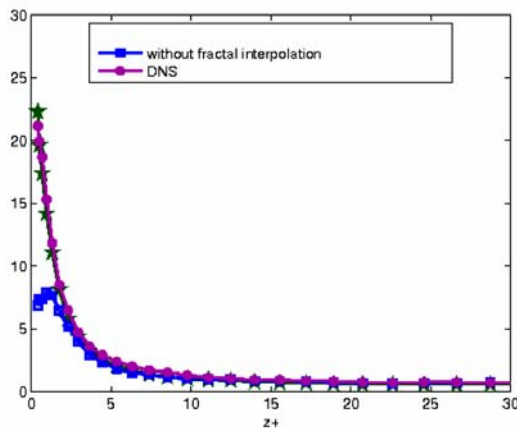


Fig. 3. Instantaneous concentration profiles for  $St = 25$  particles, obtained starting from DNS and filtered DNS without fractal interpolation.

resolution is DNS like. Either a cut-off or a top-hat filter is applied in the wave number space. Starting from these filtered fields, the motion equation (1) is integrated for the previously described set of particles, with and without the fractal interpolation procedure.

When fractal interpolation is used the velocity field is reconstructed up to the DNS resolution.

Particle statistics and concentration are computed and compared with those obtained starting from the DNS velocity fields. The results of a-priori tests carried out without fractal interpolation show that, except for the largest considered particles ( $St = 125$ ), filtering has a significant effect on the particle velocity fluctuations and on the particle concentration, especially near the wall, also at resolutions commonly used in LES. The particle set characterized by  $St = 25$  appears to be the most sensitive to filtering.

As an example, Fig. 3 shows the instantaneous concentration of this set of particles as a function of the wall normal coordinate (in wall units), obtained using the velocity fields from DNS and those filtered at a resolution of  $32 \times 32$  Fourier modes through a cutoff filter, without fractal interpolation.

It can be seen that filtering, without any closure in the particle equation of motion, leads to a large underestimate of the turbophoresis phenomenon, i.e. the tendency

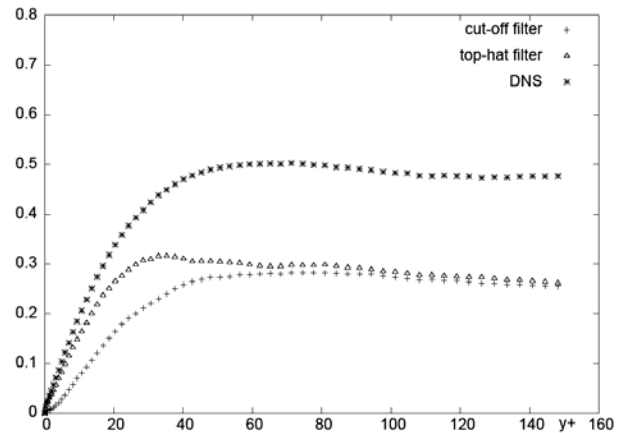


Fig. 4. Normal profiles of the r.m.s of the wall normal component of the particle velocity ( $St = 25$ ) obtained with fractal interpolation with a  $16 \times 16 \times 129$  grid resolution.

of particle to cluster near the wall. The results obtained with fractal interpolation, by using the constant values of the stretching parameters of  $\pm 2^{\frac{1}{3}}$ , show an improved agreement with DNS for both particle statistics and concentrations. However, in our opinion, the previous constant values of the stretching parameters are not well suited for channel flow, since they were obtained from

homogeneous and isotropic turbulence velocity signals.

A preliminary analysis, carried out by simply changing the values of the stretching parameters, showed that the results obtained for small particles are significantly sensitive to the adopted values. Thus, we repeated the same a-priori tests with fractal interpolation by using the new stretching parameters computed following the previously described procedure. Preliminary results are shown in Fig. 4, in which the profiles of the r.m.s of the wall normal velocity component obtained for particles having  $St = 25$  starting from fluid velocities filtered on a  $16 \times 16 \times 129$  grid are compared with those obtained from the DNS flow fields. It is evident that with the new values of the stretching parameters the particle velocity fluctuations are significantly underestimated, at least for this very coarse grid resolution. The analysis of the reasons of this behavior will be the object of further investigation.

## 6. CONCLUSIONS

The fracture-stretch algorithm creates fractal time series with zero means, as expected for a fractional Brownian motion.

In the created time series, the increment size is consistent with that of a persistent fractional Brownian motion, unless the intended  $H$  is 0.5. However, that persistent fractional Brownian motion does not necessarily have the  $H$  that the algorithm intended to produce.

The greatest difference between the intended  $H$  and the value of  $H$  estimated from the size of increments in the time series occurs when the algorithm intends to produce an anti-persistent fractional Brownian motion. Instead, the generated time series exhibits persistence. The problem with the algorithm lies in the

calculation of stretch. For intended  $H > 0.5$ , the addition of stretch to the time series guarantees that the minimum  $B(t_{\min})$  and maximum  $B(t_{\max})$  of the regular Brownian motion time series within the current time span become separated by a vertical distance of  $R_H$ , the range that corresponds to the intended  $H$ . For intended  $H < 0.5$ , the value of stretch is chosen so as to shrink the distance between  $B(t_{\min})$  and  $B(t_{\max})$ .

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## GLOBAL ATTRACTIVITY IN A HIGHER ORDER NONLINEAR DIFFERENCE EQUATION

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**Abstract:** Our aim in this paper is to investigate the global attractivity of the recursive sequence

$$u_{n+1} = \frac{\alpha - \beta u_n}{\gamma - u_{n-k}}, \quad n=0,1,\dots,$$

where  $\alpha \geq 0, \gamma > \beta > 0$  are real numbers and  $k \geq 1$  is an integer. We show that one positive equilibrium of the equation is a global attractor with a basin that depends on certain conditions imposed on the coefficients.

**2000 Mathematics Subject Classification:** Primary 39A10; secondary 39A11.

### 1. INTRODUCTION

The asymptotic stability of the rational recursive sequence

$$u_{n+1} = \frac{\alpha + \beta u_n}{\gamma + \sum_{i=0}^k \gamma_i u_{n-i}}, \quad n=0,1,\dots, \quad (1)$$

was investigated when the coefficients  $\alpha, \beta, \gamma$  and  $\gamma_i$  are nonnegative, (see Kocic [4]), and Kocic and Ladas. Studying the asymptotic behavior of the rational sequence (1) when some of the coefficients are negative was suggested by Kocic and Ladas in [4]. Recently, Aboutaleb et al. [2] studied the rational recursive sequence

$$u_{n+1} = \frac{\alpha - \beta u_n}{\gamma + u_{n-k}}, \quad n=0,1,\dots,$$

where  $\alpha, \beta$  and  $\gamma$  are nonnegative real numbers and obtained sufficient conditions for the global attractivity of the positive equilibrium.

Our aim in this paper is to study the global attractivity of the rational recursive sequence

$$u_{n+1} = \frac{\alpha - \beta u_n}{\gamma - u_{n-k}}, \quad n=0,1,\dots, \quad (2)$$

where  $\alpha \geq 0, \gamma > \beta > 0$  are real numbers and  $k \geq 1$  is an integer number, and the initial conditions  $u_{-k}, u_{-k+1}, \dots, u_{-1}$  and  $u_0$  are

arbitrary. We prove that the positive equilibrium  $\bar{u}$  of equation (2) is a global attractor with a basin that depends on certain conditions of the coefficients.

The linearized equation associated with equation (3) is

$$z_{n+1} = \sum_{i=0}^k \frac{\partial f}{\partial u_i}(\bar{u}, \bar{u}, \dots, \bar{u}) z_{n-i}, \quad n=0,1,\dots$$

and the characteristic equation associated is

$$\lambda^{n+1} - \sum_{i=0}^k \frac{\partial f}{\partial u_i}(\bar{u}, \bar{u}, \dots, \bar{u}) \lambda^{k-i} = 0$$

We start this section with the following known result which will be used in our proofs.

**Lemma 1.** [1] Assume that  $p, q \in \mathbb{R}$  and  $k \in \{0, 1, \dots\}$ . Then

$$|p| + |q| < 1$$

is a sufficient condition for the asymptotic stability of the difference equation :

$$u_{n+1} + pu_n + qu_{n-k} = 0,$$

$$n=0,1,\dots,$$

Now, let us consider the rational recursive sequence

$$u_{n+1} = \frac{\alpha - \beta u_n}{\gamma - u_{n-k}}, \quad n=0,1,\dots, \quad (4)$$

where

$$\alpha > 0, \gamma > \beta > 0, k \in \{1, 2, 3, \dots\}. \quad (5)$$

If (5) holds, and  $\alpha = (\beta + \gamma)^2/4$ , then equation (3) has a unique positive equilibrium  $\bar{u}_0 = (\beta + \gamma)/2$ . If (5) holds and  $\alpha < (\beta + \gamma)^2/4$ , then equation (4) has two positive equilibria

$$\bar{u}_{1,2} = \frac{\beta + \gamma \pm \sqrt{(\beta + \gamma)^2 - 4\alpha}}{2}.$$

The linearized equation of equation (4) about the equilibrium  $\bar{u}_i$  is

$$z_{n+1} + \frac{\beta}{\gamma - \bar{u}_i} z_n - \frac{\bar{u}_i}{\gamma - \bar{u}_i} z_{n-k} = 0 \quad (6)$$

$$i = 0, 1, 2, \quad n = 1, 2, \dots,$$

The characteristic equation associated with equation (6) about  $\bar{u}_0$  is

$$\lambda^{k+1} + \frac{2\beta}{\gamma - \beta} \lambda^k - \frac{\lambda + \beta}{\gamma - \beta} = 0$$

Since  $(\gamma + \beta)/(\gamma - \beta) > 1$ , the equilibrium  $\bar{u}_0$  of equation (4) is unstable.

The characteristic equation associated with equation (6) about  $\bar{u}_1$  is

$$\lambda^{k+1} + \frac{2\beta}{\gamma - \beta - \sqrt{(\beta + \gamma)^2 - 4\alpha}} \lambda^k - \frac{\gamma + \beta + \sqrt{(\beta + \gamma)^2 - 4\alpha}}{\gamma - \beta - \sqrt{(\beta + \gamma)^2 - 4\alpha}} = 0$$

In view of

$$\left| \frac{\gamma + \beta + \sqrt{(\beta + \gamma)^2 - 4\alpha}}{\gamma - \beta - \sqrt{(\beta + \gamma)^2 - 4\alpha}} \right| > 1$$

the equilibrium  $\bar{u}_1$  of equation (4) is also unstable. For the positive equilibrium  $\bar{u}_2$ , in view of condition (5) and  $\alpha < (\beta + \gamma)^2/4$ , we have

$$\bar{x}_2 = \frac{\beta + \gamma - \sqrt{(\beta + \gamma)^2 - 4\alpha}}{2} < \frac{\beta + \gamma}{2} < \gamma$$

Hence, if

$$0 < \alpha < \beta(\gamma - \beta), \quad (7)$$

then

$$\begin{aligned} & \sqrt{(\beta + \gamma)^2 - 4\alpha} \sqrt{(\beta + \gamma)^2 - 4\beta(\gamma - \beta)} \\ & > \sqrt{(\beta + \gamma)^2 - (\gamma + 3\beta)(\gamma - \beta)} \\ & = \sqrt{(\beta + \gamma)^2 - (\beta + \gamma)^2 + 4\beta^2} = 2\beta \end{aligned}$$

and so

$$\left| \frac{\beta + \bar{x}_2}{\gamma - \bar{x}_2} \right| = \frac{\beta + \bar{x}_2}{\gamma - \bar{x}_2} = \frac{3\beta + \gamma - \sqrt{(\beta + \gamma)^2 - 4\alpha}}{\gamma - \beta - \sqrt{(\beta + \gamma)^2 - 4\alpha}}$$

$$< \frac{3\beta + \gamma - 2\beta}{\gamma - \beta + 2\beta} = \frac{\beta + \gamma}{\gamma + \beta} = 1,$$

which, by Lemma 1, implies that  $\bar{u}_2$  (in the sequel, we will denote  $\bar{u}_2$  as  $\bar{u}$ ) is locally asymptotically stable. Before stating our result related to permanence, we list a lemma which is useful in proving our main result.

**Lemma 2.** Let  $f(u, v) = (\alpha - \beta u)/(\gamma - v)$  and assume that (5) and (7) hold. Then the following statements are true:

- a.  $0 < \bar{u} < \alpha/\beta$ , and  $\alpha/\beta < \bar{u}_1 < \infty$ ,
- b.  $f(u, u)$  is a strictly decreasing function in  $(-\infty, \alpha/\beta]$ , and
- c. let  $u, v \in (-\infty, \alpha/\beta]$ , then  $f(u, v)$  is a strictly decreasing function in  $u$ , and a strictly increasing function in  $v$ .

**Proof.** We only prove (a). The proofs of (b) and (c) are simple and will be omitted. In view of (5) and (7), we have

$$\bar{u} = \frac{\beta + \gamma - \sqrt{(\beta + \gamma)^2 - 4\alpha}}{2} < \frac{\beta + \gamma}{2} < \gamma$$

By Eq.(4), we have

$$\bar{u} = \frac{\alpha - \beta \bar{u}}{\gamma - \bar{u}} > 0$$

and so  $\bar{u} < \alpha/\beta$ . Also, in view of (5) and (7) we have

$$\begin{aligned} 0 < \frac{\alpha - \beta \bar{u}_1}{\gamma - \bar{u}_1} = \bar{u}_1 &= \frac{\beta + \gamma + \sqrt{(\beta + \gamma)^2 - 4\alpha}}{2}, \\ &\geq \frac{\beta + \gamma \pm \sqrt{(\beta + \gamma)^2 - 4\beta(\gamma - \beta)}}{2} \\ &= \frac{\beta + \gamma + \sqrt{(\beta + \gamma)^2 + 4\beta^2}}{2} > \frac{\beta + \gamma \pm \sqrt{(\beta - \gamma)^2}}{2} = \gamma \end{aligned}$$

and so  $\alpha - \beta \bar{u}_1 < 0$ , which implies that  $\bar{u}_1 > \alpha/\beta$ . The proof is complete.

**Lemma 3.** [4]. Consider the difference equation

$$u_{n+1} = f(u_n, u_{n-k}), \quad n = 0, 1, 2, \dots, \quad (8)$$

where  $k \geq 1$ . Let  $I = [a, b]$  be some interval of real numbers, and assume that

$f : [a, b] \times [a, b] \rightarrow [a, b]$  is a continuous function satisfying the following properties:

- a.  $f(u, v)$  is a nonincreasing function in  $u$ , and a nondecreasing function in  $v$ , and
- b. if  $(m, M) \in [a, b] \times [a, b]$  is a solution

of the system

$$m=f(M,m) \text{ and } M=f(M,m), \quad (9)$$

then  $m = M$ . Then equation (9) has a unique positive equilibrium point  $\bar{u}$  and every solution of equation (9) converges to  $\bar{u}$ .

## 2. MAIN RESULTS

In this section, we will study the global attractivity of positive solutions of equation (4). We show that the positive equilibrium  $\bar{u}$  of equation (4) is a global attractor with a basin that depends on certain conditions imposed on the coefficients.

**Theorem 1.** Assume that (5) and (7) hold and let  $u_n$  be any solution of equation (4). If  $u_i \in (-\infty, \alpha/\beta]$  for  $i=-k, -(k-1), \dots, -1, 0$ , then  $0 \leq u_n < \alpha/\beta$  for  $n = 1, 2, \dots$ ,

**Proof.** By part (c) of Lemma 2., we have  $0 = \frac{\alpha - \beta \alpha/\beta}{\gamma - \bar{u}_{-k}} \leq \bar{u}_1 = \frac{\alpha - \beta \bar{u}_0}{\gamma - \bar{u}_{-k}} \leq \frac{\alpha - \beta u_0}{\gamma - \alpha/\beta} < \frac{\alpha}{\beta}$

and

$$0 = \frac{\alpha - \beta \alpha/\beta}{\gamma - \bar{u}_{-k+1}} \leq \bar{u}_2 = \frac{\alpha - \beta \bar{u}_1}{\gamma - \bar{u}_{-k+1}} \leq \bar{u} = \frac{\alpha - \beta \cdot 0}{\gamma - \alpha/\beta} < \frac{\alpha}{\beta}$$

The result now follows by induction. The proof is complete.

**Theorem 2.** Assume that the conditions (5) and (7) hold. Then the positive equilibrium  $\bar{u}$  of equation (4) is a global attractor with a basin  $S = [0, \alpha/\beta]^{k+1}$ .

**Proof.** For  $u, v \in [0, \alpha/\beta]$ , set

$$f(u, v) = \frac{\alpha - \beta u}{\lambda - v}$$

We claim that  $f: [0, \alpha/\beta] \times [0, \alpha/\beta] \rightarrow [0, \alpha/\beta]$ .

In fact, set  $a = 0$  and  $b = \alpha/\beta$ , then

$$f(b, a) = \frac{\alpha - \beta b}{\lambda - a} = \frac{\alpha - \alpha}{\lambda} = 0 = a,$$

and in view of  $0 < \alpha < \beta(\gamma - \beta)$ , we have

$$f(b, a) = \frac{\alpha - \beta b}{\gamma - b} = \frac{\alpha}{\gamma - \alpha/\beta} < \frac{\alpha}{\beta} = b.$$

Since  $f(u, v)$  is decreasing in  $u$  and increasing in  $v$ , it follows that

$$a \leq f(u, v) \leq b, \text{ for } u, v \in [a, b],$$

which implies that our assertion is true. On the other hand, the conditions (a) and (b) of Lemma 3. are clearly true. Let  $\{x_n\}$  be a solution of equation (4) with initial conditions  $(u_{-k}, \dots,$

$u_{-1}, u_0) \in S$ . By Lemma 3. we have  $\lim_{n \rightarrow -\infty} u_n = \bar{u}$ ,

the proof is complete.

By Theorems 1 and 2, we have the following more general result.

**Theorem 3.** Assume that the conditions (5) and (7) hold, then the positive equilibrium  $\bar{u}$  of equation (4) is a global attractor with a basin  $S = (-\infty, \alpha/\beta]^k \times (0, \alpha/\beta]$ .

**Proof.** Let  $u_n$  be a solution of equation (4) with initial conditions  $(u_{-k}, \dots, u_{-1}, u_0) \in S$ . Then by Theorem 1, we have

$$u_n \in [0, \alpha/\beta], \quad n = 1, 2, \dots, k, k+1, \dots$$

By Theorem 2. we have  $\lim_{n \rightarrow -\infty} u_{n+k} = \bar{u}$ , and so

$\lim_{n \rightarrow -\infty} u_n = \bar{u}$ . The proof is complete.

In the above discussion, we always assume that  $0 < \alpha < \beta(\gamma - \beta)$ . In fact, the following example shows that the upper bound  $\beta(\gamma - \beta)$  may be the best.

**Example 3.1.** Consider the difference equation

$$u_{n+1} = \frac{1 - u_n}{2 - u_{n-k}}, \quad n = 0, 1, 2, \dots,$$

where  $k \geq 1$ . Obviously,  $\alpha = \beta(\gamma - \beta)$ . When  $k$  is odd, however, it is easy to see that the solution of this equation with initial conditions  $u_{-k} = 0, u_{-k+1} = 1, \dots, u_{-1} = 0$  and  $u_0 = 1$  is periodic with period 2. Motivated by the above example, we shall prove that the following general result is also true if

$$\beta(\gamma - \beta) \leq \alpha < (\gamma - \beta)(\gamma + 3\beta)/4. \quad (10)$$

**Theorem 4.** Assume that (4) holds. Then equation (3) has prime period two nonnegative solutions if and only if  $k$  is odd and (10) holds.

**Proof.** By direct computation, it is easy to see that there exist no period two solutions when  $k$  is even and if  $k$  is odd the period two solution must be of the form

$$\dots, \frac{\gamma - \beta + \sqrt{(\gamma + 3\beta)(\gamma - \beta) - 4\alpha}}{2}, \dots, \frac{\gamma - \beta - \sqrt{(\gamma + 3\beta)(\gamma - \beta) - 4\alpha}}{2}, \dots$$

from which our result follows. The proof is complete. If  $\alpha = 0$ , then the equation (2) is

$$u_{n+1} = -\beta u_n / (\gamma - u_{n-k}); \quad n = 0, 1, 2, \dots, \quad (11)$$

where  $\beta, \gamma > 0$ , and  $k \geq 1$ . By putting  $u_n = \beta v_n$ . Equation (11) yields

$$v_{n+1} = \frac{-v_n}{A - v_{n-k}}, \quad n=0,1,2,\dots, \quad (12)$$

where  $A = \gamma/\beta$ . Equation (12) has two equilibrium points

$$\bar{v}_1 = 0, \quad \bar{v}_2 = 1 + A$$

The linearized equation associated with equation (12) about  $\bar{v}_1$  is

$$z_{n+1} + \frac{1}{A - \bar{v}_1} z_n + \bar{v}_1 z_{n-k} = 0; \quad (13)$$

$$n = 0, 1, \dots,$$

The characteristic equation of (13) about  $\bar{v}_2$  is

$$\lambda^{k+1} - \lambda^k + 1 + A = 0$$

Since  $1 + A > 1$ , then the equilibrium  $\bar{v}_2$  of equation (12) is unstable. The characteristic equation of (13) about  $\bar{v}_1$  is

$$\lambda^{k+1} + \frac{1}{A} \lambda^k = 0$$

This equation has two roots  $\lambda_1 = 0$  and  $\lambda = -1/A$ . Hence,

1. if  $\gamma > \beta$  then  $\bar{v}_1$  is asymptotically stable,
2. if  $\gamma < \beta$  then  $\bar{v}_1$  is a saddle point, and
3. if  $\gamma = \beta$  then linearized stability analysis fails.

In the following results we assume that  $A \geq 2$ .

**Lemma 4.** Assume that the initial conditions  $v_{-i} \in [-1, 1]$  for  $i = 1, 2, \dots, k$  and  $v_0 \in [-1, 0]$ . Then  $v_{2n-1}$  is nonnegative and monotonically decreasing to zero, while  $v_{2n}$  is non-positive and monotonically increasing to zero.

**Proof.** Suppose that  $v_{-i} \in [-1, 1]$  for  $i = 1, 2, \dots, k$  and  $v_0 \in [-1, 0]$ . Clearly,  $0 \leq v_1 \leq 1$  and  $-1 \leq v_2 \leq 0$ . By induction we can see that  $0 \leq v_{2n-1} \leq 1$  and  $-1 \leq v_{2n} \leq 0$  for  $n \geq 1$ . Since

$$\frac{v_{2n-1}}{v_{2n+1}} = (A - v_{2n-k})(A - v_{2n-k-1}) > 1$$

Then

$$v_{2n-1} > v_{2n+1}, \quad n = 1, 2, \dots$$

Similarly, we can show that

$$v_{2n} < v_{2n+2}, \quad n = 1, 2, \dots$$

The proof is complete.

**Lemma 5.** Assume that the initial conditions

$v_{-i} \in [-1, 1]$  for  $i = 1, 2, \dots, k$ , and  $v_0 \in [0, 1]$ . Then  $v_{2n-1}$  is non-positive and monotonically increasing to zero, while  $v_{2n}$  is non-negative and monotonically decreasing to zero. The proof is similar to that of Lemma 4. and will be omitted.

**Corollary 1.** The equilibrium  $\bar{v}_1$  of Eq.(12) is a global attractor with a basin  $S = [-1, 1]^{k+1}$ .

**Theorem 5.** The equilibrium  $\bar{v}_1 = 0$  of equation (12) is a global attractor with a basin  $S = (-\infty, 1]^k \times [-A + 1, A - 1]$ .

**Proof.** Assume that  $(v_{-k}, \dots, v_{-1}, v_0) \in S$ .

We have

$$-1 \leq \frac{A-1}{-(A-v_{n-k})} \leq \bar{v}_1 = \frac{-v_0}{A-v_{n-k}} \leq \frac{A-1}{A-1} = 1$$

and

$$-1 \leq \frac{1}{-(A-v_{n-k+1})} \leq \bar{v}_2 = \frac{-v_1}{A-v_{n-k+1}} \leq 1$$

By induction, it is easy to see that  $v_i \in [-1, 1]$  for  $i \geq 1$ . Our result now follows from Corollary 1. The proof is complete.

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## ABOUT SURFACE MODELING USING FRACTALS

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**Abstract:** *Digital surface representation from a set of three-dimensional samples is an important issue of computer graphics that has applications in different areas of study such as engineering, geology, geography, meteorology, medicine, etc. The digital model allows important information to be stored and analyzed without the necessity of working directly with the real surface. In addition, we can integrate products from digital terrain model (DTM) and other data in a geospatial information system (GIS) environment.*

*The objective of this work is to model surfaces from a set of scattered three dimensional samples. The basic structure used to represent the surface is the triangulated irregular network (TIN). Another goal of the paper is evaluation of the quality of digital terrain models for representing spatial variation. This work presents stochastic methods for triangular surface fitting. One of the most popular stochastic models to represent curves and surfaces are based on fractal concept. A fractal is a geometrical or physical structure having an irregular or fragmented shape at all scales of measurement. In addition, a fractal is based on self-similarity concept indicating that each part of its structure is similar to the whole. Brownian motion is the most popular model used to perform fractal interpolations from a set of samples.*

**Key words:** *Three-dimensional, DEM/DTM, Land, Modelling*

### 1. INTRODUCTION

The Fractional Brownian motion (FBM), derived from Brownian motion, can be used to simulate topographic surfaces. FBM provides a method of generating irregular, self-similar surfaces that resemble topography and that have a known fractional dimension. Fractal concept has been used for optimum sampling in generating a digital terrain model. Results of the research have shown that the method can be successfully used in DTM generation. In addition fractals allow us to create realistic surfaces in shorter time than with exact calculations. Another advantage of the fractal concept is the possibility of computing surfaces to arbitrary levels of detail without increasing size of the database.

So far we have assumed that sharp boundaries or smooth shapes exist for real entities. This assumption reflects a map model or geometric bias rather than an appropriate model to represent nature.

Smoothed curves and surfaces are subjects of Euclidean geometry and are adequate to represent artificial shapes like parts of mechanical and aeronautical projects, furniture, toys, etc. Natural objects like clouds, coastlines and mountains have irregular or fragmented features. These are better represented by the Fractal geometry that was first formalized by Mandelbrot (1982) [3].

Fractal geometry has enough capability to represent more adequately than Euclidean geometry real world entities that are not smoothly formed, as in the case with most natural objects.

The word fractal implies properties as in fraction or fragmented. In essence fractal

geometry has ideas of fragmentation and selfsimilarity (Laurini and Thompson 2002).

Even though objects may be rough or irregular, there is fragmented, they may at the same time have some similar semblance of shape or pattern when viewed from different distance.

Self-similarity is symmetry across different scales; there are patterns within patterns. Or, as Mandelbort says, fractals are geometric shapes that are equally complex in their details as in their overall form (Mandelbrot 1982).

To better understand this concept we describe steps for producing the geometrical shape of natural objects like snowflake. Suppose that we have a triangle. By dividing each side to three parts and replacing the middle part with two equal parts a polygon with twelve sides will be generated.

By repeating the above stage for each side, at step two there are forty-eight sides. At each step, the number of sides are multiplied by four. So for an initiator perimeter of length 1, the perimeter becomes  $1\left(\frac{4}{3}\right)^N$  which number evidently tends to infinity, although the area tends to a finite limit. The selfsimilarity ratio is  $\frac{1}{3}$ .

Therefore, fractal geometry has promise for some of the requirements of spatial information systems. Two-dimensional stochastic interpolations are useful for terrain modeling (Felgueiras and Goodchild 1995; Goodchild and Mark 1987). One dimensional application use of fractal concept is for coastlines (Cheng et al 2001) or boundaries of entire continents.

Fractals may also be used for image error analysis (Kolibal and Monde 1998), assigning color palette (Cheng and Qingmou 2002), and land cover classification of forest (Blanco and Garcia 1997) [2].

In this paper we use fractal for optimum sampling in generating a digital terrain model (DTM).

## 2. CONCEPT OF FRACTAL DIMENSION

Recent advances in the area of fractal geometry have allowed us to model natural objects dimensionality. For example, the length of a coastline can vary depending on scale, ranging from an apparently infinitely high length to a very short distance if we highly generalize the shape. It is interesting that fractal geometry can give us measure of the dimensionality of objects that are different from Euclidian geometry.

The fractal dimension tells us how densely a phenomenon occupies the space in which it is located. It is independent from the measurement units used or alteration of the space by stretching or condensing.

The fractal dimension of many entities can be obtained by the Equation 1 or 2 (Laurini and Thompson 2002):

$$d = \frac{\log n}{\log\left(\frac{1}{r}\right)} \quad (1)$$

Or

$$d = \frac{\log n}{\log(s)} \quad (2)$$

Where: n=number of pieces in the repetitor  
r=self-similarity ratio  
d=fractal dimension

Alternatively, s, the scaling factor, the inverse of the selfsimilarity ratio, can be thought of as the number of pieces that an entity is split into. In the case of the snowflake example already mentioned,  $n = 4$ ,  $r = \frac{1}{3}$ , giving  $d = 1.2619$ . We can imagine a continuum where a value of d close to 0 would mean an entity is close to a point, a value of 1 means a line, and if it is near 2, it is an area.

Similarly, a smooth line will have a dimensionality of 1, but an irregular line has a higher value, certainly greater than 1. For coastlines the mean fractal dimension is  $d = 1.2$ , whereas for terrain, d is about 2.3

Brownian motion is the most popular model used to perform fractal interpolations from a set of samples. Brownian motion, first observed by Robert Brown in 1827, is the motion of small particles caused by continual bombardment by other neighboring particles.

Brown found that the distribution of the particle position is always *Gaussian* with a

variance dependent only on the length of the time of the movement observation (Laurini and Thompson 2002).

The Fractional Brownian motion (FBm), derived from Brownian motion, can be used to simulate topographic surfaces. FBm provides a method of generating irregular, self-similar surfaces that resemble topography and that have a known fractional dimension.

The FBm functions can be characterized by variograms (graphic that plots the phenomenon variation against the spatial distance between two points) of the form (Felgueiras and Goodchild 1995):

$$E[(z_i - z_j)]^2 = K * (d_{ij})^{2H} \quad (3)$$

where E=statistical expectation

$z_i, z_j$ =heights of the surface at the points i and j

$d_{ij}$ =spatial distance between these points

K=constant of proportionality

H=parameter in the range 0 to 1

K is also related to a vertical scale factor S that controls the roughness of the surface. H describes the relative smoothness at different scales and has a relation with the fractal dimension D as formulated in Equation 4 (Felgueiras and Goodchild 1995):

$$D = 3 - H \quad (4)$$

When H is 0.5 we get the pure Brownian motion. The smaller H, the larger D and the more irregular is the surface. On the contrary, the larger H, the smaller D and the smoother the surface.

Fournier et al (1982) presented recursive procedures to render curves and surfaces based on stochastic models. They described two methods to construct two-dimensional fractal surface primitives. The first one is based on a *subdivision of polygons* to create fractal polygons while the second approach is based on the *definition of stochastic parametric surfaces*. The *subdivision of polygons* is based on the *fractal poly line subdivision* method.

A fractal poly line subdivision is a recursive procedure that interpolates intermediate points of a poly line. The algorithm recursively subdivides the closest extreme intervals and generates a scalar value at the midpoint which is proportional to the current standard deviation  $\sigma_c$  times the scale or roughness factor **S**.

So, the  $m$  z value of the middle point between two consecutive points,  $i$  and  $j$ , of a poly line is determined by the Equation 5 (Felgueiras and Goodchild 1995):

$$z_m = \frac{(z_i + z_j)}{2} + S * \sigma_c * N(0,1) \quad (5)$$

Where  $c$  s varies according to Equation 5 and  $N(0,1)$  is a Gaussian random variable with zero mean and unit variance. The subdivision of polygons method is suitable to create stochastic surfaces based on TIN digital models. Each triangle of the TIN model can be subdivided into four smaller triangles by connecting the midpoints of the triangles. The z value of the midpoints is calculated by the fractal poly line subdivision method presented above. The subdivision can be continued until the area or a side of the current triangle reaches a predefined limit. So the original triangle is transformed into a fractal triangle whose irregular surface consists of many small triangular facets. As pointed out by Fournier and Goodchild (1995), the presented methods for rendering curves and surfaces are satisfactory approximations of fractional Brownian motion.

They allow us to create realistic surfaces in faster time than with exact calculations. Another advantage of these approaches is the possibility of computing surfaces to arbitrary levels of detail without increasing size of the database.

Figure 1 illustrates the behavior of fractal curves created using fractional Brownian motion, different values of **H**, and a constant vertical scale factor. The curves were rendered using the fractal poly line subdivision method.

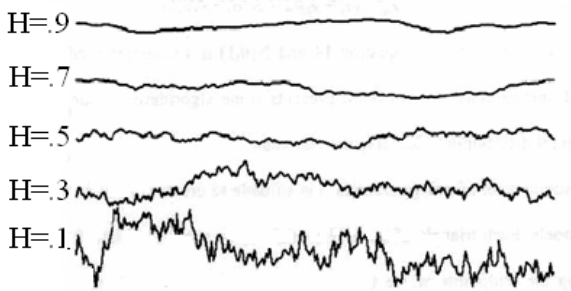


Fig.1. Stochastic curves rendered for different values of the parameter H (Fournier and Goodchild 1995).

### 3. METODOLGY

This section describes the methodology used to analyze surface fitting on TIN models [1].

The first step for modeling surfaces is the definition of the input sample set that will be used to construct the surface. This sample set

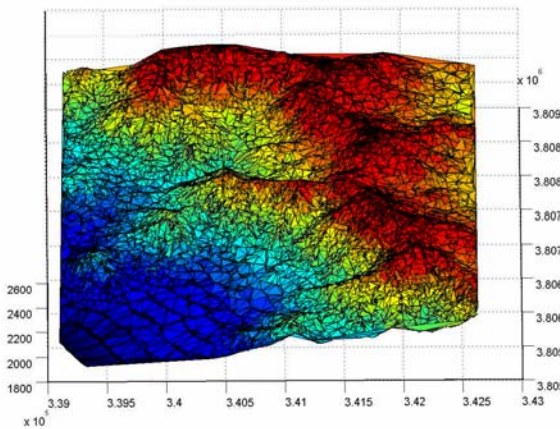


Fig.2. TIN model of one rough land in Nehoiu.

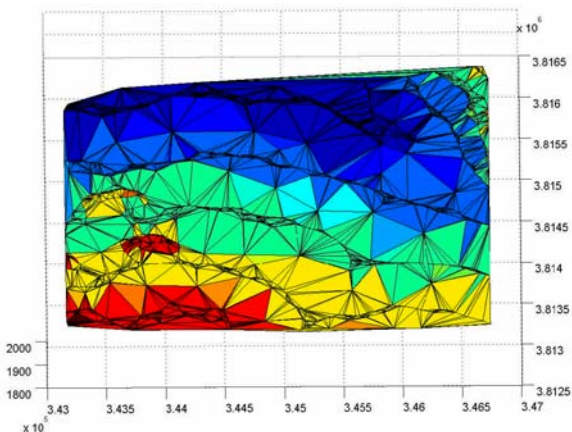


Fig.3. TIN model of one smooth land in Nehoiu

must be representative of the phenomenon to be modeled.

The next step involves the use of the sample set to construct the basic structure of the DTM model. Here the input samples were transformed on the vertices of the triangles of a TIN model.

Our case study was in two parts of Nehoiu city in Buzău (rough, smooth) that sample set has been extracted from a map at a scale of 1:25000 and then TIN model was constructed (Figure 2, 3).

Figure 2. TIN model of one rough land in Nehoiu. Units are in meter. Figure 3. TIN model of one smooth land in Nehoiu. Units are in meter.

After this stage we use fractal concept for interpolation. This method used to estimate the z values of the rectangular grid, which was based on the polygon subdivision approach presented in Felgueiras and Goodchild (1995).

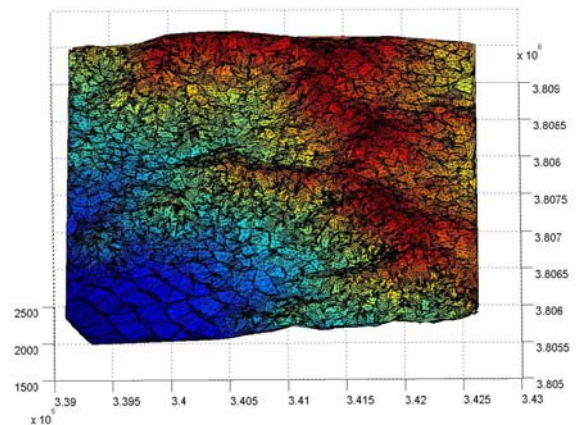


Fig.4. TIN model of Figure 2 that is condensed with fractals H=0.8.

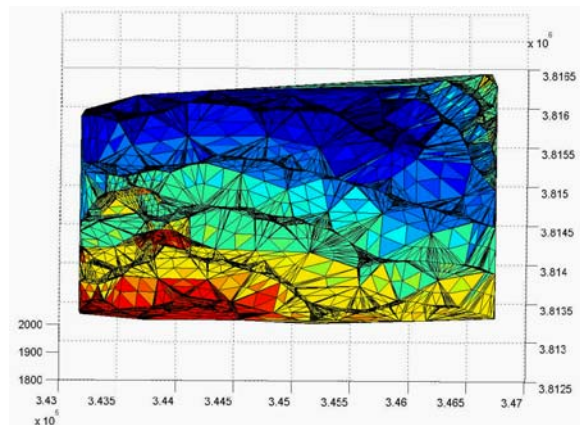


Fig.5. TIN model of Figure 3 that is condensed with fractals H=0.3.



The method begins finding the current triangle  $T_C$ , of the original TIN model, that contains the grid point  $P_i(x_i, y_i, z_i)$ . Then the triangle  $T_C$  is subdivided recursively in four smaller triangles by connecting the midpoints of its sides. A new triangle  $T_C$ , that contains the point  $P_i$ , is chosen among the four smaller triangles. The subdivisions continue until the point  $P_i$  is within a defined proximity criterion of one of the vertices of the triangle  $T_C$ . When the proximity is reached, one can define  $z_i$  equal to the  $z$  of this vertex.

In this paper, sample points of the map were condensed with fractals up to contour interval of 5 meters (Figure 4, 5) In order to perform a quantitative analysis of the surfaces rendered by the fractal interpolator approaches, we compared the results with the real surfaces. So 15-20 check points was selected for each region. Then for each point *error function* that defined as the difference between the *real elevation* and the *estimated elevation* was computed.

Table 1, Residuals on check points for smooth and rough region

Point number	Residuals on check points for smooth region (m)	Residuals on check points for rough region (m)
1	-0.090	0.340
2	0.100	0.280
3	0.060	0.210
4	-0.332	0.726
5	-0.381	-1.196
6	1.159	0.141
7	0.066	0.267
8	-0.016	6.262
9	0.037	-1.364
10	0.558	6.763
11	0.164	1.726
12	0.121	-0.056
13	-0.423	0.570
14	-0.045	-2.015
15	-0.890	-3.635
16	0.041	-0.088
17	-0.357	
18	0.010	
19	0.427	
20	0.022	

Table 1 shows the residuals on the check points for the rough and smoothed region. In addition for  $H=0.1-0.9$  with increment 0.1,

standard deviation of the error function was computed that results have shown that the best  $H$  for irregular and regular surfaces are 0.3 and 0.8 respectively (Table 2).

Table 2, Standard deviation of the error function for smooth and rough region

Point number	Standard deviation of the error function for smooth region	Standard deviation of the error function for rough region
0.1	2.675	0.419
0.2	2.680	0.425
0.3	2.682	0.404
0.4	2.713	0.435
0.5	2.676	0.465
0.6	2.666	0.550
0.7	2.789	0.598
0.8	2.618	0.626
0.9	2.888	1.283

It means that irregular surface has fractal dimension 2.7 while regular surface has fractal dimension 2.2.

#### 4. CONCLUSION

Fractal methods can be successfully used when the real surface represents a natural phenomenon like elevation. The major problem seems to be the definition of the appropriate parameters  $H$  and  $S$  ( $H$  is relative smoothness at different scales and  $S$  is scale or roughness factor) to best represent the variations of the real surface.

Fractal interpolation is recommended for modeling natural terrain surfaces when interest lies in visualization, and when the parameters of the fractal interpolation can be adjusted to create a realistic-looking representation.

In the same way in which irregular curves have been applied to the study and modelling of complex forms such as plants, trees, molecular chains, clouds, shells, ice formation or ocean waves.

The extension is developed using a functional representation based on mappings which define levels of detail through geometric transformations.

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## APPROVED SECURITY FUNCTIONS FOR FIPS PUB 140-2

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**Abstract:** *The approved security functions applicable to FIPS PUB 140-2 are applied for testing cryptographic modules. This paper presents the following methods:*

- *Block Cipher Modes of Operation, Methods and Techniques;*
- *Triple Data Encryption Algorithm (TDEA) Block Cipher;*
- *Digital Signature Standard (DSS).*

**Keywords:** *security functions, cryptographic modules, block cipher, TDEA, Digital Signature Standard.*

### 1. CRYPTOGRAPHIC MODULES TESTING AND VALIDATION

Continuous increasing of the information exchange, particularly of the digital format data exchange, involve a special attention to sensitive information, to protect it against the unauthorised access.

Cryptographic-based security systems protect sensitive information in computer and telecommunication systems (including voice systems). To assure information protection are used frequently certain methods. The essential elements of the security systems are the cryptographic modules.

*Cryptographic module* is the set of hardware, software, and/or firmware that implements approved security functions (including cryptographic algorithms and key generation) and is contained within the cryptographic boundary.

Testing and validation of the cryptographic modules are very important activities because of the risk of compromising the confidentiality of the information due to unidentified vulnerabilities of the cryptographic modules.

Since information security requirements vary for different applications, organizations should identify their information resources and determine the sensitivity to and the potential impact of losses. Controls should be based on

the potential risks and should be selected from available controls, including administrative policies and procedures, physical and environmental controls, information and data controls, software development and acquisition controls, and backup and contingency planning.

The security requirements relate to the secure design and implementation of a cryptographic module. The requirements are derived from the following high-level functional security objectives for a cryptographic module:

1. To employ and correctly implement the approved security functions for the protection of sensitive information.

2. To protect a cryptographic module from unauthorized operation or use.

3. To prevent the unauthorized disclosure of the contents of the cryptographic module, including plaintext cryptographic keys and Critical Security Parameters (CSPs).

4. To prevent the unauthorized and undetected modification of the cryptographic module and cryptographic algorithms, including the unauthorized modification, substitution, insertion, and deletion of cryptographic keys and CSPs.

5. To provide indications of the operational state of the cryptographic module.

6. To ensure that the cryptographic module performs properly when operating in an approved mode of operation.

7. To detect errors in the operation of the cryptographic module and to prevent the compromise of sensitive data and CSPs resulting from these errors.

General Flow of the cryptographic modules FIPS PUB 140-2 Testing and Validation process is illustrated in fig. 1.

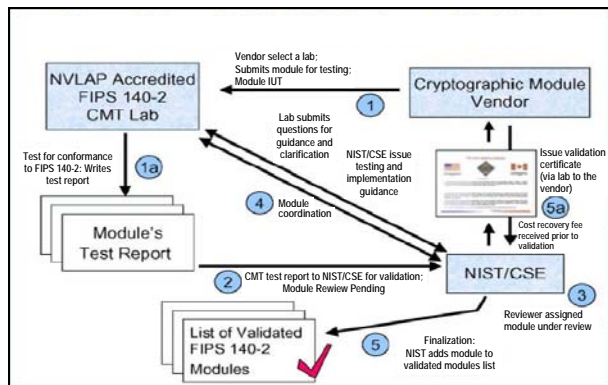


Fig. 1. General Flow FIPS PUB 140-2 Testing and Validation

METRA is a part of the same structure implemented in Romania. It has a laboratory for cryptographic modules, products and systems testing. Its activities are at beginning and the reason for our interest in approved security FIPS PUB 140-2 functions is: *we are searching the models for our activities.*

## 2. BLOCK CIPHER ALGORITHM

A confidentiality mode of operation of the block cipher algorithm consists of two processes that are inverses of each other: encryption and decryption. Encryption is the transformation of a usable message, called the plaintext, into an unreadable form, called the ciphertext; decryption is the transformation that recovers the plaintext from the ciphertext.

One of the two functions is designated as the forward cipher function, denoted  $CIPH_K$ ; the other function is then called the inverse cipher function, denoted  $CIPH_K^{-1}$ . The inputs and outputs of both functions are called input blocks and output blocks. The input and output blocks of the block cipher algorithm have the same bit length, called the block size, denoted  $b$ .

For all of the modes in this recommendation, the plaintext must be represented as a sequence of bit strings; the requirements on the lengths of the bit strings vary according to the mode:

For the ECB and CBC modes, the total number of bits in the plaintext must be a multiple of the block size,  $b$ ; in other words, for some positive integer  $n$ , the total number of bits in the plaintext must be  $nb$ . The plaintext consists of a sequence of  $n$  bit strings, each with bit length  $b$ . The bit strings in the sequence are called data blocks, and the plaintext is denoted  $P_1, P_2, \dots, P_n$ .

For the CFB mode, the total number of bits in the plaintext must be a multiple of a parameter, denoted  $s$ , that does not exceed the block size; in other words, for some positive integer  $n$ , the total number of bits in the message must be  $ns$ . The plaintext consists of a sequence of  $n$  bit strings, each with bit length  $s$ . The bit strings in the sequence are called data segments, and the plaintext is denoted  $P_{\#1}, P_{\#2}, \dots, P_{\#n}$ .

For the OFB and CTR modes, the plaintext need not be a multiple of the block size. Let  $n$  and  $u$  denote the unique pair of positive integers such that the total number of bits in the message is  $(n-1)b+u$ , where  $1 \leq u \leq b$ . The plaintext consists of a sequence of  $n$  bit strings, in which the bit length of the last bit string is  $u$ , and the bit length of the other bit strings is  $b$ . The sequence is denoted  $P_1, P_2, \dots, P_{n-1}, P_{\#n}$ , and the bit strings are called data blocks, although the last bit string.

The input to the encryption processes of the CBC, CFB, and OFB modes includes, in addition to the plaintext, a data block called the initialization vector (IV), denoted  $IV$ . The IV is used in an initial step in the encryption of a message and in the corresponding decryption of the message.

The IV need not be secret; however, for the CBC and CFB modes, the IV for any particular execution of the encryption process must be unpredictable, and, for the OFB mode, unique IVs must be used for each execution of the encryption process.

### 3. BLOCK CIPHER MODES OF OPERATION

This paper presents two basic modes of operation from the five possibly modes: the Electronic Codebook (ECB) mode and the Cipher Block Chaining (CBC) mode.

The Electronic Codebook (ECB) mode is a confidentiality mode that features, for a given key, the assignment of a fixed ciphertext block to each plaintext block, analogous to the assignment of code words in a codebook. The Electronic Codebook (ECB) mode is defined as follows:

ECB Encryption:

$$C_j = CIPH_k(P_j) \text{ for } j = 1 \dots n. \quad (01)$$

ECB Decryption:

$$P_j = CIPH_k^{-1}(C_j) \text{ for } j = 1 \dots n. \quad (02)$$

In ECB encryption, the forward cipher function is applied directly and independently to each block of the plaintext. The resulting sequence of output blocks is the ciphertext.

In ECB decryption, the inverse cipher function is applied directly and independently to each block of the ciphertext. The resulting sequence of output blocks is the plaintext.

In ECB encryption and ECB decryption, multiple forward cipher functions and inverse cipher functions can be computed in parallel.

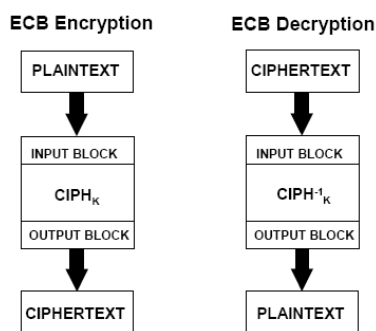


Fig. 2. The ECB Mode

In the ECB mode, under a given key, any given plaintext block always gets encrypted to the same ciphertext block. If this property is undesirable in a particular application, the ECB mode should not be used.

The ECB mode is illustrated in Figure 2.

The Cipher Block Chaining (CBC) mode is a confidentiality mode whose encryption process features the combining (“chaining”) of the plaintext blocks with the previous ciphertext blocks.

The CBC mode requires an IV to combine with the first plaintext block. The IV need not be secret, but it must be unpredictable; the generation of such IVs is discussed in Appendix C. Also, the integrity of the IV should be protected, as discussed in Appendix D. The CBC mode is defined as follows:

CBC Encryption:

$$C_1 = CIPH_k(P_1 \oplus IV); \quad (03)$$

$$C_j = CIPH_k(P_j \oplus C_{j-1}) \text{ for } j = 2 \dots n. \quad (04)$$

CBC Decryption:

$$P_1 = CIPH_k^{-1}(C_1) \oplus IV; \quad (05)$$

$$P_j = CIPH_k^{-1}(C_j) \oplus C_{j-1} \text{ for } j = 2 \dots n. \quad (06)$$

In CBC encryption, the first input block is formed by exclusive-OR-ing the first block of the plaintext with the IV. The forward cipher function is applied to the first input block, and the resulting output block is the first block of the ciphertext.

This output block is also EXCLUSIVE-OR-ed with the second plaintext data block to produce the second input block, and the forward cipher function is applied to produce the second output block. This output block, which is the second ciphertext block, is EXCLUSIVE-OR-ed with the next plaintext block to form the next input block.

Each successive plaintext block is EXCLUSIVE-OR-ed with the previous output/ciphertext block to produce the new input block. The forward cipher function is applied to each input block to produce the ciphertext block.

In CBC decryption, the inverse cipher function is applied to the first ciphertext block, and the resulting output block is EXCLUSIVE-OR-ed with the initialization vector to recover the first plaintext block.

The inverse cipher function is also applied to the second ciphertext block, and the resulting output block is EXCLUSIVE-OR-ed

with the first ciphertext block to recover the second plaintext block.

In general, to recover any plaintext block (except the first), the inverse cipher function is applied to the corresponding ciphertext block, and the resulting block is exclusive-ORed with the previous ciphertext block.

In CBC encryption, the input block to each forward cipher operation (except the first) depends on the result of the previous forward cipher operation, so the forward cipher operation cannot be performed in parallel. In CBC decryption, however, the input blocks for the inverse cipher function, i.e., the ciphertext blocks, are immediately available, so that multiple inverse cipher operations can be performed in parallel.

The CBC mode is illustrated in Figure 3.

#### 4. TRIPLE DATA ENCRYPTION ALGORITHM (TDEA) BLOCK CIPHER

The Triple Data Encryption Algorithm (TDEA) is an approved cryptographic algorithm as required by FIPS 140-2, *Security Requirements for Cryptographic Modules*. The algorithm specified in this recommendation may be implemented in software, firmware, hardware, or any combination thereof.

The specific implementation may depend on several factors such as the application, the environment, the technology used, etc. Implementations that may comply with this recommendation include electronic devices (e.g., VLSI chip packages), microprocessors using Read Only Memory (ROM), Programmable Read Only Memory (PROM), or Electronically Erasable Read Only Memory (EEROM), and computers<sup>3</sup> using Random Access Memory (RAM). When an algorithm is implemented in software or firmware, the processor on which the algorithm runs must be specified as part of the validation process.

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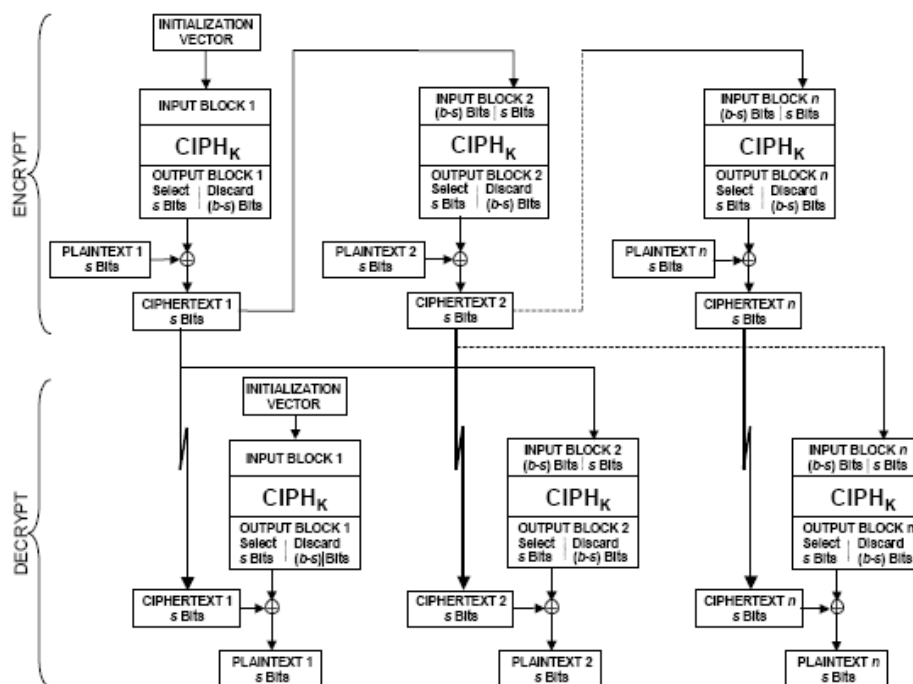


Fig. 3. The CBC Mode

The specific implementation may depend on several factors such as the application, the environment, the technology used, etc. Implementations that may comply with this recommendation include electronic devices (e.g., VLSI chip packages), microprocessors using Read Only Memory (ROM), Programmable Read Only Memory (PROM), or Electronically Erasable Read Only Memory (EEROM), and computers using Random Access Memory (RAM). When an algorithm is implemented in software or firmware, the processor on which the algorithm runs must be specified as part of the validation process.

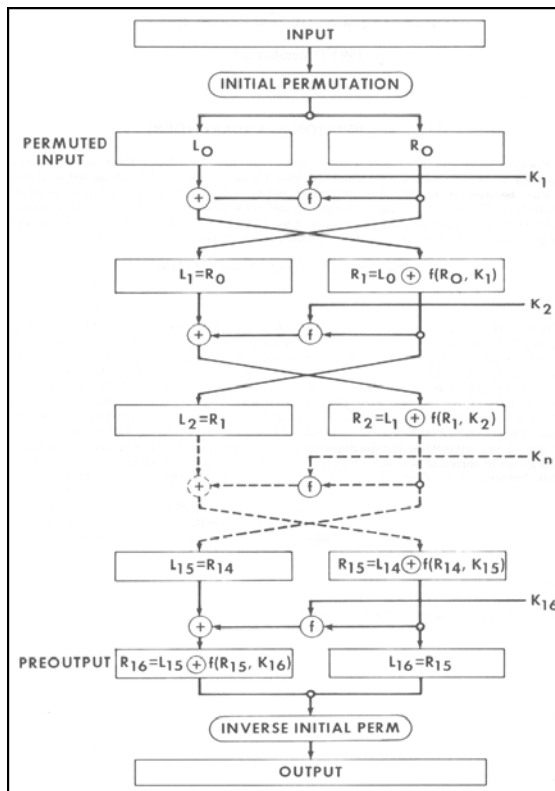


Fig. 4. Forward Transformation of the DEA Cryptographic Engine

The choice of the primitive functions  $KS$ ,  $S1, \dots, S8$  and  $P$  is critical to the strength of the transformations resulting from the algorithm.

FIPS 140.2 Annex A - NIST Special Publication 800-67 specify the functions  $S1, \dots, S8$  and  $P$ .

### 5. DIGITAL SIGNATURE STANDARD

A digital signature is represented in a computer as a string of binary digits. A digital signature is computed using a set of rules and a set of parameters such that the identity of the signatory and integrity of the data can be verified. An algorithm provides the capability to generate and verify signatures. Signature generation makes use of a private key to generate a digital signature. Signature verification makes use of a public key which corresponds to, but is not the same as, the private key. Each user possesses a private and public key pair. Public keys are assumed to be known to the public in general. Private keys are never shared. Anyone can verify the signature of a user by employing that user's public key. Signature generation can be performed only by the possessor of the user's private key.

A hash function is used in the signature generation process to obtain a condensed version of data, called a message digest (Fig. 5). The message digest is then input to the digital signature (ds) algorithm to generate the digital signature. The digital signature is sent to the intended verifier along with the signed data (often called the message). Hash Standard (SHS), FIPS 180-1.

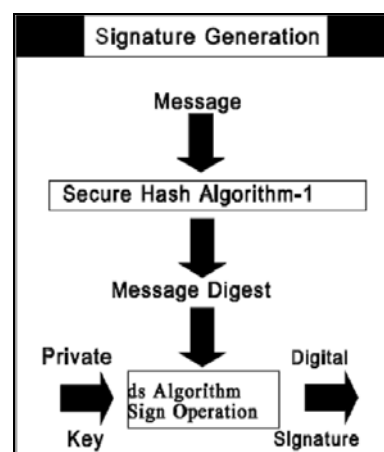


Fig. 5. Signature generation

The verifier of the message and signature verifies the signature by using the sender's public key. The same hash function must also be used in the verification process. The hash

function is specified in a separate standard, the Secure Hash Standard (SHS), FIPS 180-1

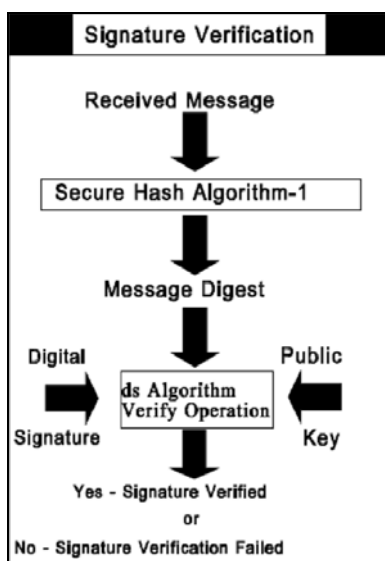


Fig. 6. Signature verification

## 6. USE OF A DIGITAL SIGNATURE ALGORITHM

A digital signature (ds) algorithm is used by a *signatory* to generate a digital signature on data and by a *verifier* to verify the authenticity of the signature. Each signatory has a public and private key. The private key is

used in the signature generation process and the public key is used in the signature verification process.

For both signature generation and verification, the data which is referred to as a message, M, is reduced by means of the Secure Hash Algorithm (SHA-1) specified in FIPS 180-1. An adversary, who does not know the private key of the signatory, cannot generate the correct signature of the signatory. In other words, signatures cannot be forged. However, by using the signatory's public key, anyone can verify a correctly signed message. A means of associating public and private key pairs to the corresponding users is required. That is, there must be a binding of a user's identity and the user's public key. This binding may be certified by a mutually trusted party.

For example, a certifying authority could sign credentials containing a user's public key and identity to form a certificate. Systems for certifying credentials and distributing certificates are beyond the scope of the standards.

### REFERENCES:

1. FIPS PUB 140-2, "Security requirements for cryptographic modules"



## CRYPTOGRAPHIC MODULES TESTING AGAINST FIPS 140-2

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**Abstract:** *This paper presents the requirement that must be achieved by cryptographic-based security systems which are to be used to provide protection for sensitive or valuable data. The cryptographic module within a security system is necessary to maintain the confidentiality and integrity of the information protected by the module.*

*The USA Federal organizations use FIPS 140.2 standard that specifies the security requirements that will be satisfied by a cryptographic module for testing cryptographic-based security systems. This standard present security requirements cover areas related to the secure design and implementation of a cryptographic module. These areas include cryptographic module specification, cryptographic module ports and interfaces, roles, services, and authentication, finite state model, physical security, operational environment, cryptographic key management, electromagnetic interference / electromagnetic compatibility (EMI/EMC), self-tests, design assurance, and mitigation of other attacks.*

**Keywords:** *cryptographic module, cryptographic-based security systems, cryptographic key management, authentication, confidentiality, integrity.*

### 1.OVERVIEW OF THE FOUR SECURITY LEVELS

The standard provides four increasing, qualitative levels of security intended to cover a wide range of potential applications and environments [1].

The security requirements cover areas related to the secure design and implementation of a cryptographic module.

Table 1 summarizes the security requirements in each of these areas.

#### 1.1 Security Level 1

Security Level 1 provides the lowest level of security. Basic security requirements are specified for a cryptographic module (at least one Approved algorithm or Approved security function shall be used). No specific physical security mechanisms are required in a Security Level 1.

An example of a Security Level 1 cryptographic module is a personal computer (PC) encryption board 1.

#### 1.2 Security Level 2

Security Level 2 enhances the physical security mechanisms of a Security Level 1 cryptographic module by adding the requirement for tamper-evidence, which includes the use of tamper-evident coatings or seals or for pick-resistant locks on removable covers or doors of the module. Tamper-evident coatings or seals are placed on a cryptographic module so that the coating or seal must be broken to attain physical access to the plaintext cryptographic keys and critical security parameters (CSPs) within the module.

Security Level 2 requires, at a minimum, role-based authentication in which a cryptographic module authenticates the authorization of an operator to assume a specific role and perform a corresponding set of services.

Table 1: Summary of security requirements

Security Level 1	Security Level 2	Security Level 3	Security Level 4	
<b>Cryptographic Module Specification</b>		Specification of cryptographic module, cryptographic boundary, Approved algorithms, and Approved modes of operation. Description of cryptographic module, including all hardware, software, and firmware components. Statement of module security policy.		
<b>Cryptographic Module Ports and Interfaces</b>		Required and optional interfaces. Specification of all interfaces and of all input and output data paths.	Data ports for unprotected critical security parameters logically or physically separated from other data ports.	
<b>Roles, Services, and Authentication</b>	Logical separation of required and optional roles and services.	Role-based or identity-based operator authentication.	Identity-based operator authentication.	
<b>Finite State Model</b>		Specification of finite state model. Required states and optional states. State transition diagram and specification of state transitions.		
<b>Physical Security</b>	Production grade equipment.	Locks or tamper evidence.	Tamper detection and response for covers and doors.	Tamper detection and response envelope. EFP or EFT.
<b>Operational Environment</b>	Single operator. Executable code. Approved integrity technique.	Referenced PPs evaluated at EAL2 with specified discretionary access control mechanisms and auditing.	Referenced PPs plus trusted path evaluated at EAL3 plus security policy modeling.	Referenced PPs plus trusted path evaluated at EAL4.
<b>Cryptographic Key Management</b>		Key management mechanisms: random number and key generation, key establishment, key distribution, key entry/output, key storage, and key zeroization.		
Secret and private keys established using manual methods may be entered or output in plaintext form.		Secret and private keys established using manual methods shall be entered or output encrypted or with split knowledge procedures.		
<b>EMI/EMC</b>	47 CFR FCC Part 15. Subpart B, Class A (Business use). Applicable FCC requirements (for radio).		47 CFR FCC Part 15. Subpart B, Class B (Home use).	
<b>Self-Tests</b>		Power-up tests: cryptographic algorithm tests, software/firmware integrity tests, critical functions tests. Conditional tests.		
<b>Design Assurance</b>	Configuration management (CM). Secure installation and generation. Design and policy correspondence. Guidance documents.	CM system. Secure distribution. Functional specification.	High-level language implementation.	Formal model. Detailed explanations (informal proofs). Preconditions and postconditions.
<b>Mitigation of Other Attacks</b>		Specification of mitigation of attacks for which no testable requirements are currently available.		

### 1.3 Security Level 3

In addition to the tamper-evident physical security mechanisms required at Security Level 2, Security Level 3 attempts to prevent the intruder from gaining access to CSPs held

within the cryptographic module. Physical security mechanisms required at Security Level 3 are intended to have a high probability of detecting and responding to attempts at physical access, use or modification of the cryptographic module.

The physical security mechanisms may include the use of strong enclosures and tamper detection/response circuitry that zeroizes all plaintext CSPs when the removable covers/doors of the cryptographic module are opened.

Security Level 3 requires identity-based authentication mechanisms, enhancing the security provided by the role-based authentication mechanisms specified for Security Level 2.

Security Level 3 requires the entry or output of plaintext CSPs (including the entry or output of plaintext CSPs using split knowledge procedures) be performed using ports that are physically separated from other ports, or interfaces that are logically separated using a trusted path from other interfaces. Plaintext CSPs may be entered into or output from the cryptographic module in encrypted form (in which case they may travel through enclosing or intervening systems).

#### **1.4 Security Level 4**

Security Level 4 provides the highest level of security defined in this standard. At this security level, the physical security mechanisms provide a complete envelope of protection around the cryptographic module with the intent of detecting and responding to all unauthorized attempts at physical access. Penetration of the cryptographic module enclosure from any direction has a very high probability of being detected, resulting in the immediate zeroization of all plaintext CSPs. Security Level 4 cryptographic modules are useful for operation in physically unprotected environments.

Security Level 4 also protects a cryptographic module against a security compromise due to environmental conditions or fluctuations outside of the module's normal operating ranges for voltage and temperature.

Intentional excursions beyond the normal operating ranges may be used by an attacker to thwart a cryptographic module's defenses.

A cryptographic module is required to either include special environmental protection features designed to detect fluctuations and zeroize CSPs, or to undergo rigorous

environmental failure testing to provide a reasonable assurance that the module will not be affected by fluctuations outside of the normal operating range in a manner that can compromise the security of the module.

## **2. SECURITY REQUIREMENTS**

This standard present security requirements cover areas related to the secure design and implementation of a cryptographic module. These areas include cryptographic module specification, cryptographic module ports and interfaces, roles, services, and authentication, finite state model, physical security, operational environment, cryptographic key management, electromagnetic interference / electromagnetic compatibility (EMI/EMC), self-tests, design assurance, and mitigation of other attacks.

### **2.1. Cryptographic Module Specification**

A cryptographic module shall be a set of hardware, software, firmware, or some combination thereof that implements cryptographic functions or processes, including cryptographic algorithms and, optionally, key generation, and is contained within a defined cryptographic boundary. A cryptographic module shall implement at least one Approved security function used in an Approved mode of operation.

### **2.2. Cryptographic Module Ports and Interfaces**

A cryptographic module shall restrict all information flow and physical access points to physical ports and logical interfaces that define all entry and exit points to and from the module. The cryptographic module interfaces shall be logically distinct from each other although they may share one physical port (e.g., input data may enter and output data may exit via the same port) or may be distributed over one or more physical ports (e.g., input data may enter via both a serial and a parallel port).

### 2.3. Roles, Services, and Authentication

A cryptographic module shall support authorized roles for operators and corresponding services within each role. Multiple roles may be assumed by a single operator. If a cryptographic module supports concurrent operators, then the module shall internally maintain the separation of the roles assumed by each operator and the corresponding services. An operator is not required to assume an authorized role to perform services where cryptographic keys and CSPs are not modified, disclosed, or substituted (e.g., show status, self-tests, or other services that do not affect the security of the module).

Authentication mechanisms may be required within a cryptographic module to authenticate an operator accessing the module, and to verify that the operator is authorized to assume the requested role and perform the services within the role.

A cryptographic module shall support the following authorized roles for operators:

**User Role.** The role assumed to perform general security services, including cryptographic operations and other Approved security functions.

**Crypto Officer Role:** The role assumed to perform cryptographic initialization or management functions (e.g., module initialization, input/output of cryptographic keys and CSPs, and audit functions).

**Maintenance Role:** The role assumed to perform physical maintenance and/or logical maintenance services (e.g., hardware/software diagnostics). All plaintext secret and private keys and unprotected CSPs shall be zeroized when entering or exiting the maintenance role.

#### Operator Authentication

Authentication mechanisms may be required within a cryptographic module to authenticate an operator accessing the module and to verify that the operator is authorized to assume the requested role and perform services within that role. Depending on the security level, a cryptographic module shall

support at least one of the following mechanisms to control access to the module:

**Role-Based Authentication:** If role-based authentication mechanisms are supported by a cryptographic module, the module shall require that one or more roles either be implicitly or explicitly selected by the operator and shall authenticate the assumption of the selected role (or set of roles).

**Identity-Based Authentication:** If identity-based authentication mechanisms are supported by a cryptographic module, the module shall require that the operator be individually identified, shall require that one or more roles either be implicitly or explicitly selected by the operator, and shall authenticate the identity of the operator and the authorization of the operator to assume the selected role (or set of roles).

### 2.4. Finite state model

The operation of a cryptographic module shall be specified using a finite state model (or equivalent) represented by a state transition diagram and/or a state transition table.

A cryptographic module shall include the following operational and error states: Power on/off states. States for primary, secondary, or backup power.

Crypto officer states. States in which the crypto officer services are performed (e.g., cryptographic initialization and key management).

Key/CSP entry states. States for entering cryptographic keys and CSPs into the cryptographic module.

User states. States in which authorized users obtain security services, perform cryptographic operations, or perform other Approved or non-Approved functions.

Self-test states. States in which the cryptographic module is performing self-tests.

Error states. States when the cryptographic module has encountered an error (e.g., failed a self-test or attempted to encrypt when missing operational keys or CSPs).

Error states may include "hard" errors that indicate an equipment malfunction and that may require maintenance, service or repair of the cryptographic module, or recoverable "soft" errors that may require initialization or resetting of the module.

Bypass states. States in which a bypass capability is activated and services are provided without cryptographic processing (e.g., transferring plaintext through the cryptographic module).

Maintenance states. States for maintaining and servicing a cryptographic module, including physical and logical maintenance testing.

## **2.5. Physical Security**

Physical security requirements are specified for three defined physical embodiments of a cryptographic module:

- Single-chip cryptographic modules are physical embodiments in which a single integrated circuit (IC) chip may be used as a standalone device or may be embedded within an enclosure or a product that may not be physically protected.

Multiple-chip embedded cryptographic modules are physical embodiments in which two or more IC chips are interconnected and are embedded within an enclosure or a product that may not be physically protected.

- Multiple-chip standalone cryptographic modules are physical embodiments in which two or more IC chips are interconnected and the entire enclosure is physically protected.

## **Environmental Failure Protection/Testing**

The electronic devices and circuitry are designed to operate within a particular range of environmental conditions. Deliberate or accidental excursions outside the specified normal operating ranges of voltage and temperature can cause erratic operation or failure of the electronic devices or circuitry that can compromise the security of the cryptographic module. Reasonable assurance that the security of a cryptographic module cannot be compromised by extreme environmental conditions can be provided by

having the module employ environmental failure protection (EFP) features or undergo environmental failure testing (EFT).

## **Environmental Failure Protection Features (Alternative 1)**

Environmental failure protection (EFP) features shall protect a cryptographic module against unusual environmental conditions or fluctuations (accidental or induced) outside of the module's normal operating range that can compromise the security of the module.

The EFP features shall involve electronic circuitry or devices that continuously measure the operating temperature and voltage of a cryptographic module. If the temperature or voltage fall outside of the cryptographic module's normal operating range, the protection circuitry shall either (1) shutdown the module to prevent further operation or (2) immediately zeroize all plaintext secret and private cryptographic keys and CSPs.

## **2.6. Operational Environment**

The operational environment of a cryptographic module refers to the management of the software, firmware, and/or hardware components required for the module to operate. The operational environment can be non-modifiable (e.g., firmware contained in ROM, or software contained in a computer with I/O devices disabled), or modifiable (e.g., firmware contained in RAM or software executed by a general purpose computer).

## **2.7. Cryptographic Key Management**

Key management includes random number and key generation, key establishment, key distribution, key entry/output, key storage, and key zeroization.

If a cryptographic module employs Approved or non-Approved RNGs in an Approved mode of operation, the module shall perform the following continuous random number generator test on each RNG that tests for failure to a constant value:

1. If each call to a RNG produces blocks of  $n$  bits (where  $n > 15$ ), the first  $n$ -bit block generated after power-up, initialization, or reset shall not be used, but shall be saved for comparison with the next  $n$ -bit block to be generated. Each subsequent generation of an  $n$ -bit block shall be compared with the previously generated block. The test shall fail if any two compared  $n$ -bit blocks are equal.

2. If each call to a RNG produces fewer than 16 bits, the first  $n$  bits generated after power-up, initialization, or reset (for some  $n > 15$ ) shall not be used, but shall be saved for comparison with the next  $n$  generated bits. Each subsequent generation of  $n$  bits shall be compared with the previously generated  $n$  bits. The test fails if any two compared  $n$ -bit sequences are equal.

Key Generation:

A cryptographic module may generate cryptographic keys internally. Cryptographic keys generated by the cryptographic module for use by an Approved algorithm or security function shall be generated using an Approved key generation method. Approved key generation methods are listed in Annex C to this standard.

Key Establishment:

Key establishment may be performed by automated methods (e.g., use of a public key algorithm), manual methods (use of a manually-transported key loading device), or a combination of automated and manual methods.

Key Entry and Output:

Cryptographic keys may be entered into or output from a cryptographic module. If cryptographic keys are entered into or output from a cryptographic module, the entry or output of keys shall be performed using either manual (e.g., via a keyboard) or electronic methods (e.g., smart cards/tokens, PC cards, or other electronic key loading devices).

All encrypted secret and private keys, entered into or output from a cryptographic module and used in an Approved mode of operation, shall be encrypted using an Approved algorithm.

## 2.8. **Electromagnetic Interference / Electromagnetic Compatibility** (EMI/EMC)

Cryptographic modules shall meet the following requirements for EMI/EMC:

For Security Levels 1-2/ Levels 3-4, a cryptographic module shall (at a minimum) conform to the EMI/EMC requirements specified by 47 Code of Federal Regulations, Part 15, Subpart B, Unintentional Radiators, Digital Devices, Class A /B.

## 2.9. **Self-Tests**

A cryptographic module shall perform power-up self-tests and conditional self-tests to ensure that the module is functioning properly. Power-up self-tests shall be performed when the cryptographic module is powered up. Conditional self-tests shall be performed when an applicable security function or operation is invoked (i.e., security functions for which self-tests are required).

-Cryptographic algorithm test:

A cryptographic algorithm test using a known answer shall be conducted for all cryptographic functions (e.g., encryption, decryption, authentication, and random number generation) of each Approved cryptographic algorithm implemented by a cryptographic module.

-Conditional Tests:

Conditional tests shall be performed by a cryptographic module when the conditions specified for the following tests occur: pairwise consistency test, software/firmware load test, manual key entry test, continuous random number generator test, and bypass test

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1. FIPS PUB 140-2, "Security requirements for cryptographic modules". May 25, 2001.
2. Implementation Guidance for FIPS PUB 140-2 and the Cryptographic Module Validation Program.

# AUTOMATIC SPEAKER RECOGNITION ARCHITECTURES

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**Abstract:** Automatic speaker recognition is the use of a machine to recognize a person from a spoken phrase. These systems can operate in two modes: to identify a particular person or to verify a person's claimed identity. In this paper we try to summarize the main approaches used in current automatic speaker recognition architectures, their performances and the future work in this field.

**Keywords:** speaker recognition, speech processing, access control, biometric, identification of persons, verification.

## 1. INTRODUCTION

Human speech is a complex signal, an outcome of the influence of several physiological, psychological and environmental factors. The acoustic signal we produce when we speak is determined by, among others, the physiology of the vocal tract and articulators, childhood language and dialect acquisition, regional traits, and training from life experiences. These features give a distinctive "identity" to the speech of different individuals. The speech signal conveys many levels of information to the listener. At the primary level, speech conveys a message via words. But at other levels speech conveys information about the language being spoken and the emotion, gender and, generally, the identity of the speaker. While speech recognition aims at recognizing the word spoken in speech, the goal of automatic speaker recognition systems is to extract, characterize and recognize the information in the speech signal conveying speaker identity.

## 2. CLASSIFICATION OF AUTOMATIC SPEAKER RECOGNITION SYSTEMS

Speaker recognition systems can be classified based on their functionality as: speaker identification systems and speaker verification systems, and based on the method

used as: text-dependent and text-independent [1].

The principal structure of speaker recognition systems is presented in figure 1.

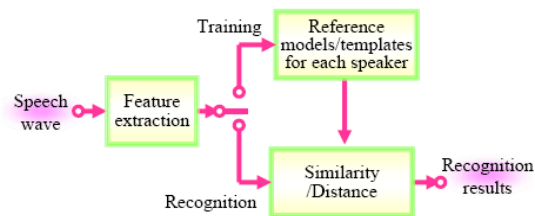


Fig. 1 The principal structure of speaker recognition systems

Speaker identification is the task of determining who is talking from a set of known voices or speakers. The unknown person makes no identity claim and so the system must perform a 1:N classification. Generally it is assumed the unknown voice must come from a fixed set of known speakers, thus the task is often referred to as *closed-set* identification.

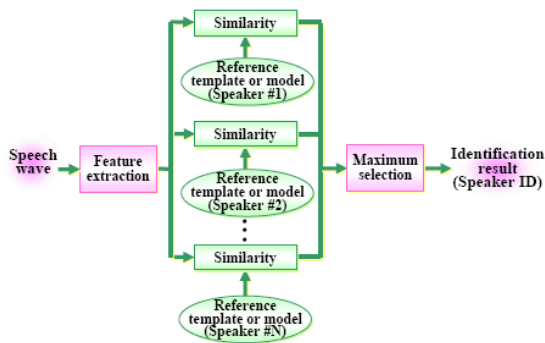


Fig. 2 Speaker identification basic structure

Speaker verification (also known as speaker authentication or detection) is the task of determining whether a person is who he/she claims to be (a yes/no decision).

Since it is generally assumed that imposters (those falsely claiming to be a valid user) are not known to the system, this is referred to as an open-set task.

By adding a “none-of-the-above” option to the closed-set identification task one can merge the two tasks for what is called open-set identification.

In general, most compelling applications of speaker recognition technology use open-set speaker verification.

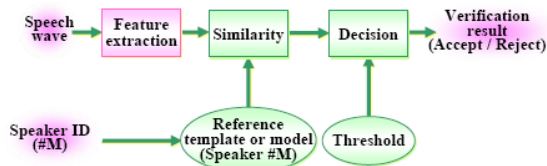


Fig. 3 Speaker verification basic structure

Depending on the level of user cooperation and control in an application, the speech used for these tasks can span from text-dependent to text-independent [2]. In a pure text-dependent application, a speaker speaks the same text during enrollment and verification and the recognition system has prior knowledge of this text.

An example of this would be a common or user-specific pass-phrase (e.g., “Open sesame”). Without being as rigid, a text-constrained application allows a speaker to use text from a limited vocabulary, such as the

digits. The system has prior knowledge of the constrained vocabulary to be used and may have exact knowledge of the text to be spoken, as when using prompted phrases.

In both text-dependent and text-constrained applications it is expected that the user will cooperatively speak the fixed text or words from the prescribed vocabulary.

The prior knowledge and constraint of the text can greatly boost performance of a recognition system. In a text-independent application, there is no prior knowledge by the system of the text to be spoken, such as when using extemporaneous speech.

Text-independent recognition is more difficult but also more flexible, for example allowing verification of a speaker while he/she is conducting other speech interactions (background verification).

As speaker and speech recognition system merge and speech recognition accuracy improves, the distinction between text-independent and text-dependent applications will decrease.

Of the two basic tasks, text-dependent speaker verification is currently the most commercially viable and useful technology, although there has been much research conducted on both tasks.

### 3. SYSTEMS STRUCTURE

The general approach to automatic speaker recognition consists of five steps [3]: digital speech data acquisition, feature extraction and selection, pattern matching, making a decision, and enrollment to generate speaker reference models.

#### A. Speech Signal Acquisition

Initially, the acoustic sound pressure wave is transformed into a digital signal suitable for voice processing. A microphone or telephone handset can be used to convert the acoustic wave into an analog signal.

This analog signal is conditioned with antialiasing filtering (and possibly additional filtering to compensate for any channel impairments). The antialiasing filter limits the bandwidth of the signal to approximately the



Nyquist rate (half the sampling rate) before sampling.

The conditioned analog signal is then sampled to form a digital signal by an analog-to-digital (A/D) converter. Today's A/D converters for speech applications typically sample with 12–16 bits of resolution at 8000–20 000 samples per second.

Oversampling is commonly used to allow a simpler analog antialiasing filter and to control the fidelity of the sampled signal precisely (e.g., sigma–delta converters).

In local speaker-verification applications, the analog channel is simply the microphone, its cable, and analog signal conditioning.

Thus, the resulting digital signal can be very high quality, lacking distortions produced by transmission of analog signals over long-distance telephone lines.

### **B. Feature extraction and selection**

Feature extraction is the estimation of variables, called a feature vector, from another set of variables (e.g., an observed speech signal time series). Feature selection is the transformation of these observation vectors to feature vectors. The goal of feature selection is to find a transformation to a relatively low-dimensional feature space that preserves the information pertinent to the application while enabling meaningful comparisons to be performed using simple measures of similarity.

For speaker recognition purposes, optimal feature has the following properties [4]:

- high inter-speaker variation,
- low intra-speaker variation,
- easy to measure,
- robust against disguise and mimicry,
- robust against distortion and noise,
- maximally independent of the other features.

The known parameters used for speaker recognition are:

- Vocal tract features: Autocorrelation coefficients (COR), Linear Prediction Coefficients (LPC) [5], [6], Partial Correlation coefficients (PARCOR) [5], Log Area Ratio (LAR), Perceptual Linear Prediction -PLP [7];

- Acoustic and cepstral features: LSP (Line Spectrum Pairs), Linear Filter Banks, Nonlinear Filter Banks (Mel scale), Cepstral Coefficients (CC), Mel Frequency Cepstral Coefficients (MFCC) [8];

### **C. Pattern matching**

The pattern-matching task of speaker verification involves computing a match score, which is a measure of the similarity of the input feature vectors to some model. Speaker models are constructed from the features extracted from the speech signal. To enroll users into the system, a model of the voice, based on the extracted features, is generated and stored (possibly on an encrypted smart card). Then, to authenticate a user, the matching algorithm compares/scores the incoming speech signal with the model of the claimed user.

The models can be classified in stochastic models, template models and the other models. In stochastic models, the pattern matching is probabilistic and results in a measure of the likelihood, or conditional probability, of the observation given the model. For template models, the pattern matching is deterministic.

The best techniques and model used for speaker recognition are:

- Stochastic models: Gaussian Mixture Models (GMMs) [13],[14 and Hidden Markov Models (HMMs) [15];
- Template models: Dynamic Time Warping (DTW) [9], [10]; Vector Quantization (VQ) [11], [12] and Nearest Neighbors (NN) [3];
- Neural Networks [16];
- Support Vector Machines (SVM) [17], [18].

### **D. Decision**

Having computed a match score between the input speech-feature vector and a model of the claimed speaker's voice, a verification decision is made whether to accept or reject the speaker or to request another utterance (or, without a claimed identity, an identification decision is made). The accept or reject decision process can be an accept, continue, time-out, or reject hypothesis-testing problem.

In this case, the decision-making, or classification, procedure is a sequential hypothesis-testing problem.

This step has three problem to solve: setting of decision threshold, the score ormalization and the score fusion.

*The decision threshold*

The Bayesian hypothesis test is usually proposed in the state-of-the-art as the decision framework. If this solution seems well suited to set the decision threshold, different points remain sensitive. Particularly, while the statistical estimation theory provides a good way of estimating the client hypothesis, the situation is different for the anti-speaker hypothesis. Figure 4 how to choose the threshold, were FA = False Acceptation and FR = False Rejection.

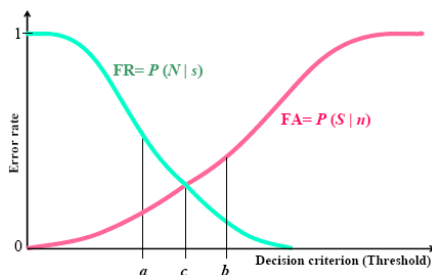


Fig 4. Relationship between error rate and decision criterion (threshold) in speaker verification

*Score normalization*

This technique is used for improving the robustness of speaker recognition systems. The usually methods used are :cepstral mean subtraction (CMS), variance normalization, feature warping, T-norm, Z-norm and the cohort method.

*Score fusion*

A speaker recognition system can be reduced to:

- From a set of tests: data against an identity;
- It computes a score for each test;

The method used for this problem are:

- Logistic regression
- SVM regression

- SVM classification
- Artificial neural networks

A solution for the fusion problem is presented in figure 5.

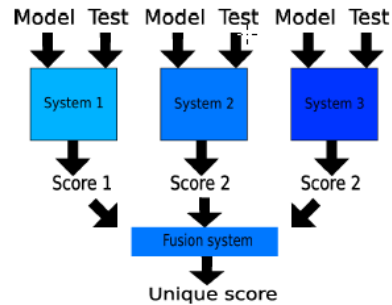


Fig.5 Score fusion

**4. APPLICATIONS**

The applications of speaker recognition technology are quite varied and continually growing.

- **Access Control:** Originally for physical facilities, more recent applications are for controlling access to computer networks (add biometric factor to usual password and/or token) or websites (thwart password sharing for access to subscription sites). Also used for automated password reset services.
- **Transaction Authentication:** For telephone banking, in addition to account access control, higher levels of verification can be used for more sensitive transactions. More recent applications are in user verification for remote electronic and mobile purchases (e- and m-commerce).
- **Law Enforcement:** Some applications are home-parole monitoring (call parolees at random times to verify they are at home) and prison call monitoring (validate inmate prior to outbound call). There has also been discussion of using automatic systems to corroborate aural/spectral

inspections of voice samples for forensic analysis.

- **Speech Data Management:** In voice mail browsing or intelligent answering machines, use speaker recognition to label incoming voice mail with speaker name for browsing and/or action (personal reply). For speech skimming or audio mining applications, annotate recorded meetings or video with speaker labels for quick indexing and filing.
- **Personalization:** In voice-web or device customization, store and retrieve personal setting/preferences based on user verification for multi-user site or device (car climate and radio settings). There is also interest in using recognition techniques for directed advertisement or services, where, for example, repeat users could be recognized or advertisements focused based on recognition of broad speaker characteristics (e.g. gender or age).

## 5. CONCLUSION AND FUTURE TRENDS

Some of the future trends in speaker recognition research and development are presented here:

- **Exploitation of higher-levels of information:** In addition to the low-level spectrum features used by current systems, there are many other sources of speaker information in the speech signal that can be used. These include idiolect (word usage), prosodic measures and other long-term signal measures. This work will be aided by the increasing use of reliable speech recognition systems for speaker recognition R&D. High-level features not only offer the potential to improve accuracy, they may also help improve

robustness since they should be less susceptible to channel effects.

- **Focus on real world robustness:** Speaker recognition continues to be data-driven field, setting the lead among other biometrics in conducting benchmark evaluations and research on realistic data. The continued ease of collecting and making available speech from real applications means that researchers can focus on more real-world robustness issues that appear. Obtaining speech from a wide variety of handsets, channels and acoustic environments will allow examination of problem cases and development and application of new or improved compensation techniques. Currently NIST conducts annual speaker verification evaluations in which participation is open to any interested parties.

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## EUROPEAN OPTIONS EVALUATION THROUGH CRANK-NICOLSON METHOD

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**Abstract:** Nowadays, options are transacted in over fifty stock exchanges all around the world, and in Romania only at Monetary-Financial and Goods Stock Exchange in Sibiu. An option can be defined as a right, obtained through a certain procedure, to buy or to sell a certain quantity of a financial asset at previously fixed price and at an agreed-upon date. Value determination of an option is made through solving an equation with derivatives. Finding the analytical solutions is not at hand, reason for which the problem of determining numerical solutions is raised. The paper presents the determinate option through Crank-Nicolson method.

**Key words:** stock exchange, financial, method, boundary, European options.

### 1. INTRODUCTION

Nowadays, options are transacted in over fifty stock exchanges all around the world, and in Romania only at Monetary-Financial and Goods Stock Exchange in Sibiu. On the other hand, through their significance, options can be assimilated to the majority of managerial decisions.

Because these reasons, studying the problem of options becomes very important.

Value determination of an option is made through solving an equation with derivatives. Finding the analytical solutions is not at hand, reason for which the problem of determining numerical solutions is raised.

An option can be defined as a right, obtained through a certain procedure, to buy or to sell a certain quantity of a financial asset at previously fixed price and at an agreed-upon date.

The buyer of an option has the right, but he has not the obligation, to buy or to sell at a previously fixed price and at an agreed-upon date a certain quantity of underlying assets (material, financial, of currency etc.).

The seller of an option irrevocably undertakes the obligation to sell or to buy a certain quantity of assets, under the terms

stipulated in the optional contract, even if the market is not favorable for him at the moment of option expiration.

A buying option is a **call** option and a selling option is a **put** option.

From the point of view of the expiration date, there are two types of options: European if the expiration can be made only at the maturity (exercise) and American if the expiration can be made at any moment before maturity.

### 2. THE PROBLEM OF DETERMINING THE VALUE OF A FINANCIAL OPTION

In the following part, the price of a call option, as well as a put option, will be designated through the current moment of time  $t$ , through  $E$ -strike price (the price of the transaction), through  $S(t)$  (or  $S$ )-price of the underlying asset, through  $T$ -strike expiration date, through  $\sigma$  - volatility (standard deviation of the financial asset value), through  $r$ -rate of interest and through  $C(S,t)$ ,  $P(S,t)$  (or  $C,P$ ).

When the rate of interest and the volatility are constant in time, the problem of determining the value of a European call option is:

$$(P1) \begin{cases} \frac{\partial C}{\partial t} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 C}{\partial S^2} + rS \frac{\partial C}{\partial S} - rC = 0 \\ C(S, T) = \max(S - E, 0) \\ C(0, t) = 0 \\ C(S, t) \approx S, \text{ c\u00e2nd } S \rightarrow \infty \end{cases}$$

and of a European put option is:

$$(P2) \begin{cases} \frac{\partial P}{\partial t} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 P}{\partial S^2} + rS \frac{\partial P}{\partial S} - rP = 0 \\ P(S, T) = \max(E - S, 0) \\ P(0, t) = Ee^{-r(T-t)} \\ P(S, t) \rightarrow 0, \text{ c\u00e2nd } S \rightarrow \infty \end{cases}$$

The partial differential equation from (P1) and (P2) is called Black-Scholes equation. [15] To solve these problems, it is necessary to make transformations to obtain more simple problems that are at the diffusion equation with one initial condition and two boundaries conditions.

Thus, problems (P1) and (P2) are equivalent to:

$$(P11) \begin{cases} \frac{\partial u}{\partial \tau} = \frac{\partial^2 u}{\partial x^2}, \quad -\infty < x < \infty, \quad \tau > 0 \\ u(x, 0) = u_0(x) = \max \left[ e^{\frac{1}{2}(k_1+1)x} - e^{\frac{1}{2}(k_1-1)x}, 0 \right] \\ \lim_{x \rightarrow -\infty} u(x, \tau) = 0 \\ \lim_{x \rightarrow \infty} u(x, \tau) \approx e^{\frac{1}{2}(k_1+1)x + \frac{1}{4}(k_1+1)^2 \tau} \end{cases}$$

respectively:

$$(P21) \begin{cases} \frac{\partial u}{\partial \tau} = \frac{\partial^2 u}{\partial x^2}, \quad -\infty < x < \infty, \quad \tau > 0 \\ u(x, 0) = u_0(x) = \max \left[ e^{\frac{1}{2}(k_1-1)x} - e^{\frac{1}{2}(k_1+1)x}, 0 \right] \\ \lim_{x \rightarrow +\infty} u(x, \tau) = 0 \\ \lim_{x \rightarrow -\infty} u(x, \tau) \approx e^{\frac{1}{2}(k_1-1)x + \frac{1}{4}(k_1-1)^2 \tau} \end{cases}$$

where:

$$\begin{cases} S = Ee^x; \quad S \geq 0 \Rightarrow x \in \mathbf{R} \dots \dots \dots (1) \\ t = T - \frac{\tau}{\frac{1}{2}\sigma^2}; \quad t \leq T \Rightarrow \tau \geq 0 \dots \dots \dots (2) \\ V(S, t) = Ee^{-\frac{1}{2}(k_1-1)x - \frac{1}{4}(k_1+1)^2 \tau} u(x, \tau) \dots \dots (3) \\ k_1 = \frac{r}{\frac{1}{2}\sigma^2} \dots \dots \dots (4) \end{cases}$$

and  $V(S, t)$  is  $C(S, t)$  or  $P(S, t)$ .

Consequently, solving through numeric methods of the determining problem of the value of a European option of any kind is reduced to the solving of the following generic problem:

$$(P) \begin{cases} \frac{\partial u}{\partial \tau} = \frac{\partial^2 u}{\partial x^2}, \quad -\infty < x < \infty, \quad \tau > 0 \dots (5) \\ u(x, 0) = u_0(x) \dots \dots \dots (6) \\ \lim_{x \rightarrow -\infty} u(x, \tau) = f(x, \tau) \dots \dots \dots (7) \\ \lim_{x \rightarrow +\infty} u(x, \tau) = g(x, \tau) \dots \dots \dots (8) \end{cases}$$

where the analytical forms of the functions  $f, g$  and  $u_0$  depend on the actual type of financial option that to be evaluated.

### 3. EVALUATING THE EUROPEAN OPTIONS THROUGH NUMERICAL METHODS

We have to determine the solution of diffusion equation (5) with the initial condition (6) and boundaries conditions (7) and (8) in domain:  $D = \{(x, \tau) \mid x \in \mathbf{R}, \tau \geq 0\}$ .

For this we choose  $h = \delta x$  and  $k = \delta \tau$  very small and consider the net:

$$R_{nk} = \{(x_n, \tau_m) \mid x_n = nh, \tau_m = mk, n \in \mathbf{Z}, m \in \mathbf{N}^+\}$$

If we consider  $h$  to be constant,  $(-\infty < x < \infty)$ , we can to consider an infinite number of points on the  $Ox$  axis. In order to avoid this disadvantage our attention is focused on a finite interval on the  $Ox$  axis, making the limitation  $-N^-h \leq x \leq N^+h$ , with  $N^-h$  and  $N^+h$  large.

Because  $t$  is the passed time from the option closing, and  $T$  the expiration date, it thus follows that  $T - t$  represents the remaining time until the expiration date. Under these

circumstances, the  $\tau = \frac{1}{2}\sigma^2(T - t)$  (according to (2)), represents a time scaling until the date of expiration, and as a result, is  $\tau \in \left[0, \frac{1}{2}\sigma^2 T\right]$ . Because the above interval of size  $\frac{1}{2}\sigma^2 T$  is divided in intervals of size  $k$ , for the points in the net earlier discussed, we have  $0 \leq m \leq M$ , where  $M$  is obtained from  $Mk = \frac{1}{2}\sigma^2 T$ .

From the above net, only the points  $(x_n, \tau_m) = (nh, mk)$  remain with  $-N^- \leq n \leq N^+, 0 \leq m \leq M$ .

In every point  $(x_n, \tau_m)$  of this net, it is sought the numerical solution  $v(x_n, \tau_m)$  noted  $V_n^m$ , which approximates the exact value of the solution  $u(x_n, \tau_m)$ .

**4. CRANK – NICOLSON METHOD**

Crank – Nicolson Method [10, 11], developed by John Crank and Phyllis Nicolson in the mid 20th century, is based on the following formula:

$$(1 + \alpha)v_n^{m+1} - \frac{\alpha}{2}v_{n-1}^{m+1} - \frac{\alpha}{2}v_{n+1}^{m+1} = (1 - \alpha)v_n^m + \frac{\alpha}{2}v_{n-1}^m + \frac{\alpha}{2}v_{n+1}^m \tag{9}$$

or:

$$(1 + \alpha)v_n^{m+1} - \frac{\alpha}{2}v_{n-1}^{m+1} - \frac{\alpha}{2}v_{n+1}^{m+1} = z_n^m \tag{10}$$

after noting:

$$z_n^m = (1 - \alpha)v_n^m + \frac{\alpha}{2}v_{n+1}^m + \frac{\alpha}{2}v_{n-1}^m. \tag{11}$$

By using the initial condition and boundaries conditions we have from the beginning the values of the solutions in certain points from the boundary. Thus, from (6), (7) and (8), to which (10) is added, the following problem is obtained:

$$\begin{cases} (1 + \alpha)v_n^{m+1} - \frac{\alpha}{2}v_{n-1}^{m+1} - \frac{\alpha}{2}v_{n+1}^{m+1} = z_n^m, \\ -N^- < n < N^+, 0 \leq m < M \\ v_n^0 = u_0(nh), -N^- \leq n \leq N^+ \\ v_{-N^-}^m = f(-N^-h, mk), 0 < m \leq M \\ v_{N^+}^m = g(N^+h, mk), 0 < m \leq M \end{cases}$$

being necessary to determine  $V_n^m$ , for  $m \geq 1, -N^- < n < N^+$ .

The formula (10) is written as the following matrix equation:

$$Cv^{m+1} = z^m \tag{12}$$

where:  $v^{m+1}$  is the column vector with the following components:

$$v_{N^+-1}^{m+1}, v_{N^+-2}^{m+1}, v_0^{m+1}, v_{-N^-+1}^{m+1}$$

$z^m$  is the column vector with the following components:

$$z_{N^+-1}^{m+1}, z_{N^+-2}^{m+1}, z_0^{m+1}, z_{-N^-+1}^{m+1}$$

$$C = \begin{pmatrix} 1 + \alpha & -\alpha/2 & 0 & \dots & 0 & 0 \\ -\alpha/2 & 1 + \alpha & -\alpha/2 & \dots & 0 & 0 \\ 0 & -\alpha/2 & 1 + \alpha & \dots & 0 & 0 \\ \dots & \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & 0 & \dots & 1 + \alpha & -\alpha/2 \\ 0 & 0 & 0 & \dots & -\alpha/2 & 1 + \alpha \end{pmatrix} \tag{13}$$

On the basis of (11),  $z^m$  is computed component by component using the components of  $v^m$ , previously obtained. Then, with  $z^m$  thus determined, the system  $Cv^{m+1} = z^m$  is solved, operation made for every values of  $m$ .

The Crank-Nicolson method, like all the open methods, means solving some linear

systems. It follows the necessity of using some quick methods for solving these systems.

As it is already known, for solving linear systems exact and iterative methods are used.

From the first group, we shall use the Gauss method, and from the iterative ones (that consist of generating a sequence of vectors that converges to the solution) one will use the Jacobi method, Gauss-Seidel method [12] and the successive over relaxation method.

#### 4.1. USING THE GAUSS METHOD

We omit the index which marks the time and we rewrite (12) as follows:

$$\begin{cases} a_1 v_{N^+-1} + c_1 v_{N^+-2} = z_{N^+-1} \\ b_1 v_{N^+-1} + a_2 v_{N^+-2} + c_2 v_{N^+-3} = z_{N^+-2} \\ \dots \\ b_{j-1} v_{N^+-j+1} + a_j v_{N^+-j} + c_j v_{N^+-j-1} = z_{N^+-j} \\ \dots \\ b_{N-1} v_{-N^++2} + a_N v_{-N^++1} = z_{-N^++1} \end{cases}$$

where:

$$N = N^+ + N^- - 1$$

and:

$$a_i = 1 + \alpha, i = \overline{1, N}; b_i = c_i = -\frac{\alpha}{2},$$

$$i = \overline{1, N-1}.$$

With the first equation,  $v_{N^+-1}$  is eliminated from the second equation resulting a new one in  $v_{N^+-2}$  and  $v_{N^+-3}$ . With this equation,  $v_{N^+-2}$  is eliminated from the third one and so on. Using the last but one equation  $v_{-N^++2}$  is eliminated from the last one result an equation in  $v_{-N^++1}$ . After determining  $v_{-N^++1}$  from the last equation, the other unknowns are obtained through a reverse process, starting the last but one equation.

One can notice that in this process of eliminating, coefficient  $c_j$  is the same. During the  $j$  stage of the eliminating process, the equation  $j-1$  which was a subject of the eliminating process and the equation  $j$  which is about to be subject of the eliminating process is as follows:

$$\begin{cases} \beta_{j-1} v_{N^+-j+1} + c_{j-1} v_{N^+-j} = x_{j-1} \\ b_{j-1} v_{N^+-j+1} + a_j v_{N^+-j} + c_j v_{N^+-j-1} = z_{N^+-j} \end{cases}$$

After eliminating  $v_{N^+-j+1}$  we obtain:

$$\left( a_j - \frac{c_{j-1} b_{j-1}}{\beta_{j-1}} \right) v_{N^+-j} + c_j v_{N^+-j-1} = z_{N^+-j} - \frac{x_{j-1} b_{j-1}}{\beta_{j-1}}$$

or the following type:

$$\beta_j v_{N^+-j} + c_j v_{N^+-j-1} = x_j \tag{14}$$

from which it follows the recurrence formulas:

$$\begin{cases} \beta_j = a_j - \frac{c_{j-1} b_{j-1}}{\beta_{j-1}}, \\ x_j = z_{N^+-j} - \frac{x_{j-1} b_{j-1}}{\beta_{j-1}}, \end{cases}$$

$$j = 2, 3, N; \quad \beta_1 = a_1 \tag{15}$$

$$j = 2, 3, N; \quad x_1 = z_N \tag{16}$$

After eliminating  $v_{-N^++2}$  from the last equation we obtain:

$$\beta_N v_{-N^++1} = x_N \tag{17}$$

formula from which we determine  $v_{-N^++1}$ .

Equation (14) is a generic one; it allows determining an unknown  $(v_{N^+-j})$  according to the previous unknown  $(v_{N^+-j-1})$ .

From (17) and (14) the solution if the initial system is computed:



$$\left\{ \begin{array}{l} v_{-N^-+1} = \frac{x_N}{\beta_N} \\ v_{N^+-j} = v_{N-N^- -j+1} = \frac{1}{\beta_j} (x_j - c_j v_{N^+-j-1}) \end{array} \right. \quad j = N-1, N-2, 2,$$

after  $\beta_j$  and  $x_j$  it is recurrently computed with formulas (15) and (16).

### 4.2. USING THE JACOBI METHOD

First we consider a linear system of  $n$  equations with  $n$  unknowns written as a matrix equation  $Ax = b$ .

As it is known, at the Jacobi method [13] the solution is obtained on the basis of the iterative formula:

$$x_i^{(l+1)} = \frac{1}{a_{ii}} \left[ b_i - \sum_{j=1, j \neq i}^n a_{ij} x_j^{(l)} \right] \quad i = 1, 2, n, \quad l=1, 2,$$

2,  $n$ ,  $l=1, 2$ ,

Coming back to (12), whose matrix  $C$  is given by (13) and whose constant terms are given by (11).

Applying the iterative method Jacobi we generate a sequence  $v^{(1)}, v^{(2)}, \dots, v^{(l)}, \dots$

which approximates  $v^{m+1}$ , and when writing the components of these vectors we avoid moment  $m+1$ . Using the components of vector  $v^m$ , with (11) we compute

$z_n^m$  (for  $-N^- < n < N^+$ ), which we rewrite as  $Zn$ . The iteration of the Jacobi method is:

$$\left\{ \begin{array}{l} v_{-N^-+1}^{(l+1)} = \frac{1}{\alpha+1} \left( z_{-N^-+1} + \frac{\alpha}{2} v_{-N^-+2}^{(l)} \right) \\ v_n^{(l+1)} = \frac{1}{\alpha+1} \left( z_n + \frac{\alpha}{2} v_{n-1}^{(l)} + \frac{\alpha}{2} v_{n+1}^{(l)} \right) \\ v_{N^+-1}^{(l+1)} = \frac{1}{\alpha+1} \left( z_{N^+-1} + \frac{\alpha}{2} v_{N^+-2}^{(l)} \right) \end{array} \right.$$

$n = -N^- + 2, -N^- + 3, \dots, 0, \dots, N^+ - 2$ , for  $l=1, 2$ ,

### 4.3. USING THE GAUSS-SEIDEL METHOD

For the general case (system  $Ax = b$ ), at the Gauss-Seidel method [14], the iterative formula is:

$$x_i^{(l+1)} = \frac{1}{a_{ii}} \left( b_i - \sum_{j=1}^{i-1} a_{ij} x_j^{(l+1)} - \sum_{j=i+1}^n a_{ij} x_j^{(l)} \right)$$

$i = 1, 2 \dots n, \quad l = 1, 2 \dots$

For (12),  $v^{m+1}$  approximation through the Gauss-Seidel method is given by:

$$\left\{ \begin{array}{l} v_{-N^-+1}^{(l+1)} = \frac{1}{\alpha+1} \left( z_{-N^-+1} + \frac{\alpha}{2} v_{-N^-+2}^{(l)} \right) \\ v_n^{(l+1)} = \frac{1}{\alpha+1} \left( z_n + \frac{\alpha}{2} v_{n-1}^{(l+1)} + \frac{\alpha}{2} v_{n+1}^{(l)} \right) \\ v_{N^+-1}^{(l+1)} = \frac{1}{\alpha+1} \left( z_{N^+-1} + \frac{\alpha}{2} v_{N^+-2}^{(l+1)} \right) \end{array} \right.$$

$n = -N^- + 2, -N^- + 3, \dots, 0, \dots, N^+ - 2$ , for  $l=1, 2$

### 4.4. USING THE METHOD OF SUCCESSIVE OVER RELAXATIONS

In case of the system  $Ax = b$ , the vector that approximates the solution in stage  $l+1$  is given by:

$$x^{(l+1)} = x^{(l)} + \omega (x^{-(l+1)} - x^{(l)}) = (1-\omega)x^{(l)} + \omega x^{-(l+1)}$$

Where:  $x^{-(l+1)}$  is the approximation from stage  $l+1$  obtained through Gauss-Seidel method, and  $\omega$  real parameter, known as relaxation factor.

If  $\omega=1$ , then  $x^{(l+1)} = x^{-(l+1)}$ , so the method of successive over relaxations is in fact the Gauss-Seidel method.

In fact, the method means applying the Gauss-Seidel method for  $x^{-(l+1)}$  approximation determining and then improving the solution applying the above formula.

Coming back to (12), after computing we obtain:

$$\begin{cases} v_{-N+1}^{(l+1)} = \frac{\omega}{\alpha+1} \left( z_{-N+1} + \frac{\alpha}{2} v_{-N+2}^{(l)} \right) + (1-\omega) v_{-N+1}^{(l)} \\ v_n^{(l+1)} = \frac{\omega}{\alpha+1} \left( z_n + \frac{\alpha}{2} v_{n-1}^{(l+1)} + \frac{\alpha}{2} v_{n+1}^{(l)} \right) + (1-\omega) v_n^{(l)} \\ v_{N-1}^{(l+1)} = \frac{\omega}{\alpha+1} \left( z_{N-1} + \frac{\alpha}{2} v_{N-2}^{(l+1)} \right) + (1-\omega) v_{N-1}^{(l)} \end{cases}$$

$$n = -N + 2, -N + 3, \dots, 0, \dots, N - 2,$$

for  $l=1, 2, \dots$  which allow determining  $v^{m+1}$  approximations.

## 5. CONCLUSION

Because the analyze methods for determination of European options are very complication, a simple solution is Crank-Nicolson method, a numerical method. This is an implicit method that implies calculating of the linear equations systems.

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## CRYPTOGRAPHIC ALGORITHMS AND SERVICES IN THE LOCAL AREA NETWORK

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**Abstract:** Today, the majority of people who use computer networks use them for electronic mail or for file and document transmissions. The most documents have a personal and private character. The users do not want private or confidential electronic documents read by anyone else. The new Privacy Document Interchange (PDI) systems must be enhancement with the cryptographic services for guarantee the confidentiality of messages transmitted in computer networks.

**Keywords:** cryptoserver's function, privacy document interchange, cryptographic algorithms.

### 1. CRYPTOSERVER'S FUNCTION

The *OSI security reference model* define the following *security services* that can be used by PDI users:

- The *confidentiality*, which protects the contents of a message against unauthorized disclosure, to other then, the recipients specified by the message sender. It can be used against interception of data.
- The *data origin authentication* service permits to the recipient of a message to determine in a reliable way the identity of the originator of the message. This service is useful today, because in the current PDI system is often very easy to forge the identity of the sender of a message.
- The *connectionless integrity* service provides the recipient the assurance that the received message content is identical to the content sent by the originator. Although authentication and integrity are described as independent, they are usually provided in tandem.
- The *message non repudiation* service allows a message to be forwarded to a third

party, who can verify the identity of the sender and that the message has not been altered, even by the authentically sender. This service is very useful for example in commerce, for secure transmission of purchase orders and for providing receipts.

The *Cryptoserver* is a specialized computer, PC type, placed in a Local Area Network (LAN) or near by the host computer in a Wide Area Network (WAN). The purpose of the Cryptoserver is to help a Privacy Document Interchange (PDI) application to achieve or to check data security functions. In fact, it is a computer specialized in security services not in data transmission. The Cryptoserver is called by the data transfer application, using dedicated routines with proper communication protocols, when data transmission security needed.

A Cryptoserver achieve the following basic functions:

- *Authentication* function permits to the recipient of a message to determine, in a reliable way, the identity of the originator of the

message and the integrity of the message.

- *Encryption* function for ensure the contents confidentiality of a message.

- *Filtering*. An electronic encryption mechanism must be compatible with the transparency constraints of its underlying network facilities. These constraints are generally established based on expected user requirements and on the characteristics of anticipated endpoint and transport facilities. For example, in E-mail context, the encoding conforms to SMTP constraints. To prepare a message for SMTP transmission, the following requirements must be met:

- all characters must be members of the 7-bit ASCII character set.

- text lines, delimited by the character pair <CR><LF>, must be no more than 1000 characters long. Although SMTP specifies a standard representation for line delimiters (ASCII <CR><LF>), numerous systems in the INTERNET use a different native representation to delimit lines.

- since the string <CR><LF>. <CR><LF> indicates the end of a message, it must not occur in text prior to the end of a message.

The filtering function has the goal to convert the bit stream obtained after the encryption algorithm in a character string, compatible with SMTP protocol. The filtering process used in implementation represents 24-bit groups of input bits as output strings of 4 encoded characters. Proceeding from left to right across a 24-bit input group each 6-bit group is used as an index into an array of 64 printable characters. The character referenced by the index is placed in the output string,

- *Key management* function has the goal to supply a reliable way to exchange cryptographic keys between users. The CCITT X12.42 standard defines a set of transactions that permit to exchange cryptographic keys through the network.

Cryptoserver must to keep a *database* with security information, needed to:

- identify users;
- determine users' public key;
- determine users' private key;
- identify Cryptoserver's public and private keys (needed for calling Cryptoserver's services).

## 2. CRYPTOSERVER'S CRYPTOGRAPHIC ALGORITHMS AND SERVICES

For providing security services, the Cryptoserver must use a variety of *cryptographic mechanisms (ciphers)*. A *cipher* is used to transform data through an *encryption process*. The input to this process is called *plaintext* and the output is called *ciphertext*. A decryption process that accepts ciphertext as input and obtains plaintext inverts the encryption. In both cases, a key controls the process, which is a parameter of the process.

In a *symmetric (secret key) cipher*, the same key is used to encrypt and decrypt data. This key is kept secret and is shared by the sender and receiver. The transfer of this type of key between two partners through traditional mail is a complex problem and requires public key mechanisms. Symmetric encryption mechanisms are used in confidentiality services to encipher messages.

$$\begin{array}{ll} \text{User A} & \text{User B} \\ C = S_{sk}(M) & M = S^{-1}_{sk}(C) \end{array}$$

$M$  = message (plaintext);  $C$  = ciphertext;  
 $S$  - symmetric encryption algorithm;  
 $sk$  = secret key.

The Cryptoserver can use like symmetric encryption mechanism one of the following algorithms: American standard *DES*, the international standard *IDEA* and the Japanese standard *FEAL-8*.

An *asymmetric (public key) cipher* consist of a pair of distinct, but mathematically related

(they are generated simultaneously), keys that are used for encryption and decryption. One key is kept private and is known only by its owner, the other key is made public. Data encrypted with the user's private key can be decrypted using his public key.

$$\begin{array}{ll} \text{User A} & \text{User B} \\ C = E_{kpb}(M) & M = D_{kpr}(C) \end{array}$$

$M$  = message (plaintext);  $C$  = ciphertext  
 $E$  = asymmetric encryption algorithm, using  $kpb$  - user B public key  
 $D$  = asymmetric decryption algorithm, using  $kpr$  - user B private key

Since the performance of asymmetric ciphers is not very good (computational time is expensive), they are not used to encipher data directly. Instead, these ciphers are used for digital signatures and for the distribution of symmetric keys. The public key algorithms used by the Cryptoserver are *RSA* (Rivest-Shamir Adleman), *EG* (El Gamal) and the American standard *DSA* (Digital Signature Algorithm).

A digital signature is created using public key mechanisms and a *one-way hash function*. The hash function is used to calculate a value (digest) that is a complex function of the document to be signed; this value is like a fingerprint of the document, because is infesable to construct two distinct documents yelling the same digest. Document is signed by encrypting the digest of the data using owner's private key. The one-way hash functions implemented are *MAC-DES algorithm*, the Japanese *NHask* scheme and the Rivest's *MD5* algorithm.

Using these cryptographic algorithms, the Crvptoserver supplies the following *security services*:

- *Confidentiality*. The goal of this service is to ensure the privacy protection of the

documents. To achieve this service, it can be used symmetric or asymmetric ciphers. Privacy protection by symmetric mechanisms is relatively easy in small networks, requiring the exchange of secret encryption keys between each party. But as a network grows in size, securely exchanging secret keys becomes complicated and increasingly expensive.

- *Digital Envelope*. This service ensures the following security functions:

- the confidentiality of the documents, using a symmetric key cipher;
- the confidentiality of the symmetric key used in the symmetric cipher with a public key cipher.

It allows secure communications without any previous sharing or distribution of secret keys between parties. The document author generates a random symmetric key, every time he sends an encrypted message. But how will the recipient know which symmetric key to use? The sender scrambles this random key with the recipient's public key, then sends the whole package to the destination. Only the intended recipient can use his private key to recover the symmetric key, then use it to decode the document.

- *Digital Signature*. The goal of this service is to ensure the authentication of documents and theirs senders. Digital signature has the following properties:

- depend on the content of signed document;
- depend on the document sender.

For this purpose it is used a hash function to create a document digest. This digest is then encrypted with secret key of the sender for obtaining the signature. The recipient of the document with the attached digital signature separates the signature from the message and then uses the same hash function to compute an independent document digest, based on the message just received. Then, he descrambles the signature with the sender's public key to obtain the original document digest and

compares them. If the two message digests match, then the message is authentic.

•*Digital Seal.* This service is a combination of the confidentiality and digital signature services. It ensures the confidentiality of the documents with a symmetric key cipher and the authentication with digital signature.

•*Certified Document.* This service ensures confidentiality, integrity and data origin authentication of documents, using (public-key) certificates issued by a mutually trusted authority. A (*public-key*) *certificate* is a data structure that contains the name of a user, the public key of that user, and the name of an entity (Issuer Authority-IA) which vouches that the public component is bound to the named user. The issuer authority using his private key cryptographically signs this data, along with a time interval over which the certificate is valid. Certificates are used to provide the originator of a document with the (authenticated) public component of each recipient and to provide each recipient with the (authenticated) public component of the originator. The following brief discussion illustrates the procedures for both originator and recipients.

Prior to sending an encrypted document, an originator must acquire a certificate for each recipient and must validate these certificates. Checking the validity time interval and the digital signature in the certificate, using the public component of the issuer key performs validation. Once a certificate for a recipient is validated, the public component contained in the certificate is extracted and used to encrypt the symmetric key, which, in turn, is used to encrypt the document itself. The resulting encrypted symmetric key is incorporated into a field of the encrypted document. Upon receipt of an encrypted message, a recipient employs his private key to decrypt this field, extracting the symmetric

key, and then uses this key to decrypt the document.

In order to provide message integrity and data origin authentication, the originator generates a message digest using a hash function, signs (encrypts) the message digest using his private key, and includes the resulting value in a field of the signed message. The certificate of the originator is optionally included in the signed message. Upon receipt of a privacy-enhanced message, a recipient validates the originator's certificate checks to ensure that it has not been revoked, extracts the public key from the certificate, and uses that value to recover (decrypt) the message digest. The recovered message digest is compared against the locally calculated message digest to verify the integrity and data origin authenticity.

### 3. CONCLUDING REMARKS

The Cryptoserver can implement security-enhanced functions in PDI applications. This approach assures protection and authentication for the document transfer in large national and international computer networks. A company LAN can have his own dedicated Cryptoserver PC, which create and verify the security services for the most important documents that will to be electronically transferred out of this LAN, in a WAN link with other computer. The Cryptoserver implementations are in progress.

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## BHP UNIVERSALITY HYPOTHESIS VERIFICATION FOR BET-FI INDEX FROM BVB

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**Abstract:** In this material we intend to prove the assumption of universality BET-FI index from BVB on the assumption of universality issued [2] on the Dow Jones index composition (DJIA30) and Standard & Poors 100 (S & P100).

**Key words:** BHP distribution, universality hypothesis, BET-FI, BVB.

### 1. a-DAILY FLUCTUATION OF AN INDEX

In [2], *Gonçalves and Pinto* have proposed a new way to check the universality hypothesis from stock indexes. They were tested in [2] hypothesis on the component indices *Dow Jones* (DJIA30) and *Standard & Poors 100* (S & P100) on the *New York Stock Exchange*. We present the construction of *Pinto and Gonçalves*: Let  $I$  an index with composition  $\{s_1, s_2, \dots, s_n\}$ . Let  $P(I,t)$  closing value on day  $t$  of index  $I$  and  $P(s,t)$  closing value on day  $t$  of symbol  $s$ .

For a symbol or an index  $s$ , we denote daily return  $t$  as:

$$R(s,t) = (P(s,t) - P(s,t-1)) / P(s,t-1).$$

For each day  $t$  define mean of index at closing the day  $t$  as:

$$m(I,t) = (P(s_1,t)^a + P(s_2,t)^a + \dots + P(s_n,t)^a) / n,$$

and dispersion of the day  $t$ :

$$s(I,t) = [(P(s_1,t)^{2a} + P(s_2,t)^{2a} + \dots + P(s_n,t)^{2a}) / n - m^2(I,t)]^{1/2}.$$

With these notations define the  $a$ -daily fluctuation of the index  $I$  as:

$$df(I,t) = (P(I,t)^a - m(I,t)) / s(I,t).$$

### 2. UNIVERSALITY HYPOTHESIS OF 2/3-DAILY FLUCTUATION

Based on notations can issue the following conjecture (reviewed in [2] for the U.S. stock market indices remember where):

**Conjecture (of universality):** For  $a = 2/3$ , the series  $(df(I,t))_{t>0}$  verifies the BHP distribution (see [1] for informations about BHP distribution).

**Note:** The type of  $P(.,t)^{2/3}$  are called in [2] as Cubic Root of the Daily Return Squared (abbreviated CRDRS).

### 3. CONJECTURE VERIFICATION ON BET-FI FROM BVB

We try to check conjecture with the following values of the Bucharest Stock Exchange (see [4]), where trading Romanian regional Financial Investment Companies (SIF Moldova, SIF Muntenia, SIF Transilvania, SIF Oltenia, SIF Banat-Crisana) and is

computed daily BET-FI index. We will resume the procedure as in the case presented by Pinto and Gonçalves about Wall Street, namely:

- a = 2 / 3
- I = BET-FI
- n = 5
- s<sub>1</sub> = SIF1
- s<sub>2</sub> = SIF2
- s<sub>3</sub> = SIF3
- s<sub>4</sub> = SIF4
- s<sub>5</sub> = SIF5.

First we will capture data from [4] (2<sup>nd</sup> semester of 2008) with a *Visual Basic for Application* scripts, some based on sequences

taken from the program [3]. Were also calculated all the elements necessary to assess the daily fluctuation df.

From df series we build a new series z by:

$$z_i = s - \ln(-\ln(df_i)) / b$$

where parameters b and s are specific BHP distribution (see [2]):

$$b = 0,936 \pm 0,002$$

$$s = 0,374 \pm 0,001$$

Testing universality df reduce testing uniformity on (0, 1) for z. A simple histogram for df (see Figure 1) shows that we have not uniformity, agglomeration benefits in an area value of 0.5:

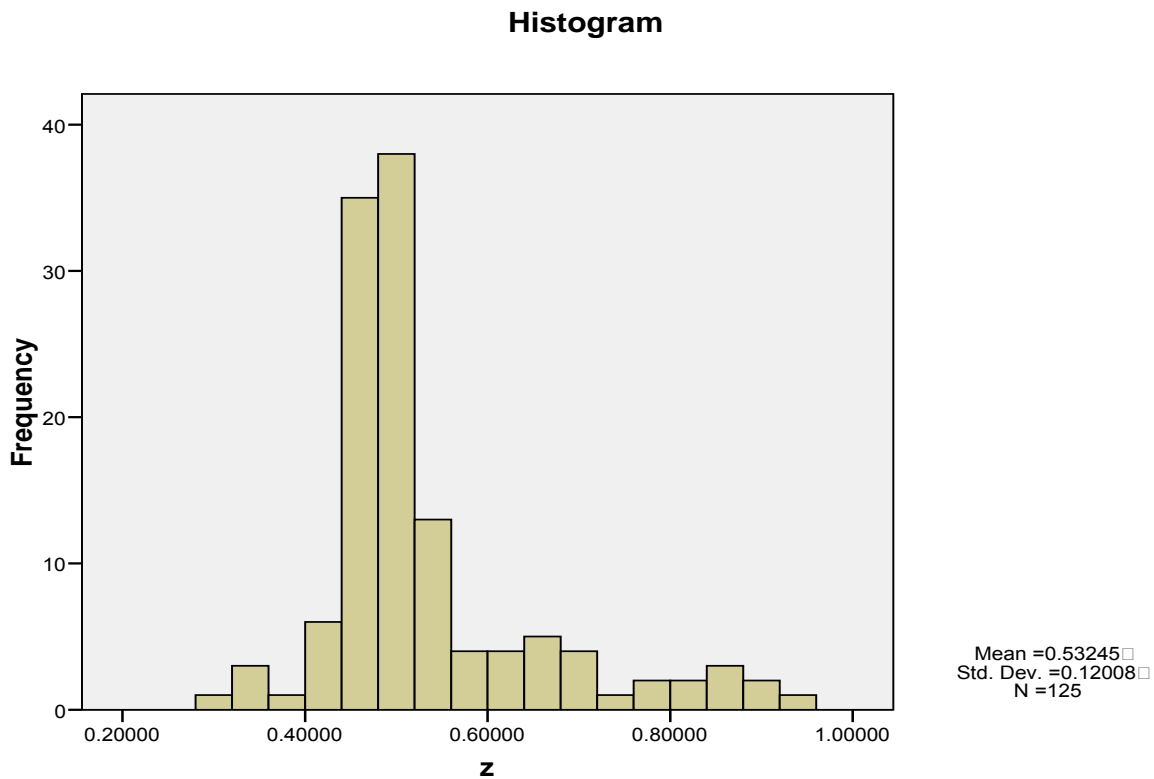


Fig. 1: Histogram for z series

This can not be certified until applying a statistical test. Applying Kolmogorov-Smirnov test for uniform distribution using SPSS 15.0 (see Figure 2) obtain a low degree

of significance, which convince us that the uniform distribution for z is rejected, ie the assumption of universality is rejected for df.



			z
N			125
Uniform Parameters(a,b)	Minimum		.29356
	Maximum		.93461
Most Extreme Differences	Absolute		.377
	Positive		.377
	Negative		-.151
Kolmogorov-Smirnov Z			4.216
Asymp. Sig. (2-tailed)			.000
Monte Carlo Sig. (2-tailed)	Sig.		.000(c)
95% Confidence Interval	Lower Bound		.000
	Upper Bound		.000

a Test distribution is Uniform.  
 b Calculated from data.  
 c Based on 10000 sampled tables with starting seed 299883525.

Fig. 2: The output of SPSS on uniformity test of z series

**4. CONCLUSIONS. FURTHER WORKS**

In our opinion, check the assumption of universality 2/3-fluctuation of BET-FI index was not conclusive, and we can not confirm or reject conjecture. Explanation can be based on:

- a) the accuracy of density function estimates for BHP (an approximation was used GFT) and distribution function, defined as full from -7 (below this value the area under the graph is negligible) amount approximated Darboux-Newton, with the rule division 0.1;
  - b) use df for a relatively short range (approximately 120 days of trading at BVB in semester II of 2008, unlike the cited paper that used a series of thousands of days).
- Several directions of development of ideas are listed below:

- 1) recalculation of density function of BHP distribution using numerical methods and methods like Monte Carlo;
- 2) finding a suitable statistical test for BHP distribution and implementation of the software;

- 3) verifying the hypothesis of universality for all stock indices on the BVB to define the period of their life;
- 4) approaches the quality of universality, that of forcing the parameter (I have seen it is fixed,  $a = 2/3$ , as the paper cited).

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## PP PLOT AND QQ PLOT TOOL FOR BHP UNIVERSAL DISTRIBUTION

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**Abstract:** In this paper we prove how a tool can be built for PP Plot and QQ Plot for universal BHP distribution. This tool is useful for empiric/visual validation for BHP distribution. BHP is not implemented yet in any major data processing/statistical software.

**Key words:** PP Plot, QQ Plot, BHP distribution.

### 1. BUILDING PP PLOT AND QQ PLOT CHARTS

Let suppose that we have a distribution of probability with specific *cumulative distribution function*:

$$F: \mathbb{R} \rightarrow [0,1]$$

Let suppose that we have same values of data, denoted

$$x(1), x(2), \dots, x(n).$$

At first step, after sorting data (from smallest to largest) we obtain the array reordered. A *probability-probability (PP) plot* and *quantile-quantile (QQ) plot* are used to see if a given set of data follows some specified distribution (identified with his cdf). It should be approximately linear if the specified distribution is the correct model.

The PP Plot algorithm (adapted from [9]) is:

```

Algorithm PP_PLOT
Call SORT(x[], n)
For I := 1 To n Do
    Call PLOT((I-1/2)/n, F(x(I)))
End For
Call LINE((0,0),(1,1))
End Algorithm
    
```

where:

PLOT(x,y)

is graphical primitive to put a plot at real coordinates (x,y) and:

LINE(x1,y1,x2,y2)

is graphical primitive to draw a line between 2 points gave on real coordinates: (x1, y1) and (x2, y2).

The QQ Plot Algorithm (adapted from [9]) is:

```

Algorithm PP_PLOT
Call SORT(x[], n)
For I := 1 To n Do
    Call PLOT(x(I),F-1((I-1/2)/n))
End For
Call LINE((x(1),x(1)),(x(n),x(n)))
End Algorithm
    
```

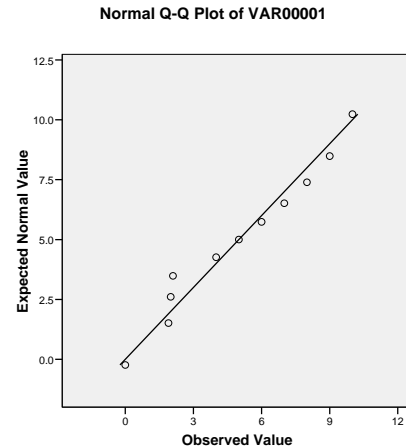
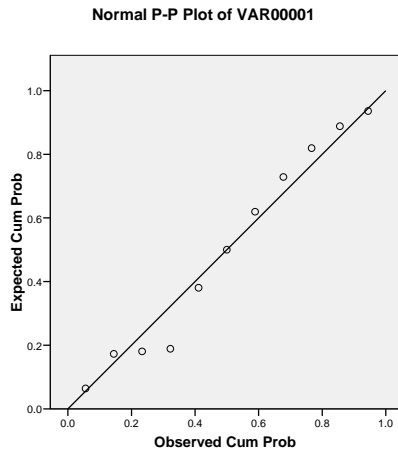
**Example:** Let next data:

```

n = 11
x(1) = 0.00
x(2) = 1.90
x(3) = 2.00
x(4) = 2.10
x(5) = 4.00
x(6) = 5.00
x(7) = 6.00
    
```

$$\begin{aligned} x(8) &= 7.00 \\ x(9) &= 8.00 \\ x(10) &= 9.00 \\ x(11) &= 10.00 \end{aligned}$$

with supposed *normal distribution* (with auto-detected parameters). We can build next two PP Plot and QQ Plot charts via SPSS 15 (see [4]) statistical program:



## 2. BHP DISTRIBUTION

S. T. Bramwell, P. C. W. Holdsworth, J. F. Pinton introduced (v. [1]) a new non-parametric distribution (called BHP) after studying some magnetization problems in 2D. Probability density function of distribution is:

$$p(x) = \int_{-\infty}^{\infty} \frac{dx}{2\pi} \sqrt{\frac{1}{2N^2} \sum_{k=1}^{N-1} \frac{1}{\lambda_k^2}} \exp \left\{ x\mu \sqrt{\frac{1}{2N^2} \sum_{k=1}^{N-1} \frac{1}{\lambda_k^2}} - \sum_{k=1}^{N-1} \left[ \frac{ix}{2N\lambda_k} - \frac{i}{2} \operatorname{arctg} \frac{x}{N\lambda_k} + \frac{1}{4} \ln \left( 1 + \frac{x^2}{N^2 \lambda_k^2} \right) \right] \right\}$$

where  $\lambda_k$  are eigenvalues of adjacency matrix of some specific graphs (v. [2]).

C. Pennetta, E. Alfinito, L. Reggiani rediscover (v. [5]-[7]) this distribution at one specific electrical resistivity problem.

Structural, a BHP distribution is a particular *Gumbel distribution* (v. [3]) named sometime *Fischer-Tippett distribution* (v. [8]). Probability density function of BHP can be approximated (v. [1]) with:

$$f_{\text{BHP}}(x) = K * \exp \{ a * [t - \exp(t)] \}$$

where parameters are (v. [1], [7]):

$$\begin{aligned} t &= b * (y - s) \\ a &= \pi / 2 \\ b &= 0.936 \\ s &= 0.374 \\ K &= 2.15 \end{aligned}$$

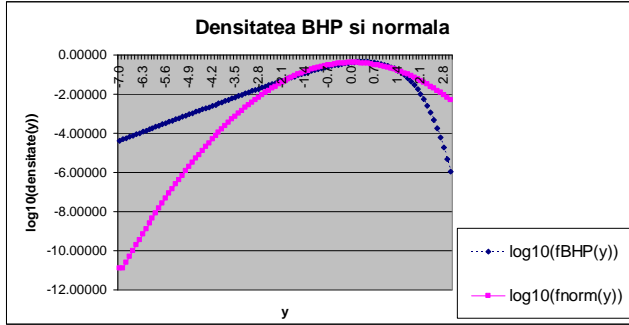
In [2] suggested values are:

$$\begin{aligned} t &= b * (y - s) \\ a &= 1.5806801 \\ b &= 0.9339355 \\ s &= 0.3731792 \\ K &= 2.1602858 \end{aligned}$$

In [5] și [6] suggested values are:

$$\begin{aligned} t &= b * (y - s) \\ a &= \pi / 2 \\ b &= 0.936 \pm 0.002 \\ s &= 0.374 \pm 0.001 \\ K &= 2.15 \pm 0.01 \end{aligned}$$

BHP pdf and normal distribution's pdf in lognormal scale can be see bellow (chart was generated via a *Visual Basic for Application* program in Microsoft Excel):



### 3. STEPS FOR BUILDING A TOOL FOR PP PLOT AND QQ PLOT

Before building a tool for PP Plot and QQ Plot, we need values of cdf of BHP distribution. We can obtain this from definition:

$$F_{BHP}(x) = \int_{-\infty}^x f_{BHP}(t) dt$$

After studying values of pdf and cdf of BHP distribution, we can rewrite

$$F_{BHP}(x) \approx \int_{-7}^x f_{BHP}(t) dt$$

For tabelation of F with a step s, we can use a Darboux sum with an algorithm like:

```

Algorithm TabelationCdfBHP
Last := 0
For x := -7 To 5 Step s
    Last := Last + s * f(x)
    F(x) := Last
EndAlgorithm
    
```

The inverse function of cdf can be computed easy via a *binary search* of the argument in ordered array of cdf tabelation.

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## AN ANALYSIS OF A H.264 MVC REFERENCE ENCODER FOR USING MULTI CORE PROCESSORS

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**Abstract:** *Our paper tries to present aspects of the H.264 Multi-View encoding, the reference software in correlation with the parallel approach. Different encoding and degradation methods were tested.*

**Key words:** *H264, MVC, OpenMP, MPI, Stereo Vision*

### 1. INTRODUCTION

As the new trend in display video information goes in the direction of 3DTV [18], it will need much more computer power and new methods to acquire depth information. The 3D display information will create new types of applications in the fields of interactive simulators used in military, medical and design.

The standardization organizations are already preparing draft standards to cope with these needs. The MPEG standard organization finalized the draft of the MPEG-C Part 3 in January 2007 which specifies a video-plus-depth format. In 2008 a more extensive format was proposed by ITU/ISO to extend the H.264/AVC (i.e. MPEG-4 Part 10 Amendment 4) known as Multi-view Video Coding (MVC).

In the past the classic method for increasing the computing power was to increase the speed of the processors, but due to thermal problems and design issues the new approach is multi core solution. The new types of CPU already have 2 cores and soon 4 cores will be the standard too. Intel presented in 2008 an 80 core x86 system, and also other companies present similar designs. This solution also requires new type of algorithms in order to achieve better performance.

We shall present the evolution of Multi Video standards, multiprocessor programming standards and some considerations regarding the JMVC reference software. In this paper we

shall present our current implementation regarding the multiprocessor approach. Our paper tries to analyze the proposed H.264 MVC reference software in correlation with the parallel approach.

### 2. 3D CODING STANDARDS

The multimedia encoding is a challenging domain and is an ongoing process to develop new algorithms in audio, video, image and multimedia object interaction.

We will focus on the new achievements related with 3D display/applications.

Major steps were done with the approval of the final version of MPEG C standard, with ISO/IEC 23002-3, which describe the “Video-Plus-Depth” method for encoding the images for 3D compression. [2], [3].

The ISO-23002-3 is based mainly on the work done in ATTEST project sustained by the European Committee. [1]. The standard also specifies additional to the depth information, an Auxiliary Video Data format, which consists of an array of N-bit values that are associated with the individual pixels of a regular video stream. This data can then be compressed like conventional luminance signals using already existing current and future MPEG video codecs.

The standard also allows for optional sub sampling of the depth map in both spatial and temporal domain. This can be useful for some applications where very low bitrates are

needed. The upsampling to the original resolution at the receiver side is left open.

The depth maps can also be encoded as 2D video sequences. The receiver must be able to distinguish these two types of data to correctly reconstruct 3D views, in order not display the the depth maps. This is done through signaling at systems level. So in order to use depth map coding in broadcast an amendment was developed to the MPEG-2 Systems standard in order to transport auxiliary video data. This amendment affects the Transport Stream in MPEG-2 (ISO/IEC 13818-1) and is known as Amd. 2 to MPEG2-TS, approved in 2008.

Another development in standardization of 3D coding was done by the Joint Video Team - JVT committee, an ITU-T and ISO join which develop standards for telecommunications but not only.

One of the most known standards is H264/MPEG 4 Part 10 or Advanced Video Coding [14].

H.264/MPEG-4 AVC Video Coding Standard has been a major advance in video coding, transmission, compression capability and also significantly advances “network friendliness” aspects.

A lot of applications and products include nowadays H264/MPEG4 AVC like: video conferencing, internet streaming, mobile phones and mobile video players, IPTV, HDTV terrestrial and satellite, Blu-ray technology and AVC HD Camcorders and others.

The JVT developed and adopted as new extensions and profiles:

- standard MVC – Multi Video Coding and Multi-view Video plus Depth
- Scalable Video Coding – SVC, include temporal, spatial, quality and transmission scalability.

These new extensions are backward-compatible extension of H.264/AVC and providing improved efficiency of new user experience: 3DTV

The Multi-video coding allows the encoding applications to combine views of the same scene, based on the fact that there is a large amount of statistical dependencies between the scenes. All the coding of multiple

views can be done, and backward compatible H.264/AVC and a high level of syntax changes. Further improvements can be achieved using techniques for inter-view prediction.

Regarding the scalability, the JVT consider these 3 modalities:

- Temporal: change of frame rate
- Spatial: change of frame size
- Quality: change of quality (e.g. SNR)

New developments that are in SVC part for spatial scalability are:

- Prediction of partitioning and motion information
- Prediction of residual data (prediction errors)
- Single motion-compensation loop for decoding.

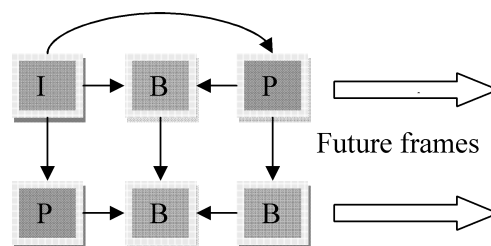


Fig. 1 Temporal/inter-view prediction structure for MVC stereo coding [10]

Other work from JVT is also related to the MPEG committee: developing new tools for expanding the current multi-view video, integration with depth/ disparity representation, view synthesis, 3DTV, reconfigurable video coding (RVC), flexible combination of coding tools, decoder configuration/adaptation, reference implementation using CAL language.

Other interests of JVT are related with ITU-T VCEG committee, which investigate 10 “Key Technology Areas” – KTA; some examples could be: adaptive motion compensation interpolation filters, 1/8th-pel motion vector precision, mode-specific intra spatial transforms and entropy coding, computational complexity reduction and loss/error robustness.

Some of the new improvements will be found in new H264 AVC profiles and some will be in the new standard “H265”.

### 3. PARALLEL APPROACH

For the parallel coding techniques there are two libraries/environments which can help an application to be parallelized.

The first is MPI – Message Passing Interface, which is a library of functions implementing a message-passing parallel programming model. It was developed by the MPI Forum, beginning from 1992. Advantages of the MPI are: independence from platforms and languages, efficient communication model for different processors and platforms. One major drawback is for parallel computational which required a large amount of data copy.

The current version of the standard is MPI-2.1, released in September 2008.

The second is OpenMP – Open Multi-Processing, an API (Application Programming Interface) which supports multi-platform shared memory multiprocessing programming in different languages (C, C++ and FORTRAN) on many platforms.

The OpenMP was developed by a group of major computer hardware and software vendors, beginning from 1997. It provides the programmers with a portable, scalable model and flexible interface for developing parallel applications for platforms ranging from the desktop to supercomputer applications.

The current version of the OpenMP standard is 3.0 and was released in May 2008.

For complex parallel applications both standards are used in order to take advantage of multi-core architectures but also of heterogenous computer nets.

For our research we used the OpenMP extensions of the Microsoft Visual C++ compiler and Intel Compilers.

OpenMP, due to its shared memory model, is suited for parallel processing image frames on multi-core systems. On the other hand, using the MPI framework’s message passing, a large, distributed system can be built.

### 4. EXPERIMENTS WITH JMVC REFERENCE SOFTWARE

We used the JMVC 3.01 reference H264/MVC encoder [4] to encode the first two views of the “Ballroom” sequence [8], by varying the quantizer parameter QP=20..30.



Fig. 2 First frame of Ballroom sequence

This test sequence consists of 8 views, each of 250 frames, resolution of 640x480 @ 25 fps. For testing we downscaled the frames to 320x240 pixels.

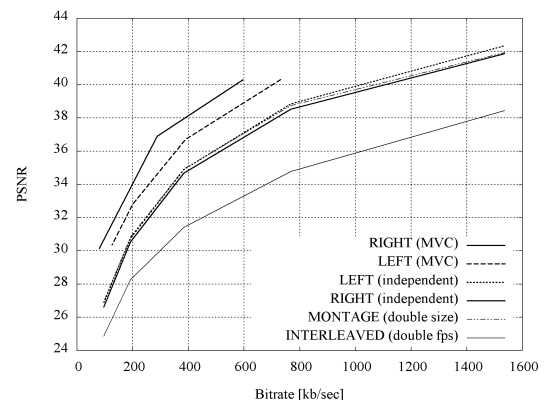


Fig.3 PSNR Rates for various encoding experiments

We encoded view 0 (“left”) and view 1 (“right”) of the test frames, using the MVC Reference encoder, using different QP values. For comparison, we also encoded, the same sequence using the x264 open-source encoder. We encoded independently the left and right views. Further, we combined the left and right frames into a double width frame in “montage”, and interleaved sequentially left/right frames in “interleaved”. For montage the bit rate parameter was doubled, and for interleaved both bit rate and frame rate were doubled.

The ‘independent’ encoding does not use correlations/motion compensation between the views, left and right views are encoded as two independent streams. We tested different degradation models – for example by encoding the views at different qualities (bitrates), by alternated skipping (and doubling) frames in both views and by horizontal blurring. However these tests are not objective, since the results depends on the perceived quality of the stereoscopic effect. We observed that, in general, if one of the pictures in a stereoscopic view is altered, the effect on the combined view is perceived less than the effect on the picture itself. There are studies on human vision that confirm this [9].

### 5. FURTHER WORKS

We need to explore the potential of parallel systems to encode multi-view sequences, to build a multi-view encoding, broadcasting and decoding system, by keeping compatibility with existing broadcasting channels in term of bandwidth and decoders. Similar work had been done in [11,12,13,15,16,17].

The computational power of modern, commodity personal computers makes feasible to build such real-time systems, by using OpenMP and MPI libraries.

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## PILOT-IN-THE-LOOP PROBLEM AND ITS SOLUTION

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**ABSTRACT** : Main purpose of the author is to summarize theoretical backgrounds dealing with mathematical modeling of the human pilot behavior, and to give some approximated models applying Padé approximation method. Importance of this paper is in derivation and application of higher order Padé approximants to model human pilot behavior. This new approach allows to model pilot behavior more precisely than before with applying its first order approximants. The lower and higher model approximants will be analyzed both in time and in frequency domain. The paper deals with derivation of the critical parameters of the human pilot destabilizing the closed loop automatic flight control systems. A new MATLAB® embedded code is generated to analyze the pilot mathematical models, and for both open and closed loop automatic flight control system's analysis.

### I. INTRODUCTION & LITERATURE OVERVIEW

Early pioneers of mathematical modeling of the pilots' behavior were McRuer and Krendel. This NATO-report deals with mathematical modeling of human pilots, with analysis of the pilot's behavior in SISO (Single Input – Single Output) and MIMO (Multi Input – Multi Output) automatic flight control systems. In [1] mathematical model of the human pilots depends also on the signals feature to be followed by the pilot. Authors introduced term of the so-called *paper pilot*, which means creation of mathematical model of the pilot as the control element of the automatic flight control systems and widely applied in flight control systems' analysis and preliminary design [1]. Mathematical handbook of G. A. Korn and T. M. Korn is cited as main source for mathematical backgrounds of the problems of approximating time delay [2]. In [3] D. McLean deals with conventional and modern mathematical modeling of the human pilot behavior making difference between aircraft and helicopter pilots. In this textbook time delay of human

pilot is approximated using first order Padé approximation, which is in many case may be unsatisfactory and time delay may be approximated by higher order of Padé-approximants. In [4] R. C. Dorf and R. H. Bishop derived mathematical model of the human operator, which has more extended applicability. In that means human operator models can be applied for any kind of drivers (e.g. car, motorcycle, ship, train, ground and air robots etc. drivers and operators). Obviously, the only common thing these models are coinciding is the structure of the mathematical models, while its parameters are quite different.

Author leans on his scientific papers [5, 6, 7, 8] published before, which are dealing with conventional and modern mathematical methods applied to model human pilot behavior [5], with derivation critical parameters of the human pilot acting in the closed loop automatic flight control system [6, 8], and, with derivation of the complex set of critical parameters of the human pilot in the aircraft lateral motion automatic flight control systems [7].

## II. PADÉ APPROXIMATION OF THE TIME DELAY

Let us consider the system given in Figure 2.1 [5, 6, 7, 8]. The transfer function  $G(s)$  represents the dynamical system consisting of pure time delay of  $\tau$ , and transfer function of  $G_0(s)$ , which is strictly proper and stable. The problem of approximation of the time delay can be formulated as follows: approximate original transfer function of  $G(s) = e^{-s\tau} G_0(s)$  by transfer function of  $\hat{G}(s) = P_d(s)G_0(s)$ , where  $P_d(s) = N_d(s)/D_d(s)$  is a rational approximation of time delay of  $\tau$ . In other words, we want to find  $P_d(s)$  so that the closed loop behavior of  $\hat{G}(s)$  matches input-output behavior of the original system, of  $G(s)$ .

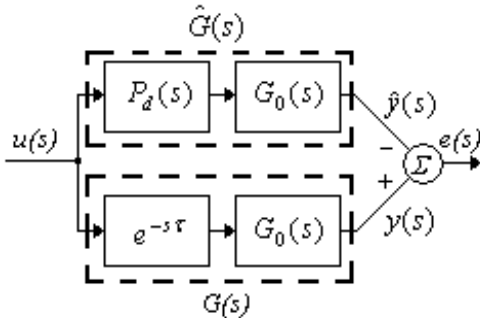


Figure 2.1. Block Diagram of the Model Matching Error Problem Formulation.

To measure the mismatch we will apply the same input  $u(s)$  to both transfer functions of  $G(s)$ , and  $\hat{G}(s)$ . By comparing output signals of  $y(s)$  and  $\hat{y}(s)$  one can derive how  $\hat{G}(s)$  approximates  $G(s)$ , or, how  $P_d(s)$  approximates time delay of  $e^{-s\tau}$ . In control theory, this problem formulated as *model-matching problem*. The so-called model-matching error (MME) can be given using following equation:

$$MME \hat{=} \sup_{u \neq 0} \frac{\|y - \hat{y}\|_2}{\|u\|_2}. \quad (2.1)$$

In eq (2.1)  $\|y - \hat{y}\|_2$  denotes the energy of the output error  $e = y - \hat{y}$  due to an input signal energy of  $\|u\|_2$ . The largest possible ratio of the output error energy over the input energy is defined to be *model-matching error*. It is well-

known from control theory that model matching error can be found using following formula:

$$MME \equiv MME_{H_\infty} \equiv MME_{L_\infty}, \quad (2.2)$$

where

$$MME_{H_\infty} = \left\| G - \hat{G} \right\|_{H_\infty}, \quad (2.3)$$

$$\begin{aligned} MME_{L_\infty} &= \sup_{\omega} |G(j\omega) - \hat{G}(j\omega)| = \\ &= \sup_{\omega} \left| |G_0(j\omega)| \cdot \left| e^{-j\omega\tau} - P_d(j\omega) \right| \right|. \end{aligned} \quad (2.4)$$

It is obvious, that if  $MME_{L_\infty}$  is small, than difference between the Nyquist plots of the transfer functions of  $G(s)$  and  $\hat{G}(s)$  is small. This observation is valid if and only if  $G_0(s)$  is stable. Therefore, for the given transfer function of  $G_0(s)$  we want to find a rational approximation of  $P_d(s)$  for time delay derived by  $e^{-s\tau}$  so that the approximation error, or in other words, the model-matching error  $MME_{L_\infty}$  is smaller than a pre-defined tolerance, say  $\delta > 0$ . For further discussion for Padé approximation we will use the following formula [5, 6]:

$$e^{-s\tau} \cong P_d(s) = \frac{N_d(s)}{D_d(s)} = \frac{\sum_{k=0}^n (-1)^k c_k \tau^k s^k}{\sum_{k=0}^n c_k \tau^k s^k}, \quad (2.5)$$

where coefficients of eq (2.5) are defined as follows:

$$c_k = \frac{(2n-k)! \cdot n!}{2n! \cdot k! \cdot (n-k)!}. \quad (2.6)$$

$$n = 1, 2, 3, 4, \dots; \quad k = 0, 1, 2, 3, \dots, n$$

Coefficients of the Padé-approximant for  $n \leq 10$  can be found in Appendix 1.

## III. MATHEMATICAL MODELS OF THE HUMAN PILOT BEHAVIOR

The simplest mathematical model of the human operator – supposing single reference

signal tracking activity – can be derived using Figure 3.1. [3, 4, 5]:

$$Y_p(s) = \frac{x_{out}(s)}{x_{in}(s)} = K_p e^{-s\tau}, \quad (3.1)$$

where  $x_{in}$  is the input signal to be tracked by the pilot,  $x_{out}$  is response signal from the pilot,  $K_p$  is pilot gain, and finally,  $\tau$  is time delay of the pilot.

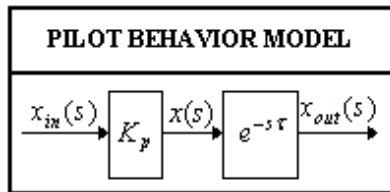


Figure 3.1 Mathematical Model of the Pilot Behavior.

From eq (3.1) it is easily can be seen that the human operator behaves as proportional (*P*) term with pure time delay (*TD*) [5, 6, 7, 8]. For simplicity let us denote eq (3.1) for *P-TD*-model. More complicated mathematical model of the human operator – including ability of the pilot to predict events and signals – can be derived using Figure 3.2:

$$Y_p(s) = \frac{x_{out}(s)}{x_{in}(s)} = K_p (1 + sT_p) e^{-s\tau}, \quad (3.2)$$

where  $T_p$  is the prediction time constant.

From eq (3.2) it is easily can be derived that the human operator behaves as a proportional-differential (*PD*) term with pure time delay (*TD*) [5, 6, 7, 8]. For simplicity let us denote mathematical model of eq (3.2) as *PD-TD*-model.

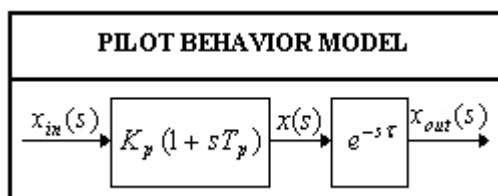


Figure 3.2 Mathematical Model of the Pilot Behavior.

For further analysis let us consider dynamic model of the muscular acting system of the

human operator. Block diagram of the human operator in this particular case can be seen in Figure 3.3.

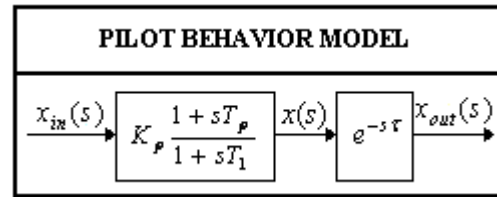


Figure 3.3. Mathematical Model of the Human Pilot Behavior.

Using Figure 3.3. transfer function of the pilot can be derived as it given below:

$$Y_p(s) = \frac{x_{out}(s)}{x_{in}(s)} = K_p \frac{1 + sT_p}{1 + sT_1} e^{-s\tau}, \quad (3.3)$$

where  $T_1$  is time constant of the muscular system of the pilot. From eq (3.3) it easily can be derived that mathematical model of the human operator is proportional-differential (*PD*) first order (*IO*) term having pure time delay (*TD*) [5, 6, 7, 8]. For further discussions let us denote eq (3.3) as *PD-IO-TD*-model.

Using Figure 3.3. following equation can be derived:

$$Y_p(s) = \frac{x_{out}(s)}{x_{in}(s)} = \frac{x(s)}{x_{in}(s)} \frac{x_{out}(s)}{x(s)} = K_p \frac{1 + sT_p}{1 + sT_1} e^{-s\tau}. \quad (3.4)$$

Using eq (3.4) the following formula can be derived:

$$x(s) = K_p \frac{1 + sT_p}{1 + sT_1} x_{in}(s). \quad (3.5)$$

Input signal  $x(t)$  of time delay term of  $\tau$  can be found using following formula:

$$\dot{x} = -\frac{1}{x} + \frac{K_p}{T_1} x_{in} + \frac{K_p T_p}{T_1} \dot{x}_{in}. \quad (3.6)$$

For approximation of time delay of  $\tau$  in eqs (3.3)-(3.5) we will use first order Padé approximants. One can write that

$$Y_p(s) = \frac{x_{out}(s)}{x_{in}(s)} = K_p \frac{1 + sT_p}{1 + sT_1} e^{-s\tau} \cong K_p \frac{1 + sT_p}{1 + sT_1} \frac{1 - \tau/2}{1 + \tau/2} \quad (3.7)$$

Modern mathematical representation of the human operator can be given using its state space representation [5, 6, 7, 8]. During derivation of this dynamical model let us choose the state variables as they are given below:

$$x_1 = x_{out} + x, \quad (3.8)$$

$$x_2 = x. \quad (3.9)$$

Using eqs (3.3)–(3.9) the state and output equations of the human pilot defined on Figure 2.3. can be found as follows [5, 6, 7, 8]:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} + \begin{bmatrix} 0 & K_p T_p \\ -\frac{K_p T_p}{T_1} & T_1 \end{bmatrix} \dot{x}_{in} = \begin{bmatrix} -\frac{2}{\tau} & \frac{4}{\tau} \\ 0 & -\frac{1}{T_1} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ \frac{K_p}{T_p} \end{bmatrix} x_m, \quad (3.10)$$

$$x_{out} = \begin{bmatrix} 1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}. \quad (3.11)$$

Finally, if to consider neuro-muscular sensing, processing and, actuating system of the human pilot following block diagram can be given [1]:

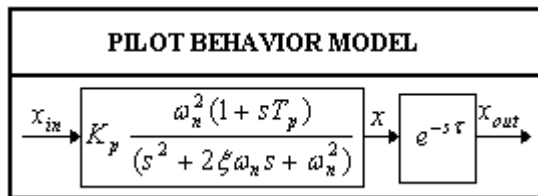


Figure 3.4. Mathematical Model of the Human Pilot Behavior.

Using Figure 3.4. following transfer function of the human pilot can be derived [1, 5]:

$$Y_p(s) = \frac{x_{out}(s)}{x_{in}(s)} = \frac{x_{out}(s)}{x(s)} \cdot \frac{x(s)}{x_{in}(s)} = K_p \frac{\omega_n^2(1 + sT_p)}{(s^2 + 2\xi\omega_n s + \omega_n^2)} e^{-s\tau}. \quad (3.12)$$

In eq (3.12) second order term of

$$\frac{\omega_n^2}{(s^2 + 2\xi\omega_n s + \omega_n^2)} \quad (3.13)$$

defines mathematical model of the neuromuscular system of the human pilot [1].

It is easy to derive that the second order proportional-differential term of eq (3.12)

$$Y = \frac{x(s)}{x_m(s)} = K_p \frac{\omega_n^2(1 + sT_p)}{(s^2 + 2\xi\omega_n s + \omega_n^2)} \quad (3.14)$$

may be rewritten in the following state space model:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -\omega_n^2 & -2\xi\omega_n \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} x_{in}, \quad (3.15)$$

$$x = \omega_n^2 K_p \begin{bmatrix} 1 & T_p \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}. \quad (3.16)$$

From equation (3.12) it easily can be derived that mathematical model of the human pilot is proportional-differential (PD) second order (2O) term having time delay (TD) [5, 6, 7, 8].

For further discussions let us denote eq (3.12) as PD-2O-TD-model. Let us introduce the following state variable

$$x_3 = x_{out} + x. \quad (3.17)$$

Time delay  $\tau$  in eq (3.12) can be approximated using first order Padé approximants, i.e.:

$$e^{-s\tau} \cong -\frac{s - 2/\tau}{s + 2/\tau}. \quad (3.18)$$

Let us substitute eq (3.18) into eq (3.12), and convert this mathematical model into the time domain. After simple mathematical manipulations one can get following state and output equations [1, 8, 9, 10]:

$$\begin{aligned} \dot{\mathbf{x}} &= \begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \\ &= \begin{bmatrix} 0 & 1 & 0 \\ -\omega_n^2 & -2\xi\omega_n & 0 \\ \left(\frac{4}{\tau} K_p \omega_n^2\right) & \left(\frac{4}{\tau} K_p T_p \omega_n^2\right) & \left(-\frac{2}{\tau}\right) \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \\ &+ \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} x_{in} \end{aligned} \quad (3.20)$$

$$x_{out} = \begin{bmatrix} -\omega_n^2 K_p & -\omega_n^2 K_p T_p & 1 \end{bmatrix} \begin{bmatrix} x_1 & x_2 & x_3 \end{bmatrix}^T. \quad (3.21)$$

#### IV. TIME DOMAIN ANALYSIS OF THE HUMAN PILOT BEHAVIOR

One of the most important kind of the human pilot activity is the reference signal tracking. Many flight tasks (e.g. semi-automated landing, refueling, air-to-air combat, air-to-ground weapon delivery, terrain following, formation flight, aerobatic close formation flight etc.) are in close relationship with this kind of actuating.

There can be defined some typical input signals to be followed by the pilots, such as step signal, ramp signal, and much other kind of pure or transformed periodical signals (e.g. saw tooth, square signals etc.). In this paper author chose for the time domain analysis the step input function, the ramp input signal, and finally, the square signal [3, 4, 5].

It is well-known from the previous sections that there are several possible mathematical model of the human pilot to be used during computer simulation. In this paper we will apply dynamical mathematical model of *PD-IO-TD* defined by eq (3.3), which is represented in Figure 3.3. For the computer-aided simulation let us use the following parameters of the mathematical model defined by eq (3.3):

$$K_p = 10; T_p = 1s; T_1 = 0,4s; \tau = 0,5s. \quad (4.1)$$

During computer simulation from the possible set of order of approximation there were chosen the 1<sup>st</sup>, the 4<sup>th</sup>, and, the 7<sup>th</sup> order of approximations. Figure 4.1 shows step responses of the human pilot having approximated mathematical model of the time delay. The input signal of the human pilot to be followed by him is  $x_{in}(t) = 1(t)$  [9, 10].

From Figure 4.1. it is obvious that increase of order of approximation result in larger amplitudes of the output signal. However, in the time delay zone, increase of the order of

the approximation results in oscillations with higher frequencies. It means that error of approximation decreases as its order increases.

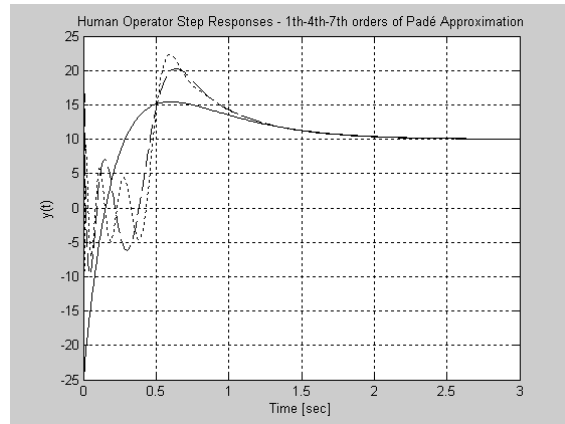


Figure 4.1. Step Responses of the Human Operator  
 ‘—’ 1<sup>st</sup> ‘- - -’ 4<sup>th</sup> ‘...’ 7<sup>th</sup> Order Approximation

Figure 4.2. shows ramp responses of the human pilot mathematical model. The input signal of the human pilot to be followed by him now is  $x_{in}(t) = t$ .

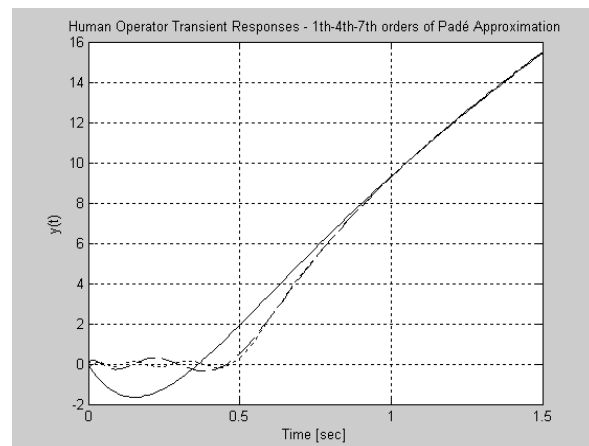


Figure 4.2. Ramp Responses of the Human Operator  
 ‘—’ 1<sup>st</sup> ‘- - -’ 4<sup>th</sup> ‘...’ 7<sup>th</sup> Order Approximation

From Figure 4.2 it is easily can be seen and derived that increase of the order of approximation results in decrease of the error of the approximation: in the time delay zone magnitude of the output signal  $x_{out}(t)$  decreases as order of the approximation is increases while output signal is going to be more and more oscillatory.

Finally, let us analyze the human operator behavior when he is tracking the periodical signal. For this kind of analysis author chosen the square signal with frequency of  $f = 0,3$  Hz, and period time of  $T = 1/0,3$  sec. Results of the computer simulation can be seen in Figure 4.3.

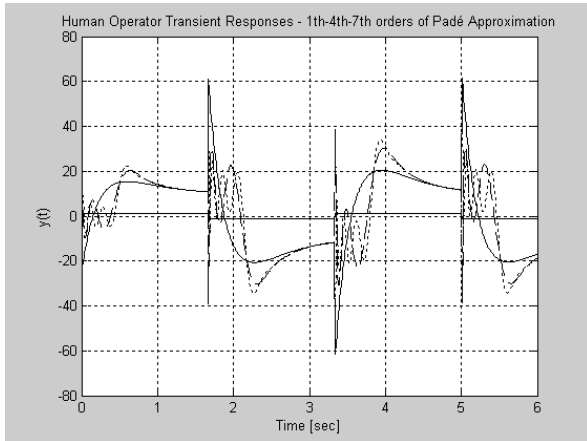


Figure 4.3. Transient Responses of the Human Operator  
 ‘—’ 1<sup>st</sup> ‘- -’ 4<sup>th</sup> ‘...’ 7<sup>th</sup> Order Approximation

From Figure 4.3. it is easily can be determined that increase of the order of approximation results in less amplitudes in output signal. In time domain of the delay the output signal becomes more oscillatory as order of approximations increases.

### V. FREQUENCY DOMAIN ANALYSIS OF THE HUMAN PILOT BEHAVIOR

Typical input signal of the human pilot is the sinusoidal with variable frequencies. Figure 5.1 shows the response of the human pilot to the harmonic input signal of the sinusoidal with unity gain [9, 10].

From Figure 5.1. it is obvious that pilot gain for each order of approximation is very close to each other. The phase angle radically decreases as order of approximation is increases [9, 10].

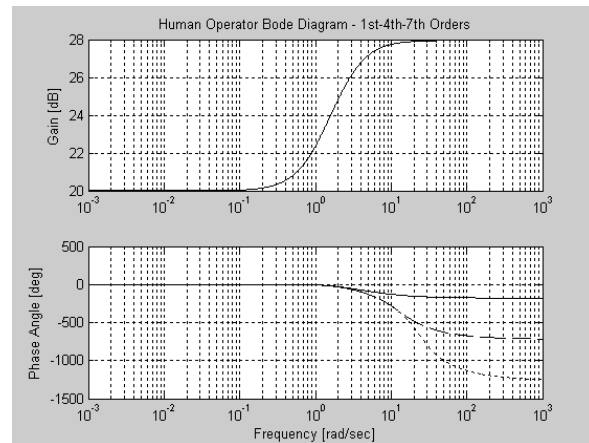


Figure 5.1. Bode Diagrams of the Human Operator  
 ‘—’ 1<sup>st</sup> ‘- -’ 4<sup>th</sup> ‘...’ 7<sup>th</sup> Order Approximation

### VI. COMPARISON OF THE HUMAN PILOT S’ BEHAVIOR IN THE TIME DOMAIN

In the practice a question ‘*what kind of the model of the pilot activity to use for the control system analysis and design?*’ often may arise. From theory of automatic flight control systems it is evident that the *pilot-in-the-loop* problem can be characterized with the multi-loop feature, i.e. many flight parameters of such regimes as semi-automated landing of the aircraft airspeed, vertical speed, height of the flight, distance from runway threshold, glide path angle, angular deflection measured from runway centre line etc. must be controlled by the pilot.

From this argue follows that increase value of the flight parameters to be controlled results in decrease of the complexity of the pilot model to be applied during analysis and design of the automatic flight control systems [1, 5, 8, 9, 10].

Let us analyze behavior of the human pilot model for several form of its mathematical model supposing second order Padé-approximation for the given time delay. During computer simulation mathematical model defined by eqs (3.1), (3.2), (3.3) and (3.12). Results of the computer simulation can be seen in Figures 6.1., 6.2., and 6.3.

Figure 6.1. represents step responses of the human pilot behavior, when input is step response function of  $x_{in}(t) = 1(t)$ .

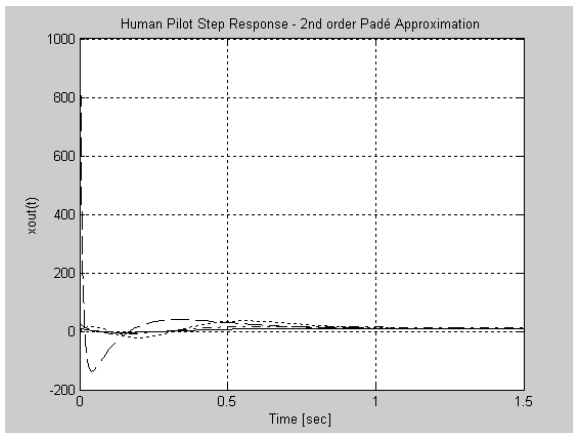


Figure 6.1. Step Response of the Human Pilot.  
 ‘—’ P-TD ‘- - -’ PD-TD ‘- . - .’ PD-1O-TD ‘...’ PD-2O-TD

Figure 6.2. shows ramp responses of different pilot models having input of  $x_{in}(t) = t$ .

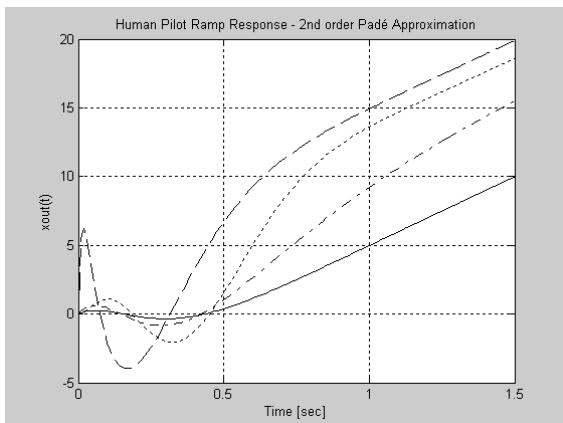


Figure 6.2. Ramp Response of the Human Pilot.  
 ‘—’ P-TD ‘- - -’ PD-TD ‘- . - .’ PD-1O-TD ‘...’ PD-2O-TD

Figure 6.3. shows transient responses of different human pilot mathematical models induced by square periodical signal with unity gain and frequency of 0,3 Hz.

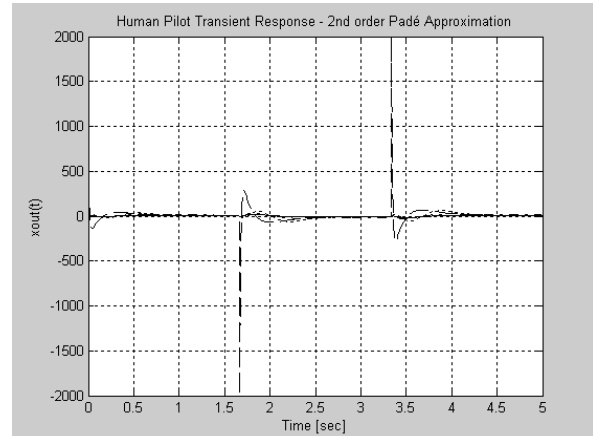


Figure 6.3. Transient Response of the Human Pilot.  
 ‘—’ P-TD ‘- - -’ PD-TD ‘- . - .’ PD-1O-TD ‘...’ PD-2O-TD

Figures 6.1, 6.2., 6.3. clearly show that if to add  $D$ -term to the proportional (see eq (3.1)) it will result in more oscillatory system (see eq (3.2)) with large amplitudes (dashed line on the figures). Introducing first order term to eq (3.2) will result in damped system reducing oscillatory feature (dash-dot line on the figures). Application of the second order term of eq (3.12) in comparison with system defined by eq (3.3) results in more oscillatory behavior (dotted line on the figures).

Using the method given above human pilot model behavior can be compared also for higher orders of the Padé-approximation.

## VII. DERIVATION OF THE CRITICAL PARAMETERS OF THE PILOT'S ACTIVITY

Knowledge of the human pilot behavior is very important from the flight safety aspects. It is difficult to model a human pilot having mathematical model considering all possible conditions. Even common mathematical models of the human pilot can be applied with great success. Purpose of the author is to show how to determine critical parameters of the human pilot? It is well known that there are many parameters of the pilot (e.g. gain, time delay, time constants, damping ratios, natural frequencies etc.) which can be analyzed and also their critical value can be found.

Due to its importance author will deal only with determination of the critical time delay of the human operator yielding instability of the control loops of the automatic flight control systems. Results and proposals of this paper can be applied for extension of the analysis shown in this article. The general method recommended by the author is well known from control systems theory but the paper suggests the new field for its application.

Pilot is the most important element in the aircraft steering system. Even if aircraft has modern control system for maneuvering driven by digital computer pilot must have the right to take control over aircraft and steer it manually. Automation of the aircraft flight phases induced the need to design semi-automated automatic flight control systems, which suggest for the pilot what kind of actuation to carry out. For this purpose high level technology displays are used in the cockpit.

Semi-automated aircraft steering is very useful because pilot takes active part in actuation process and do not reduce his ability. During flight phases semi-automated steering can be applied: semi-automated landing, refueling, air-to-air combat, dog fight, air-to-ground weapon delivery, terrain following, formation flight, aerobatic flight, close formation flight etc.

### 7.1. Derivation of the Critical Value of Human Pilot Time Delay

During semi-automatic, or manual control of the aircraft one of the problem to be solved by the pilot is reference signal tracking or, following commands suggested by the automatic flight control system, or other systems (e.g. navigation system, radar system, weapon system etc.). As it was said before commands are listed on the display: e.g. turn left, turn right, accelerate, decelerate, descend, climb, etc.

For example, in this paper the single loop automatic flight control system is analyzed. In

this particular case pilot has to control only one flight parameter. Let us choose for analysis the roll angle control system. In this system the task of the pilot to track the reference signal of the roll angle  $\gamma_R(t)$  indicated on the display. Block diagram of the semi-automated roll angle control system can be seen in Figure 7.1 [3, 4, 5, 8, 9, 10].

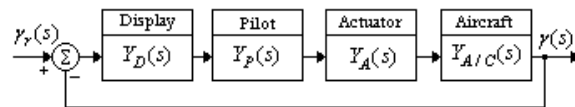


Figure 7.1. Pilot-in-the Aircraft Roll Angle Control System.

Flight parameters and data are indicated on the displays. It is supposed that display has no time delay and, any time constants. This condition is strongly satisfied for modern analogue and digital displays. Transfer function of the display can be formulated as follows [3, 5]:

$$Y_D(s) \cong 1. \tag{7.1}$$

Let us take into consideration for the modeling of pilot behavior mathematical model of the human operator. Regarding [5] transfer function, and model parameters are as follows:

$$Y_P = K_p (1 + sT_p) e^{-\tau s} \cong K_p (1 + sT_p) \frac{1 - \tau/2 s}{1 + \tau/2 s}. \tag{7.2}$$

In eq (7.2) later we will consider following parameters [5, 6, 7, 8]:

$$K_p = 10, T_p = 1 \text{ sec}. \tag{7.3}$$

From eq (7.2) it is evident that model of the aircraft applied in this section is proportional-differential (PD) one with time delay (TD), which is approximated with the first order Padé-approximation given in.

Ailerons of the aircraft are deflected using hydraulic actuator. The simplified mathematical model of the actuator can be defined as it given below:



$$Y_A(s) = \frac{20}{20+s} = \frac{1}{1+0,05s} \cong 1. \quad (7.4)$$

Lateral motion dynamics of the aircraft is supposed to be the so-called single degree of freedom approximation derived by [3, 5] and its transfer function is as follows:

$$Y_{A/C}(s) = \frac{\gamma(s)}{\delta_A(s)} = \frac{0,21}{s(s+0,9)}, \quad (7.5)$$

where  $\delta_A(s)$  is the angular deflection of the ailerons, or input of the aircraft,  $\gamma(s)$  is roll angle, or in other words, response of the aircraft to its input signal.

From [1] it is evident that pilot model parameters depend upon complexity of the task to be solved by the pilot, and also upon physical and psychical ability of the pilot. Among these parameters time delay is the most important because its presence tends closed loop automatic flight control system to its stable working boundary [3, 5, 9, 10]. Let us derive  $\tau_{crit}$ , which leads closed loop automatic flight control system to its stable working conditions. For this purpose let find the closed loop automatic flight control system transfer function related to reference input signal of  $\gamma_r(s)$ . The closed loop transfer function of the investigated system can be derived using Figure 7.1., i.e.:

$$\begin{aligned} W(s) &= \frac{\gamma(s)}{\gamma_R(s)} = \\ &= \frac{Y_D(s)Y_P(s)Y_A(s)Y_{A/C}(s)}{1 + Y_D(s)Y_P(s)Y_A(s)Y_{A/C}(s)} \cong. \quad (7.6) \\ &\cong \frac{Y_P(s)Y_{A/C}(s)}{1 + Y_P(s)Y_{A/C}(s)} \end{aligned}$$

Substituting data defined by eqs (7.1)-(7.5) into eq (7.6) yields to closed loop transfer function formula:

$$W(s) = \frac{0,21 \cdot (10+10s)(1-\frac{\tau}{2})}{(s^2+0,9s)(1+\frac{\tau}{2})+0,21 \cdot (10+10s)(1-\frac{\tau}{2})} \quad (7.7)$$

In control theory there are many available methods for determination of the closed loop

control system stability. Some of them are graphical, others are algebraic ones. These methods allow deriving stability conditions of the closed loop system. Other possible application of the algebraic stability criteria is finding critical parameter of the closed loop control system [3, 4, 5, 9, 10]. Using stability criteria formulated by Hurwitz closed loop control system is stable if and only if

1. all coefficients of the characteristic polynomial are positive ones, say  $a_i > 0$ . This is the necessary stability condition;
2. algebraic minors on the main diagonal of the Hurwitz-determinant are positive, say  $\Delta_i > 0$ . If there is a single determinant with negative value, the closed loop control system is unstable. If  $\Delta_i = 0$ , the system is upon stable working boundary and this condition can be used for determination of the critical parameters of the control system. This is the sufficient condition of the closed loop stability.

Let us find the characteristic polynomial of the closed loop control system, which is the denominator of the transfer function of eq (2.6). It is supposed that the only variable parameter is the pilot time delay  $\tau$  while all other parameters are supposed to be constant. One can easily write that:

$$K(s) = (s^2 + 9s)(1 + \frac{\tau}{2}s) + 0,21 \cdot (10+10s)(1 - \frac{\tau}{2}s) = 0 \quad (7.8)$$

After some simple mathematical procedures we get the following third order characteristic polynomial, i.e.:

$$\begin{aligned} K(s) &= \frac{\tau}{2}s^3 + (1 - 0,6\tau)s^2 + (3 - 1,05\tau)s + 2,1 = \\ &= a_0s^3 + a_1s^2 + a_2s + a_3 = 0 \end{aligned} \quad (7.9)$$

Applying necessary stability conditions using coefficients of eq (7.9) one can determine following stability inequalities:

$$a_0 = \frac{\tau}{2} > 0 \rightarrow \tau > 0, s, \quad (7.10)$$

$$a_1 = 1 - 0,61\tau > 0 \rightarrow \tau < 1,6666, s, \quad (7.11)$$

$$a_2 = 3 - 1,05\tau > 0 \rightarrow \tau < 2,8571 \text{ s.} \quad (7.12)$$

From eqs (7.10)–(7.12) it is obvious that for the stable working closed loop control system the human pilot time delay must lie in the following range:

$$0 < \tau < 1,6666 \text{ s.} \quad (7.13)$$

For the next step let us find sufficient conditions of stability using Hurwitz-determinant. The Hurwitz-determinant can be found using coefficients of the characteristic polynomial. One can write that:

$$\Delta_3 = \begin{vmatrix} 1 - 0,6\tau & 2,1 & 0 \\ \tau/2 & 3 - 1,05\tau & 0 \\ 0 & 1 - 0,6\tau & 2,1 \end{vmatrix}. \quad (7.14)$$

Using eq (7.14) the following algebraic minors leaning on main diagonal can be found. If we suppose that the system on the boundary of the stable working, following determinants can be derived [7]:

$$\Delta_i = 0. \quad (7.15)$$

From eq (7.14) we can find the following stability conditions:

$$\Delta_1 = 1 - 0,6\tau = 0 \rightarrow \tau_{crit} = 1,6666 \text{ s,} \quad (7.16)$$

$$\Delta_2 = \begin{vmatrix} 1 - 0,6\tau & 2,1 \\ \tau/2 & 3 - 1,05\tau \end{vmatrix} = 0, \quad (7.17)$$

$$0,63\tau^2 - 3,9\tau + 3 = 0 \rightarrow \begin{matrix} \tau_{1crit} = 5,2904 \text{ s} \\ \tau_{2crit} = 0,9001 \text{ s} \end{matrix}, \quad (7.18)$$

$$\Delta_3 = \begin{vmatrix} 1 - 0,6\tau & 2,1 & 0 \\ 0,5\tau & 3 - 1,05\tau & 0 \\ 0 & 1 - 0,6\tau & 2,1 \end{vmatrix} = 2,1 \cdot \Delta_2 = 0, \quad (7.19)$$

$$\Delta_2 = 0 \rightarrow \begin{matrix} \tau_{1crit} = 5,2904 \text{ s} \\ \tau_{2crit} = 0,9001 \text{ s} \end{matrix}. \quad (7.20)$$

From eqs (7.15)–(7.20) critical parameter of the human pilot time delay destabilizing closed loop automatic flight control system can be easily derived to be:

$$\tau_{crit} = 0,9001 \text{ sec.} \quad (7.21)$$

Time delay domain defined from necessary stability conditions and given by eq (7.13) is limited with time delay defined for the sufficient stability conditions given by eq (7.21). Stability conditions for the closed loop automatic flight control system given in Figure 7.1. can be derived as follows:

$$0 < \tau < 0,9001 \text{ sec.} \quad (7.22)$$

Let us calculate the step response of the closed loop automatic flight control system. In this particular case reference signal of the system to be followed by the human pilot is

$$\gamma_r(t) = 1(t) \quad (7.23)$$

Let the set of time delays considered during computer simulation be as follows:

$$\tau_{stab} = 0,3 \text{ sec; } \tau_{crit} = 0,9 \text{ sec; } \tau_{unstab} = 1 \text{ sec.} \quad (7.24)$$

Results of the computer simulation can be seen in Figure 7.2.

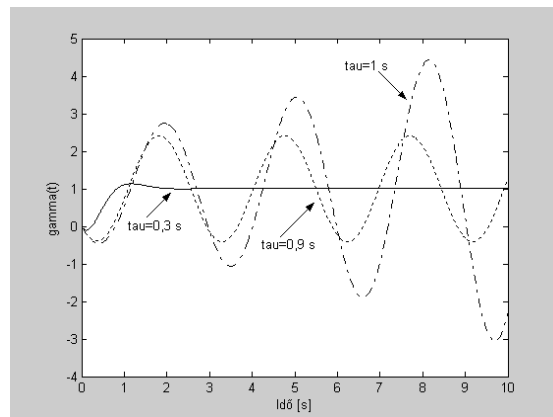


Figure 7.2. Closed Loop Automatic Flight Control System Step Responses.

Figure 7.2. shows that for small value of time delay, say  $\tau_{stab} = 0,3 \text{ sec}$ , the closed loop step response is stable: the roll angle has bounded value. Transient response time is small. It means that pilot is able to track the reference signal with no static error and the closed loop control system is stable.

In case of critical time delay of  $\tau_{crit} = 0,9 \text{ sec}$  the closed loop system including human pilot has harmonic, periodical response with

constant amplitudes. In other words, pilot unable to track the bounded reference signal.

Finally, having unstable time delay of  $\tau_{unstab} = 1 \text{ sec}$ , closed loop automatic flight control system with the pilot inside has unstable response, which is harmonic signal with increasing amplitudes. It is evident that in this particular case pilot losing the control over the aircraft and may generate the so called *pilot induced oscillation (PIO)* which can be dangerous for flight safety. In worst case situation *PIO* can lead to damage of the airframe and to fatal accident of the aircraft.

Dynamic performances of the closed loop automatic flight control system were found for three different values of the time delay defined by eq (7.24) and put into Appendix 2.

From the Appendix 2. it is evident that for  $\tau_{stab} = 0,3 \text{ sec}$  closed loop automatic flight control system is stable, and has eigenvalues of  $\lambda_1 = -1,06$ , and  $\lambda_{2,3} = -2,2 \pm 2,89j$  on the left side of the complex plane, which tells about stability.

For critical value of the time delay of  $\tau_{crit} = 0,9 \text{ sec}$  closed loop has a pair of complex roots of  $\lambda_{2,3} = -1,32 \cdot 10^{-4} \pm 2,14j$ , which is practically lies on the imaginary axis of the complex plane. These roots generate harmonic response of the closed loop automatic flight control system.

In case of  $\tau_{unstab} = 1 \text{ sec}$  closed loop automatic flight control system has a pair of roots on the right side of the complex plane, say,  $\lambda_{2,3} = 0,109 \pm 2,03j$ , which generates unstable response from the closed loop automatic flight control system.

### VIII. CONCLUSIONS

Human operators are still one of the most important 'part' of the control systems. They may monitor the physical processes, or actively actuate in the control systems. Since operator acts as simple term of the closed loop control system it is necessary to model his activity, and, to take into consideration.

Modeling human pilots is important from many aspects of aircraft maintenance both in the air and on the ground. His mathematical model depends upon complexity of the system in which he acts, upon the level of his training, upon his physical and psychical conditions, and finally, depends on signals' characteristics to be followed.

The paper dealt with determination of the human pilot's critical parameters. Author introduced widely applied mathematical models of the human operator. Paper showed a new field of application of the classical Hurwitz stability criteria. A new example was presented how it can be used for purposes of derivation of critical parameters of the pilot.

Note and underline that for complex analysis of critical parameters of the human operator (e.g. gain  $K_p$ , and prediction time constant  $T_p$ ) also must be determined. Conditions and requirements for stability of the closed loop automatic flight control system must be satisfied for all possible parameters of the human operator for all possible aircraft dynamics, i.e. for all possible flight conditions and regimes.

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**APPENDIX 1.  
COEFFICIENTS OF THE PADÉ APPROXIMANTS**

Order of Approximation	Coefficient, $k$	Padé Coefficient, $c_i$
$n = 1$	$k = 0$	$c_0 = 1$
	$k = 1$	$c_1 = \frac{1}{2}$
$n = 2$	$k = 2$	$c_2 = \frac{2!}{4!} = \frac{1}{12}$
$n = 3$	$k = 3$	$c_3 = \frac{3!}{6!} = \frac{1}{120}$
$n = 4$	$k = 4$	$c_4 = \frac{4!}{8!} = \frac{1}{1680}$
$n = 5$	$k = 5$	$c_5 = \frac{5!}{10!} = \frac{1}{30240}$
$n = 6$	$k = 6$	$c_6 = \frac{6!}{12!} = \frac{1}{665280}$
$n = 7$	$k = 7$	$c_7 = \frac{7!}{14!} = \frac{1}{17297280}$
$n = 8$	$k = 8$	$c_8 = \frac{8!}{16!} = \frac{1}{518918400}$
$n = 9$	$k = 9$	$c_9 = \frac{9!}{18!}$
$n = 10$	$k = 10$	$c_{10} = \frac{10!}{20!}$

**APPENDIX 2.**  
**DYNAMIC PERFORMANCES OF THE CLOSED LOOP**  
**AUTOMATIC FLIGHT CONTROL SYSTEM**

Time delay, $\tau$ [sec]	Eigenvalues	Damping ratio, $\xi$	Frequency, $\omega$ [rad/s]
$\tau_{stab} = 0,3$	$\lambda_1 = -1,06$ $\lambda_{2,3} = -2,2 \pm 2,89j$	$\xi_1 = 1$ $\xi_{2,3} = 0,606$	$\omega_1 = 1,06$ $\omega_{2,3} = 3,64$
$\tau_{crit} = 0,9$	$\lambda_1 = -1,02$ $\lambda_{2,3} = -1,32 \cdot 10^{-4} \pm 2,14j$	$\xi_1 = 1$ $\xi_{2,3} = 6,18 \cdot 10^{-5}$	$\omega_1 = 1,02$ $\omega_{2,3} = 2,14$
$\tau_{unstab} = 1$	$\lambda_1 = -1,02$ $\lambda_{2,3} = 0,109 \pm 2,03j$	$\xi_1 = 1$ $\xi_{2,3} = -0,0539$	$\omega_1 = 1,02$ $\omega_{2,3} = 2,14$

# STOCHASTIC NOISES AFFECTING DYNAMIC PERFORMANCES OF THE AUTOMATIC FLIGHT CONTROL SYSTEMS

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## SUMMARY

**Abstract:** External and internal disturbances affect dynamic performances of the automatic flight control systems and can lead to unwanted changes in accuracy of the closed loop control system. In worst case situation, i.e. in extreme meteorological circumstances they can lead to loose stability. The purpose of the authors is to summarize the basic features and equations of atmospheric disturbances. The paper deals with generating stochastic signals with pre-defined statistical parameters regarding different weather conditions. Main equations and transfer functions of the linear filters will be derived and given in the paper. Filter parameters will be chosen with consideration of the weather conditions given in military specifications of MIL-F-8785C, and MIL-STD-1797A. Generating of the stochastic signals with given statistical parameters, and the computer-aided simulation is supported by MATLAB<sup>®</sup> supplemented with necessary toolboxes.

## I. INTRODUCTION

The early mathematical models of the turbulent air were deterministic ones, and they made it possible to generate models such as step gust, ‘1-cos’ gust etc. It is well-known that regarding altitude atmospheric turbulence models can be defined as low altitude ones, if height is less than 2000 ft, and medium/high altitude ones, if height is greater than 2000 ft. The paper will limit investigation to that of the low-altitude random atmospheric turbulences, and will show random time series representing components of the speed of the turbulent air; namely translational component of  $u_g$ , lateral component of  $v_g$ , and finally, vertical component of  $w_g$  derived for several weather conditions. The proposed atmospheric turbulence models can be applied for design and analysis of the unmanned aerial vehicle (UAV) systems including unmanned aircraft, unmanned helicopter, or unmanned quadrotor systems flying at low altitudes and at low speed.

## II. BRIEF HISTORY & LITERATURE OVERVIEW

Basic equations, definitions, and characteristics of the random processes and random systems are given in [1]. DONALD MCLEAN in [2] propagates both deterministic and stochastic mathematical models of the atmospheric disturbances. A complex set mathematical models of the atmospheric disturbances including both deterministic and random ones are given in [2, 3, 4], and its implementation is shown in [2, 5]. In [6] SZABOLCSI and MÉSZÁROS focused attention and showed how to apply mathematical models of the low-altitude atmospheric turbulences for spreading air pollution. POKORÁDI in [7] summarizes main characteristics of the stochastic signals, and applied Markov-chains for modeling aircraft ground maintenance and repair. He also used stochastic theory for solution of diagnostics problem in aircraft technical systems. Random time series are generated and filtered to that of the components of the speed of the atmospheric turbulence using computer

packages MATLAB® [8], and Control System Toolbox [9].

### III. MATHEMATICAL MODELS OF THE CONTINUOUS ATMOSPHERIC DISTURBANCES

This chapter mainly based upon [1, 2, 3, 4, 5, 6, 7], and strictly follows methodology given in [4, 6]. The power spectral density (PSD) function of the turbulent air, the so-called von Kármán spectrum, which is better fit registrations of the turbulent air records, is given as follows [2, 3, 4]:

$$\Phi_{Kármán}(\Omega) = \frac{\sigma^2 L}{\pi} \frac{1 + \frac{8}{3}(1,339L\Omega)^2}{(1 + 1,339L^2\Omega^2)^{11/6}}, \quad (3.1)$$

where  $L$  [m] is the gust wavelength,  $\Omega = \omega U_0^{-1}$  [rad/m] is spatial frequency,  $\omega$  [rad/s] is the observed angular frequency, and finally,  $\sigma$  [m/s] is the *r.m.s.* gust velocity.

The second one, the more favored PSD function is the Dryden PSD function, which can be programmed more easily than the von Kármán-model. If there is no structural analysis is performed the use of Dryden PSD function is permissible. The Dryden PSD function can be defined as given below [2, 3, 4, 6]:

$$\Phi_{Dryden}(\Omega) = \frac{\sigma^2 L}{\pi} \frac{1 + 3L^2\Omega^2}{(1 + L^2\Omega^2)^2}. \quad (3.2)$$

Having goal to analyze hypothetical aircraft mathematical models with no interest in investigation of the structural behavior and supposing aircraft to be the rigid one, the simplest mathematical form of the PSD function defined by equation of (3.2) we will use in this article. Regarding basic references of [2, 3, 4, 6] one can define PSD functions of the component speed of the turbulent air along body axis system of the aircraft, i.e.:

$$\Phi_{u_g}(\Omega) = \frac{2\sigma_u^2 L_u}{\pi} \frac{1}{1 + (L_u \Omega)^2} \quad (3.3)$$

$$\Phi_{v_g}(\Omega) = \frac{\sigma_v^2 L_v}{\pi} \frac{(1 + 3(L_v \Omega)^2)}{[1 + (L_v \Omega)^2]^2} \quad (3.4)$$

$$\Phi_{w_g}(\Omega) = \frac{\sigma_w^2 L_w}{\pi} \frac{(1 + 3(L_w \Omega)^2)}{[1 + (L_w \Omega)^2]^2} \quad (3.5)$$

where  $\sigma_i^2 = \int_0^\infty \Phi_i(\Omega) d\Omega_i |_{i=u,v,or w}$ . Since  $\omega = U_o \Omega$  formulas of (3.3)–(3.5) may be rewritten as follows:

$$\Phi_{u_g}(\omega) = \frac{2\sigma_u^2 L_u}{U_o \pi} \frac{1}{\{1 + (L_u / U_o)^2 \omega^2\}}, \quad (3.6)$$

$$\Phi_{v_g}(\omega) = \frac{\sigma_v^2 L_v}{U_o \pi} \frac{(1 + 3(L_v / U_o)^2 \omega^2)}{\{(1 + (L_v / U_o)^2 \omega^2)\}^2}, \quad (3.7)$$

$$\Phi_{w_g}(\omega) = \frac{\sigma_w^2 L_w}{U_o \pi} \frac{(1 + 3(L_w / U_o)^2 \omega^2)}{\{(1 + (L_w / U_o)^2 \omega^2)\}^2}. \quad (3.8)$$

For generating random signals with the required intensity, scale length, and PSD functions for given speed and height of the flight, a hypothetical wide-band noise generator with PSD function of  $\Phi_N(\omega)$  must be used to provide signal with the linear filter, chosen such that it has an appropriate frequency response so that the output signal from the linear filter will have a PSD function of  $\Phi_i(\omega)$  (see Figure 3.1.) [2, 4]:

$$\begin{aligned} \Phi_i(\omega) &= \left| G_i(s) \right|_{s=j\omega}^2 \Phi_N(\omega) = \\ &= G_i(s) G_i(-s) \Big|_{s=j\omega} \Phi_N(\omega) \end{aligned} \quad (3.9)$$

If the white noise source is chosen so that its power spectrum is similar to that of called ‘white’ noise one can write that

$$\Phi_N(\omega) = 1. \quad (3.10)$$

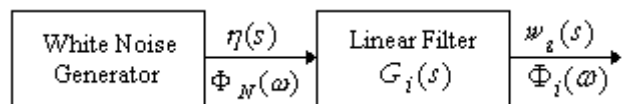


Figure 3.1. Block Diagram for Generating Stochastic Signals.

Substituting eq (3.10) into eq (3.9) result the following formula

$$\Phi_i(\omega) = |G_i(s)|_{s=j\omega}^2 \Phi_N(\omega) = G_i(s) G_i(-s)|_{s=j\omega} \quad (3.11)$$

The linear filter transfer functions of  $G_i(s)$  are given in [2] to be:

$$G_{u_g}(s) = \frac{\sqrt{K_u}}{s + \lambda_u}, \quad G_{v_g}(s) = \sqrt{K_v} \frac{s + \beta_v}{(s + \lambda_v)^2},$$

$$G_{w_g}(s) = \sqrt{K_w} \frac{s + \beta_w}{(s + \lambda_w)^2}, \quad (3.12)$$

where:

$$K_u = \frac{2U_o \sigma_u^2}{L_u \pi}, \quad K_v = \frac{3U_o \sigma_v^2}{L_v \pi}, \quad K_w = \frac{3U_o \sigma_w^2}{L_w \pi}, \quad (3.13)$$

$$\beta_v = \frac{U_o}{\sqrt{3}L_v}, \quad \beta_w = \frac{U_o}{\sqrt{3}L_w}, \quad (3.14)$$

$$\lambda_u = \frac{U_o}{L_u}, \quad \lambda_v = \frac{U_o}{L_v}, \quad \lambda_w = \frac{U_o}{L_w}. \quad (3.15)$$

It is easily can be derived that substitution equations (3.12)-(3.15) into equation (3.9) results in the PSD functions of the Dryden-models's PSD-functions of (3.6)-(3.8). If the air turbulence model is used for analysis of its effects on flight of the small UAV aircraft let the initial parameters be as they are given below:

$$H = 100 \text{ m} \cong 328,084 \text{ feet}; \quad U_o = 25 \text{ m/s} = 90 \text{ km/h} \quad (3.16)$$

From equations (3.13)–(3.15) it is evident that for derivation of transfer functions of the linear filters defined by equation (3.12) it is necessary to know turbulence scale of  $L_i$ , and turbulence intensity of  $\sigma_i$ , measured along

appropriate axis of the given coordinate system.

Let us consider NASA-parameters referred to [2, 3] to be as follows:

$$\begin{aligned} & \text{along longitudinal (OX) axis:} \\ & 3,4 \text{ m/s} \leq \sigma_u \leq 0,85 \text{ m/s} \end{aligned} \quad (3.17)$$

$$\begin{aligned} & \text{along lateral (OY) axis:} \\ & 2,8 \text{ m/s} \leq \sigma_v \leq 0,7 \text{ m/s}, \end{aligned} \quad (3.18)$$

$$\begin{aligned} & \text{along vertical (OZ) axis:} \\ & 1,8 \text{ m/s} \leq \sigma_w \leq 0,45 \text{ m/s}. \end{aligned} \quad (3.19)$$

For extreme weather conditions (thunderstorm) MCLEAN [2] suggests turbulence intensities as they given below:

$$\sigma_u = \sigma_v = \sigma_w = 7 \text{ m/s}. \quad (3.20)$$

Turbulence integral scale lengths  $L_i$  of the low altitude turbulence models for  $10 \text{ feet} \leq h \leq 1000 \text{ feet}$  can be derived using following formulas [5, 8, 9]:

$$L_u = 2L_v = \frac{h}{(0,177 + 0,000823 \cdot h)^{1,2}},$$

$$L_w = 0,5 h. \quad (3.21)$$

Regarding MCLEAN, for extreme weather conditions (thunderstorm) one can apply following integral scale lengths given in [2]:

$$L_u = L_v = L_w = 580 \text{ m}. \quad (3.22)$$

Constant speed components of the turbulent air are given in military standards of [4, 7] as function of their exceedance. For the low altitude random turbulence models intensity of the turbulence,  $\sigma_w$  can be measured as:

$$\sigma_w = 0,1 u_{20}, \quad (3.24)$$

where  $u_{20}$  is constant longitudinal component speed of the turbulent air measured at the altitude of  $h = 20 \text{ feet}$ . Using equations of (3.21)–(3.22) integral scale lengths of the air

<sup>1</sup> 1 foot  $\cong$  0,3048 m — 1 m  $\cong$  3,28084 feet



turbulence were found and they are summarized in Table 1.

Table 1. Integral scale lengths at altitude of  $H = 100\text{ m} \cong 328,084\text{ feet}$ .

Scale length, [m]	Nominal (Nom)	Extreme (Thunderstorm)
$L_u$	862,185497 feet $\cong$ 262,7941311 m	580
$L_v = 0,5 L_u$	431,0927485 feet $\cong$ 131,3970655 m	580
$L_w$	50	580

Using equations of (3.17)–(3.20) turbulence intensities were found and they are summarized in Table 2.

Table 2. Turbulence intensities.

Turbulence intensities	NASA-Min (Min)	NASA-Max (Max)	Extreme (Thunderstorm)
$\sigma_u$ , [m/s]	0,85	3,4	7
$\sigma_v$ , [m/s]	0,7	2,7	7
$\sigma_w$ , [m/s]	0,45	1,8	7

Constant longitudinal component speed of the turbulent air, called  $u_{20}$ , were found using military standard of [3], and using equations of (3.21)–(3.22). Constant speed of  $u_{20}$  are summarized in Table 3.

Table 3. Constant speed of  $u_{20}$ .

Turbulent Air Characteristics	NASA-Min (Min)	NASA-Max (Max)	Extreme (Thunderstorm)
$\sigma_w = 0,1 u_{20}$ , [m/s]	0,45	1,8	7
$u_{20}$ , [m/s] – [km/h]	4,5 – 16,2	18 – 64,8	70 – 252

Linear transfer functions defined by equations (3.12) having parameters given by equations of (3.13)–(3.15), and satisfying conditions derived by equations (3.16)–(3.24), and considering weather conditions given by Table 1., and Table 2, can be determined, and they can be found in the following tables given below [2, 3]:

Table 3. Parameters of the linear filters providing longitudinal speed component of the air turbulence,  $u_g(t)$ .

Filter Parameters		
Weather Conditions	$K_u = \frac{2 \sigma_u^2 U_o}{L_u \pi} \left[ \frac{m^2}{s^3} \right]$	$\lambda_u = \frac{U_o}{L_u} \left[ s^{-1} \right]$
NASA-Min	0,043756496	0,095131547
NASA-Max	0,700103937	0,095131547
Extreme (Thunderstorm)	1,344584864	0,043103448

Table 4. Parameters of the linear filters providing lateral speed component of the air turbulence,  $v_g(t)$ .

Filter Parameters			
Weather Conditions	$K_v = \frac{3\sigma_v^2 U_o}{L_v \pi} \left[ \frac{m^2}{s^3} \right]$	$\beta_v = \frac{U_o}{\sqrt{3}L_v} \left[ s^{-1} \right]$	$\lambda_v = \frac{U_o}{L_v} \left[ s^{-1} \right]$
NASA-Min	0,089027057	0,109848449	0,190263095
NASA-Max	1,324504595	0,109848449	0,190263095
Extreme (Thunderstorm)	8,902705783	0,024885787	0,043103448

Table 5. Parameters of the linear filters providing vertical speed component of the air turbulence,  $w_g(t)$ .

Filter Parameters			
Weather Conditions	$K_w = \frac{3\sigma_w^2 U_o}{L_w \pi} \left[ \frac{m^2}{s^3} \right]$	$\beta_w = \frac{U_o}{\sqrt{3}L_w} \left[ s^{-1} \right]$	$\lambda_w = \frac{U_o}{L_w} \left[ s^{-1} \right]$
NASA-Min	0,096686627	0,288675134	0,5
NASA-Max	1,546986047	0,288675134	0,5
Extreme (Thunderstorm)	2,016877296	0,024885787	0,043103448

Using parameters of Table 3, Table 4, Table 5, transfer functions of the linear filters defined by equation (3.12) can be derived as follows:

$$G_{u_g}^{Min}(s) = \frac{0,20918}{s + 0,09513}, \tag{3.25-1}$$

$$G_{u_g}^{Max}(s) = \frac{0,83672}{s + 0,09513}, \tag{3.25-2}$$

$$G_{u_g}^{Extr}(s) = \frac{1,15956}{s + 0,04310}, \tag{3.25-3}$$

$$G_{v_g}^{Min}(s) = 0,29837 \frac{s + 0,10984}{s^2 + 0,38052s + 0,03620} \tag{3.26-1}$$

$$G_{v_g}^{Max}(s) = 1,15087 \frac{s + 0,10984}{s^2 + 0,38052s + 0,03620}, \tag{3.26-2}$$

$$G_{w_g}^{Extr}(s) = 2,98374 \frac{s + 0,02488}{s^2 + 0,08620s + 0,00186} \tag{3.26-3}$$

$$G_{w_g}^{Min}(s) = 0,31094 \frac{s + 0,28867}{s^2 + s + 0,25}, \tag{3.27-1}$$

$$G_{w_g}^{Max}(s) = 1,24377 \frac{s + 0,28867}{s^2 + s + 0,25} \tag{3.27-2}$$

$$G_{w_g}^{Extr}(s) = 1,42016 \frac{s + 0,02488}{s^2 + 0,08620s + 0,00185} \tag{3.27-3}$$

Using linear transfer function models of equations (3.25)–(3.27) it is easy to generate random time series with given statistical parameters, which can be applied both for modeling, analysis and design purposes [9, 10].

#### IV. RESULTS OF THE COMPUTER SIMULATION

Using principle derived by Figure 1., and using transfer functions of the linear filters defined for several weather conditions one can generate computer code for solution of this problem. In our preliminary study we have used MATLAB® 6.5 computer program [8] supplemented with Control System Toolbox [9]. Regarding mathematical models of the random air outlined in Chapter 3 all components of the speeds of the turbulent air measured along axes of the aircraft body-axis system, and they will be presented in the next sections.

#### 4.1. RANDOM LONGITUDINAL SPEED COMPONENT OF THE TURBULENT AIR

The longitudinal speed component is very important from the point of view of the basic flight conditions, i.e. aircraft flight is limited with its minimum longitudinal speed of, say,  $u_{min}$ .

From Chapter 3 it is known that equilibrium speed of the hypothetical UAV aircraft is  $u_o = 25 \text{ m/s}$ . Result of the computer simulation can be seen in Figure 4.1. From Figure 4.1, it is easily can be determined that in time domain of (50÷100) seconds, in other words, in the root of the turbulent zone, the mean value of the longitudinal speed is approximately,  $u_{mean} \cong 4,2 \text{ m/s}$ , which is 16,8 % of that of the equilibrium one. There is a question arising from analysis of the characteristics of the longitudinal speed component direction, i.e. it can be coinciding one to that of the mean direction of the flight, or it can oppose aircraft flight. In other words, longitudinal speed component of the turbulent air can be called for head-wind, or, tail wind. Going that way, longitudinal speed of the aircraft flying through atmospheric turbulence can be derived as follows:

$$\text{for "head-wind": } u_{head} = u_o - u_{mean} = 25 - 4,2 = 20,8 \text{ m/s} , \quad (4.1)$$

$$\text{for "tail wind": } u_{tail} = u_o + u_{mean} = 25 + 4,2 = 29,2 \text{ m/s} . \quad (4.2)$$

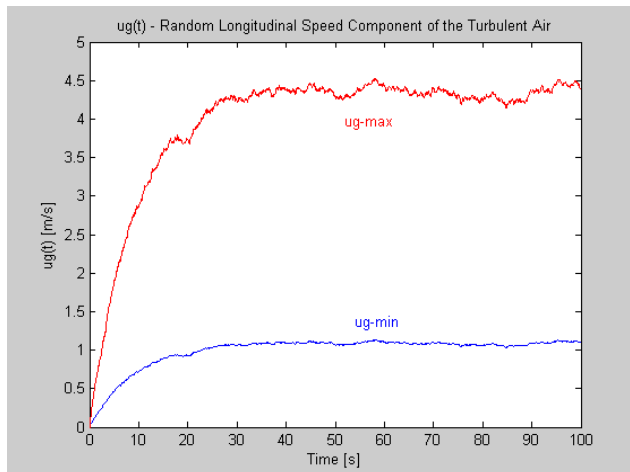


Figure 4.1. Longitudinal Speed Component of the Stochastic Air.

#### 4.2. RANDOM LATERAL SPEED COMPONENT OF THE TURBULENT AIR

Using the same manner as it was shown in previous section, computer code for random lateral speed component of the turbulent air

was generated, and results of the computer simulation can be seen in Figure 4.2. From Figure 4.2. it is easily can be seen that in the time domain of about (50÷100) seconds, the mean values of the lateral speed are:

$$v_{max} \cong 1,7 \text{ m/s} , v_{min} \cong 0,5 \text{ m/s} . \quad (4.3)$$

From eq. (4.1) it is evident that decrease of the longitudinal speed can lead to minimum allowed longitudinal speed of the aircraft for the given aircraft. If aircraft flight parameters, i.e. its speed and height of the flight, go out of the flight envelope, aircraft can stall, and finally, as worst case, aircraft can crash.

If to suppose weather conditions having statistical parameters between weather conditions of NASA-Min, and NASA-Max, it

can be supposed that mean value of the lateral speed is, approximately, of 1 m/s.

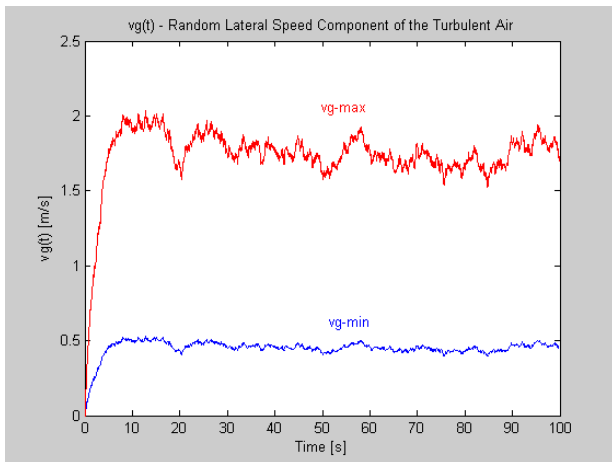


Figure 4.2. Lateral Speed Component of the Stochastic Air.

It means that during flight aircraft changes its lateral coordinate for about  $\cong 4$  m in one second. If to take into consideration the free-flight of the aircraft, or even if in normal flight aircraft “pilot” does not corrects the lateral coordinate, in 50 seconds time period, being investigated above, aircraft maintains distance of 1250 m, changing its lateral coordinate for 200 m. It is obvious, that there is a strong need to compensate lateral deviation measured from the flight direction.

### 4.3. RANDOM VERTICAL SPEED COMPONENT OF THE TURBULENT AIR

$$w_{\max} \cong 0,7 \text{ m/s} , w_{\min} \cong 0,2 \text{ m/s} . \quad (4.4)$$

Random vertical speed of the turbulent air is very important from many aspects of the altitude control of the aircraft, from the point of view of the modeling of the aeroelastic structural motion of the fuselage, and wings. There are many other reasons highlighting importance of the knowledge of the stochastic vertical speed of the atmospheric turbulences. Results of the computer simulation including NASA-Min, and NASA-Max weather conditions can be seen in Figure 4.3. From Figure 4.3. it is easily can be seen that in the time domain of about (50÷100) seconds, the mean values of the vertical speed are as follows:

If to take mean value of the vertical random speed of the wind to be of 0,5 m/s, during flight aircraft changes its altitude for 1,8 m per second. For the free-flight of the aircraft, or even if in normal flight aircraft “pilot” does not corrects the height of the flight, in 50 seconds time period, being investigated above, aircraft maintains distance of 1250 m, changing its height of the flight for 90 m, to that of the initial of  $H_o \cong 100 \text{ m}$ . It means that having no control on aircraft altitude, in turbulent air aircraft nearly duplicates its height of the flight. It is obvious, that height of the flight must be controlled, and altitude must be kept at its constant value.

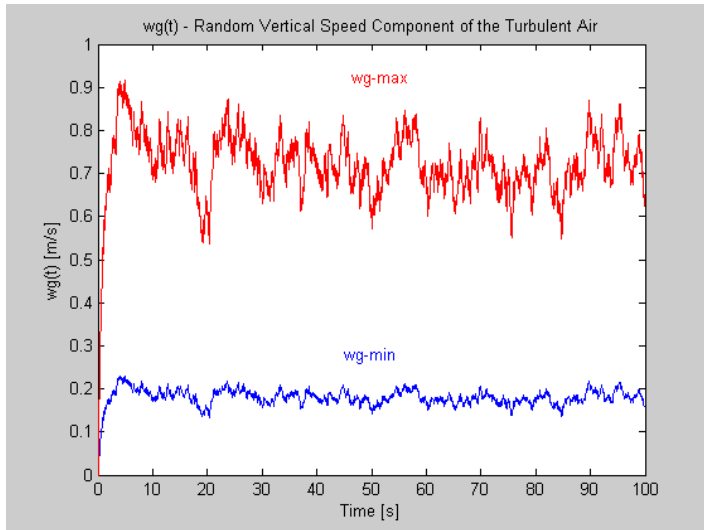


Figure 4.3. Vertical Speed Component of the Stochastic Air.

It means that having no control on aircraft altitude, in turbulent air aircraft nearly duplicates its height of the flight. It is obvious, that height of the flight must be controlled, and altitude must be kept at its constant value.

#### 4.4. RESULTS OF THE COMPUTER SIMULATION OF THE ATMOSPHERIC TURBULENCES FOR THE "NASA-MIN" WEATHER CONDITIONS

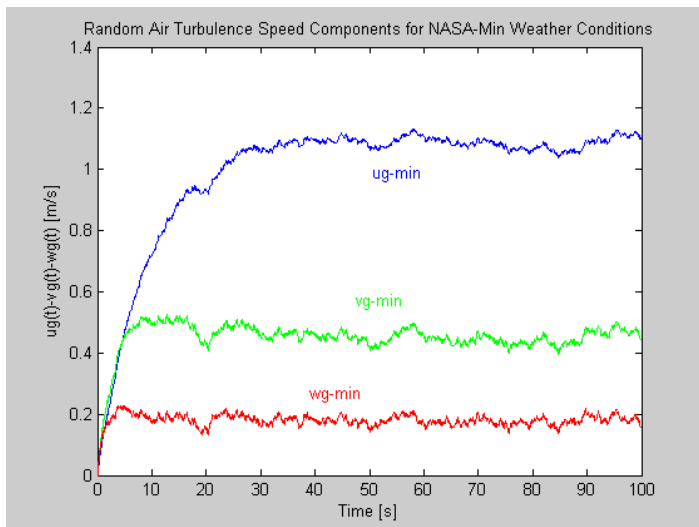


Figure 4.4. Results of the Computer Simulation for "NASA-Min" Weather Conditions.

If to take mean value of the vertical random speed of the wind to be of 0,5 m/s, during flight aircraft changes its altitude for 1,8 m per second. For the free-flight of the aircraft, or even if in normal flight aircraft "pilot" does not corrects the height of the flight, in 50 seconds time period, being investigated above, aircraft maintains distance of 1250 m, changing its height of the flight for 90 m, to that of the initial of  $H_o \cong 100 m$ .

Using results of the previous computer simulation, for "NASA-Min" weather conditions all appropriate time series of the longitudinal, lateral, and vertical components of the random air were plot in common coordinate system, and they can be seen in Figure 4.4.

From Figure 4.4. it is evident that longitudinal speed component of the atmospheric turbulence has largest mean value. If the aircraft is the piloted one the vertical speed component  $w_g(t)$  is important from point of view of the ride comfort. For UAVs vertical speed is important for fatigue reduction purposes. Finally, lateral speed  $v_g(t)$  can lead to worsening navigational performances, i.e. UAV can be lost during flight.

#### 4.5. RESULTS OF THE COMPUTER SIMULATION OF THE ATMOSPHERIC TURBULENCES FOR THE "NASA-MAX" WEATHER CONDITIONS

Using results of the computer simulation made before, for "NASA-Max" weather conditions all appropriate time series of the longitudinal, lateral, and vertical components of the random air were plot in one, common coordinate system, and they can be seen in Figure 4.5.

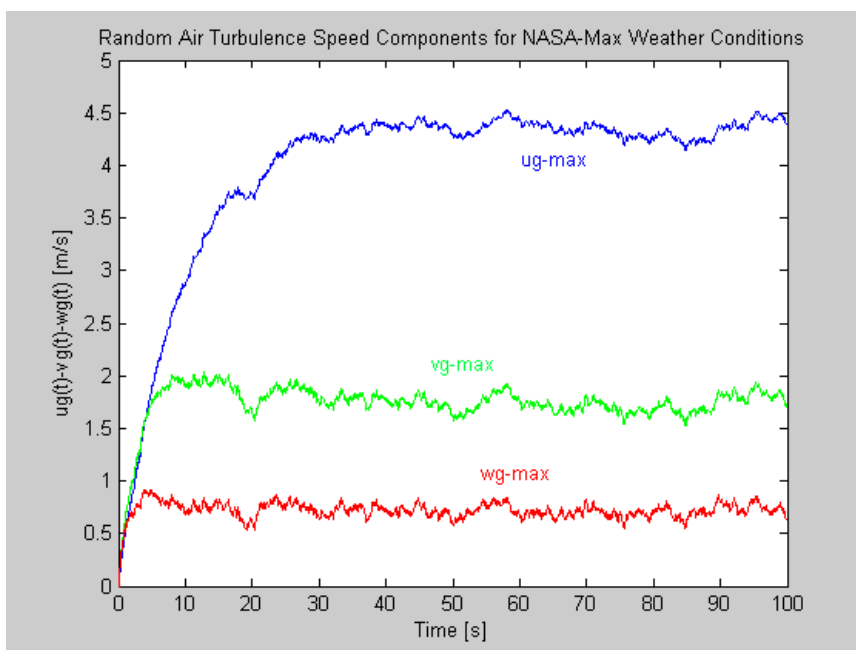


Figure 4.5. Results of the Computer Simulation for "NASA-Max" Weather Conditions.

From Figure 4.4. it is easily can be derived that longitudinal speed component,  $u_g(t)$ , of the atmospheric turbulence has largest mean value. It is evident that for head-wind weather conditions, there is exists a maximum value of the longitudinal random speed,  $u_{g_{max}}(t)$ , which is allowed to avoid stalling of the aircraft.

#### 4.6. RESULTS OF THE COMPUTER SIMULATION OF THE ATMOSPHERIC TURBULENCES FOR "EXTREME – THUNDERSTORM" WEATHER CONDITIONS

Result of these computer simulations are mainly hypothetical, however, it is necessary

to know how extreme air masses are moving. These results are very important although from the point of view of the flight achieved beyond visual range for large distances, when there are big differences between weather conditions at arrival and departure airfields. Result of the computer simulation can be seen in Figure 4.6.

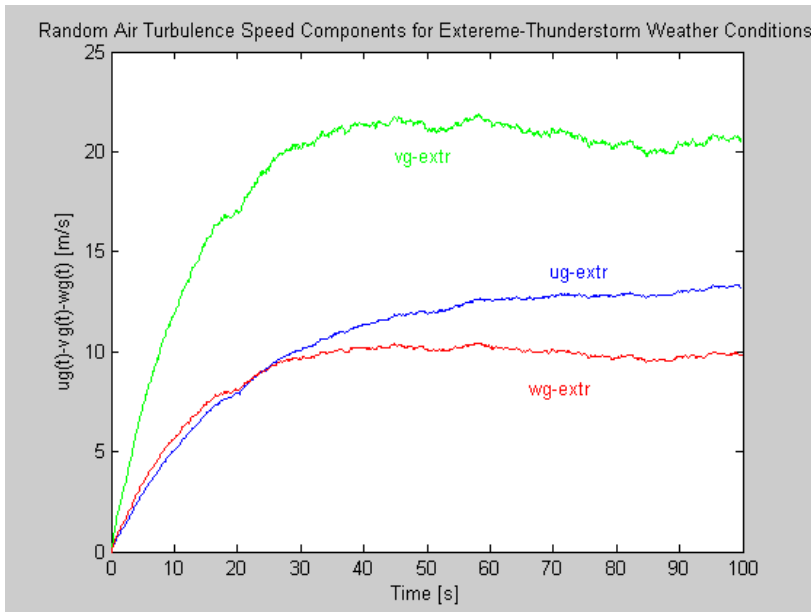


Figure 4.5. Results of the Computer Simulation for "Extreme" Weather Conditions.

It means that to avoid stalling of the aircraft it is necessary to compensate decrease of the longitudinal speed of the aircraft increasing throttle, or it is necessary to maintain maneuver to keep given flight parameters in the defined flight envelope of the given type of the aircraft.

## V. MODELING OF SENSOR NOISES IN AUTOMATIC FLIGHT CONTROL SYSTEMS

Most of the modern automatic flight control systems are driven by electric energy, i.e. outputs of the flight control systems are electrical signals proportional to state variables of the spatial motion of the aircraft. Additive noises of the output signals can be regarded as random ones. It is well-known that statistical parameters of these stochastic signals are purely described, and they can be derived from analysis of the registered time histories of the random flight parameters. The second method is the study of the computer simulation of the random time series. This particular case supposes random flight parameters to have Gaussian distribution. These signals are to be filtered from those of the output signals of the white noise generator, and in most cases are filtered using linear filters to have zero mean

The most important result is that atmospheric turbulence has largest value in the mean of lateral component of the turbulent air. The other important statement coming from this analysis, that if to consider maximum value of the longitudinal head-wind to be of  $u_{g\_head}(t) = 5 \text{ m/s}$ , this maximum value is reached at about 5 seconds of the computer-aided simulation.

value. The linear filtering scheme is shown in Figure 3.1. In general, typical drift of the attitude gyroscope is  $0,1^\circ/h$ . The accuracy of the rate gyro is  $0,1^\circ/\text{sec}$ , and  $0,1^\circ$  for attitude gyros. Static error of the accelerometers is typically  $3,5 \cdot 10^{-3} \text{ m/s}^2$ . Barometric altimeters have *r.m.s.* errors of 16m [2].

## VI. SUMMARY AND CLOSING REMARKS

This paper deals with mathematical modeling of the atmospheric turbulences. Main references are cited to highlight importance of this scientific article. Mathematical modeling of the atmospheric turbulences are important from many aspects of the flight: these models are used for derivation of the flight envelope of the aircraft, for derivation of the limitations of the flight parameters and derivation of the meteorological minimums defined for given type of the aircraft, and finally, these models are widely applied for preliminary design of the automatic flight control systems.

In this article it was discussed that statistical parameters of the atmospheric turbulence depend not only on flight parameters but on weather conditions, too. Limiting our investigations to that of the analysis of the low-altitude turbulent air models we have

considered several weather conditions, namely 'NASA-Min', 'NASA-Max', and finally, 'Extreme-thunderstorm' weather conditions were analyzed.

For given initial flight parameters and weather conditions author had created a new embedded MATLAB<sup>®</sup> m-file to produce time series applicable to visualize random speed components of the turbulent air, namely longitudinal, lateral, and finally, vertical speed components of the turbulent air were investigated.

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