THE CURRENT STAGE OF AIR DEFENSE SYSTEMS' STRUCTURE AND PERFORMANCES. S.A.M. SYSTEMS COMPARATIVE ANALYSIS IN ROMANIAN INVENTORY

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Abstract: *The integrated systems especially Surface-to-Air Missile Systems (SAMS), destined to combat the aircraft and other aerial assets, went through an accelerated loss of their performance. In this perspective I tried to define the **A**erospace System and Integrated System concepts. The financial crisis has forced an extension of the system operation even if the system is outdated. Many times, it is better to improve an existing system than buy a new one. From the institutional point of view, the main problems are: including the cost versus performance and the cost versus the remaining lifetime or technical resource.*

Finally, an important conclusion supports the possibility and necessity of the SAMS up-grade, given the change in the characteristics of the threat.

Keywords: ***Ai****rspace system, Integrated System, S.A.M.S. (Surface-to-Air Missile Systems), Technical and Institutional challenges;*

1. INTRODUCTION

The primary threat concerning the safety of numerous states around the world is one of the modern era most disputed subject, being in a constant evolution. The most important factors affecting the development of the SAM systems are the following:

- destabilization of the global security;
- the importance of aerial warfare is higher as ever even there has been a reduction in the number of aircrafts each air force has;
- the higher importance of the ballistic missiles, surface-to-air missiles, jamming missiles, cruise missiles and UAV's;
- These new technologies used on the modern battlefield are more effective and cheaper, more states being able to acquire them.

But what does Airspace system mean!

The outstanding spatial system is defined as an ensemble of air defense missile, early warning and space monitoring, interconnected networks including groups of algorithms and technical means, oriented on airspace research and aircrafts identification and on launching and targeting vehicles equipped with active propulsion systems from ground to enemy targets.

The above stated system, could give access to outer space and also optimization legislation regarding responsible behavior and maintaining interoperability of military capabilities. Spatial capabilities are a real strategic advantage for long-term security. Spatial systems have applicability in land navigation, smart ammunition guidance and also in transmitting information from the UAV to potential beneficiaries of land. It should not be overlooked that in space are located elements of early warning systems on ballistic missiles.

Is more often used the concept of collective security when speaking about space.

Integrated system

The moment we assert about some elements that are integrated we mean that there are included, embedded in a whole.

In my opinion, an ***integrated system*** represents an ensemble of systems/subsystems whose components are permanently interconnected, having well defined functions and very clearly delimited. The output of an integrated system is directly proportional with the functionality of components. All system elements contribute to achieve the goal initially established. The system components include the organization, resources and processes.

Of course, appear a series of questions such as: Why should Management Systems be integrated?

Why do we need a management integrated system? and ineluctable Whom is addressed this kind of system?

There are some reasons for which any good manager should develop his own Integrated Management System:

- reduces the copies and therefore associated costs;
- reduces the risks and increases the efficiency;
- helps defining goals;
- eliminates inappropriate responsibilities and internal relations;
- focuses the entire attention on goals;
- optimizes the decisional process;
- creates the required management consistency;
- optimizes the dissipation of used resources stress;
- improves staff training and their skills;
- allows coherent planning of activities by taking into account aspects of quality, environmental, health and security in work, information's security, social responsibility.

2. THE EVOLUTION OF THE AERIAL WARFARE MEANS AND AIR DEFENSE WEAPONS

The evolution of launching procedures of munitions used in aerial warfare and the enhancement of the aerial threats demands the analysis of the following aspects:

- effective range of the SAM systems as well as the type of munitions used;
- tactics used for the emplacement of these systems;

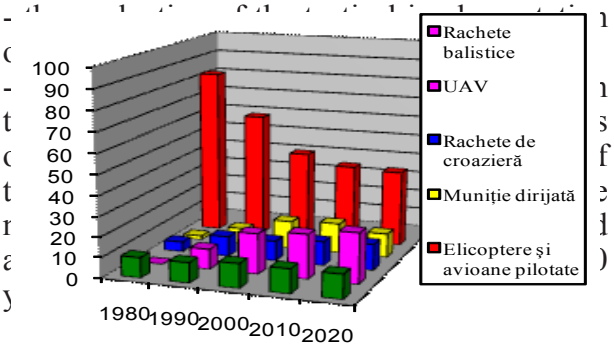

Fig 1 The evolution of the aerial warfare means

The figure nr.1 emphasizes the transition from piloted aircraft to the unmanned ones. During the 1980 combat aircrafts and helicopters represented 85% of the total attacking force, this percentage being continuously falling ever since and it is expected to reach 39% till 2020. In the future the aerial warfare means won't have a spectacular evolution. The development of threats demands the enhancement of the anti-missile systems such as missile shields.

The next graph shows the raising importance of the integrated anti-missile systems starting from 1980 to 2020.

The more organized and well synchronized aerial attacks will put an even higher strain on the integrated air defense systems. The enemy will use will use in the first phase of combat jamming systems to neutralize radar and communication systems.

Considering these risks the primary objective that needs to be fulfilled by the aerial defense will be the reaching of the so called "Near Zero Leak" (no undefended area).

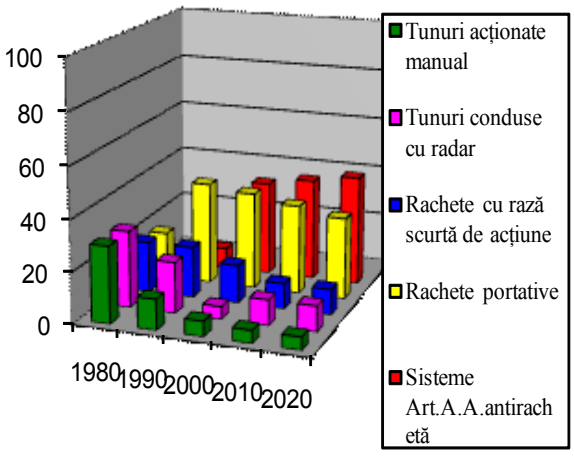

Fig 2 The usefulness of the anti-missile systems

This level of protection will be easily obtained by a joint force of surface-to-air missiles and artillery. During the acquisition programs carried out, our country focused on upgrading the medium range missile systems, but unfortunately the enhancement of the aerial defense systems stopped after the HAWK system was bought. Also the SHORAD (Short Range Air Defense)/ VSHORAD (Very Short Range Air Defense) were in the pending status for a long time but were abandoned before signing any contract. The acquisition of long range missiles never reached a status worth mentioning.

Whatever the reasons may be this issue still persists as time passes and the Russian production missiles systems come close to their demise. The next step is retiring the S-15 (Neva) or the extension of the operational period for this system.

At the moment Romania need a replacement for the SA-2 , SA-9/CA-95 systems and at least an upgrade for the SA-7/CA-94 if there won't be any acquisition programs targeting new missile systems.

Even though the SA-6 and the SA-8 are quite efficient they still need enhancements, considering the fact that the electronics on these systems are outdated. The best option is to replace these aerial warfare means with modern era ones, considering that spare parts are very scarce if a life extension program is considered.

3. S.A.M. SYSTEMS COMPARATIVE ANALYSIS IN ROMANIAN INVENTORY

For an objective comparison I chose to present the diagrams of the dynamic performances (maximum range, operational ceiling, and single shot probability) as they are presented in public sources (different from specifications mentioned by the producers). I have also mentioned the price for each missile system, and the fact that the money spent on each missile depends on the negotiations carried out by each client (the price may vary and may not be very precise).

In graph number 3, I presented a comparison between the most likely to be bought long range missile systems.

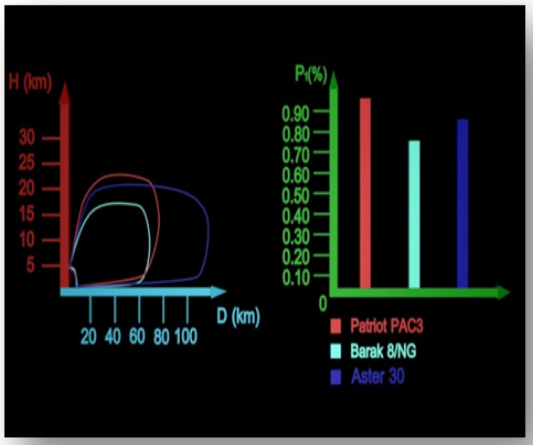

Fig. 3 Long Range Air Defence LRAD Missile Systems

Considering the fact that the American suppliers prefer the Patriot PAC-2, this system has the most chances to be bought or to be implemented at the same time with the so called "missile shield". The main issue is constituted by the fact that this system can only be bought from other current users, being no longer in production.

One of the advantages would be the low price given the fact that it is a used product.

If buying new products is considered, the best option would be the MBDA(Matra British Dynamics Alenia) Aster-30, which is the main competitor for the Bumar project in Poland. A great bonus of this program is the fact that MBDA offers a technological transfer to the one's buying their system.

The primary threat for MBDA is the fact that Poland may decide to buy cheap second hand patriots from Germany. Meanwhile beside the imminent stoppage of the MEADS program, Germany is less willing to sell its existing surface-to-air systems, meaning that Bumar and MBDA have more chances of succeeding.

The most advanced version of Patriot, PAC-2 MSE is still in its early stages of implementation and has a high price that will certainly decrease in a few years.

A surprise for the acquisition program could be Barak-8, one of the competitors in Poland, but its drawback is the fact that this missile is still in the testing phase.

In graph number 4 I have presented a comparison between medium range missile systems

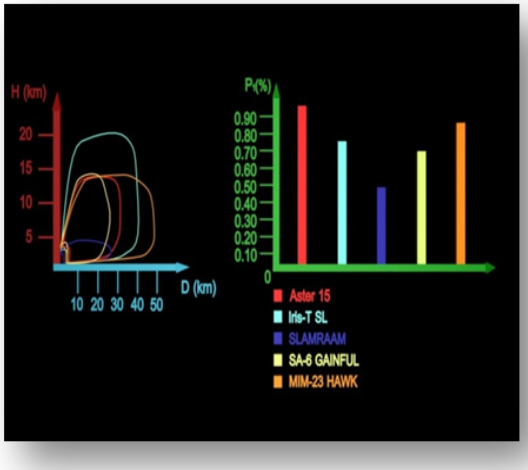

Fig. 4 Medium Range Air Defense (MRAD)

The modernization stages for the HAWK system involves the reaching of the so called XXI level (produced by Raytheon and Kongsberg), an important step leading to NASAMS II (Norwegian Advanced Surface-to-Air Missile System), which uses AMRAAM missiles launched from surface, having the same electronics.

Despite its drawbacks regarding the maximum altitude it can reach, Finland acquired this system due to its low price and the possibility to be used in a dispersed network.

A more efficient option would be the ESSM, a recent development of Kongsberg, which besides its superior performances, has as an advantage the fact that the SA-6 system can be modernized is the same time with the same missile (a similar project war proposed by the polish producer WZU and Raytheon).

Fig. 5 The modernization of the SA-6 system

Another option is the acquisition of the Spyder-MR, the drawbacks being the lack of integration with the existing HAWK system and the fact that there will be two similar systems with the same role.

The next comparison is made between SHORAD

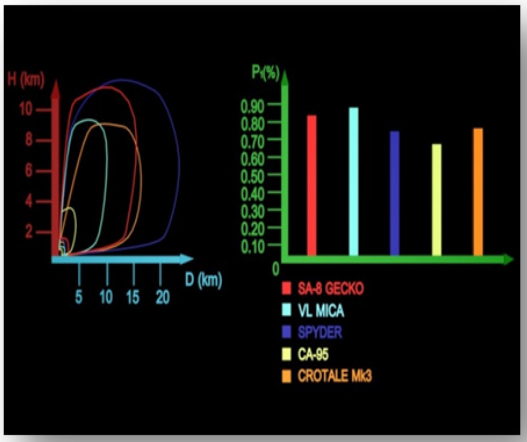

Fig 6 Short Range Air Defense (SHORAD)

In this field the contest is between VL-MICA(Vertical Launch-Missile d'Interception de Combat Aerien) and Spyder-SR both systems having the advantage of the reuse of some air-to-air missiles that are already in the Romanian Air Force inventory. A drawback of the MICA-VL system is the high price. Meanwhile, Spyder-SR won the competition in Singapore against MICA-VL and SLAMRAAM, and it was already bought by India to replace the SA-8.

The last comparison refers to VSHORAD *systems*

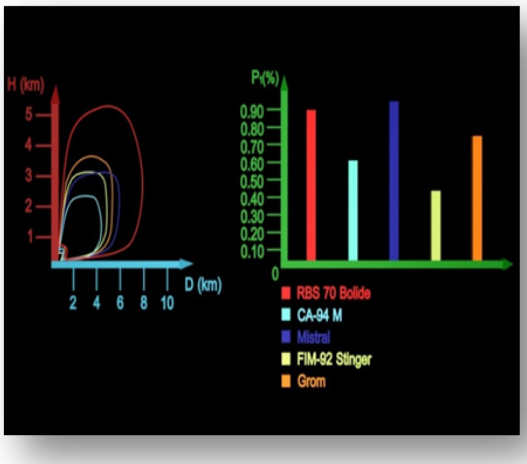

Fig. 7 Very Short Range Air Defense (VSHORAD)

Basically the competition is dominated by three systems: Stinger, Mistral and RBS-70

RBS-70 has the advantage of the newly designed laser guiding system, impossible to be jammed according to the producer (SAAB), but it requires well trained personnel . The NG version has the advantage of the automatic search and track system and the night operation mode. Another advantage of the RBS-70 system is represented by the modern warheads which is more efficient against aircrafts designed for CAS, such as SU-25 although due to its weight and sizes it requires a special launch pad.

Stinger has the advantage of portability, weighting less than RBS-70 and Mistral systems, but has the drawback of having a small warhead causing less damage

The infrared guiding system is user friendly unlike the RBS-70 but has the disadvantage of being very sensitive to electronic countermeasures.

Mistral has the advantages and disadvantages of the laser guiding system, similar to Stinger, but its sizes are similar to the ones of the RBS-70 system. Its unique advantages such as higher velocity, large warhead and high damage inflicted to the target gives this system an edge over its opponents. As well as the RBS-70 system, Mistral requires a special launch pad.

The modernization cost (mil euro) involving three types of integrated systems in the future four years is presented in the next graph

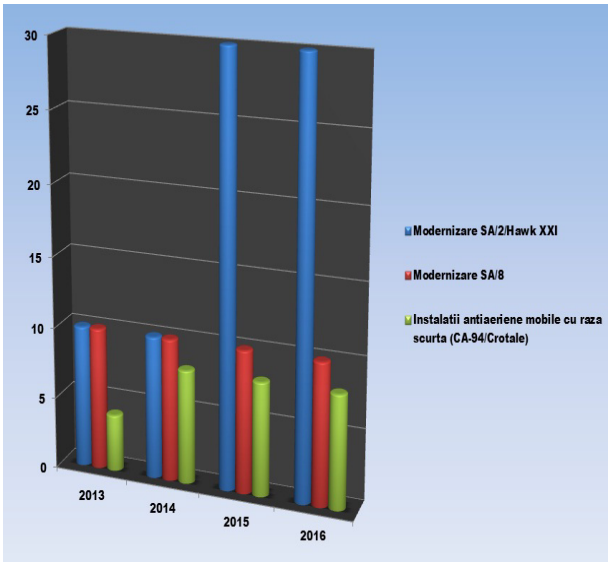

Fig. 8 Budget related to modernization systems

In figure 8 we offer an example of commands for equipments which will allow a four years respite for defense industry and it also allows Romanian Army to benefit to benefit from extra equipment, at lowest costs.

These commands, embedded in a multi-annual plan, would gradually increase the pace of production of defense industry, allowing young staff recruitment and specialization, depending on the availability of MApN budget, giving medium-term outlooks for the defense industry, alongside possible external commands and research for new equipment.

Table 1. Proposed Acquisition budget

Modernization cost / system / year	**2013**	**2014**	**2015**	**2016**
SA/2 /Hawk XXI	10 mil. euro	10 mil. euro	30 mil. euro	30 mil. euro
SA/ 8 SA-6	10 mil. euro	10 mil. euro	10 mil. euro	10 mil. euro
SHORAD (CA-94 / Crotale)	4 mil. euro	8 mil. euro	8 mil. euro	8 mil. euro

Such a production plan would avoid sudden volume increases, followed by periods of low production, (except for external orders) that would affect the stability of jobs and maintenance of skills.

To quantify the gain of such a strategy should be considered beside the industrialization and the growth of industries with very high added value also the fact that the production in our country can provide the lowest purchase price and low operating costs, the advantage being the high availability of equipment of the Romanian Army endowment, due to the independence for external factors, important things in case of conflict and also in case of peace.

4. CONCLUSIONS

Analyzing the defense integrated management we concluded that the main goal is represented by the defense resources which in turn have to be included into an integrated system which will allow their usage with maximum efficiency at the right moment for their foremost mission, in full interoperability with other similar systems belonging to the armies of the allied countries.

An Integrated Management System (IMS) brings together all the components of a mission in a coherent system in such a manner as to permit achieving the mission's goal. More, everything that has effect upon mission's goal should be integrated into a manage

In conclusion I have grouped into a summarizing table, according to the public sources, some of the technical and operational performances of the presented sy

If the medium range ary defense systems can fight with some efficiency in air operations, well organized by number, firepower and destruction probability, This equipment's cannot be replaced easily when their characteristics no longer keep pace with the progress of potential targets.

The cost of these systems can get between 50-150 million dollars.

Up-grading of such a system becomes an option both to preserve the operational performance and to save funds in the current financial crisis, instead of buying a new system.

Table 2. Technical and operational performances of systems

Systems/ performances	SA- 6	SA-7	SA- 8	SA-9
Missile	3M9M	A-94	9M33M3	A-95
Range (km.)	16	4,2	10,9	4,2
Missiles speed (mps)	950	500	550	500
Guidance	semiactiv guidance	pasive	radio comand guidance	pasive
Single shot probability	0,7	0,4 -0,7	0,3 - 0,7	0,4 -0,8
Technical resource (years)	20	5-10	10-15	5-10

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