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ON BOARD DIAGNOSIS IMPLICATIONS ON THE VIABILITY OF MILITARY PATROL AND INTERVENTION VEHICLES

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Abstract: *The constant uses of sensors, high performance actuators, as well as informatics have imposed an upward trend to the hardware and software electronics auto. In these situations the control and the management of the vehicles is very important, mainly for those which have a military purpose. The need of an on board computer diagnosis of military intervention vehicles is very useful and necessary, due, at first, to the accoutrement of any kind of vehicle equipped with a lot of electronics equipment. Secondly, the on board display of the operating parameters also offers the possibility to improve the vehicles operating in order to succeed in the combat missions.*

Keywords: *viability, reliability, diagnosis equipment, experimental determinations.*

1. VIABILITY/RELIABILITY

The viability is the reliability of the military technique assets to which a practical and tactical assembly of measures and preoccupations is added (the capacity of military technique assets and people to avoid the wastage, to avoid in time the enemy's gun strikes and their ability to fast recover their strike, fire, maneuvers and protection capacities) that guarantee the fulfillment of the intervention [1].

The reliability studies need to be done in order to:

a) freely operate the systems on which the vehicle depends to travel safety;
b) ensure a level of reliability suitable for relatively simple devices, but whose failure could attract major faults;
c) plan maintenance activities;
d) increase the efficiency of transport by reducing turnaround times.
e) spare inventory planning;

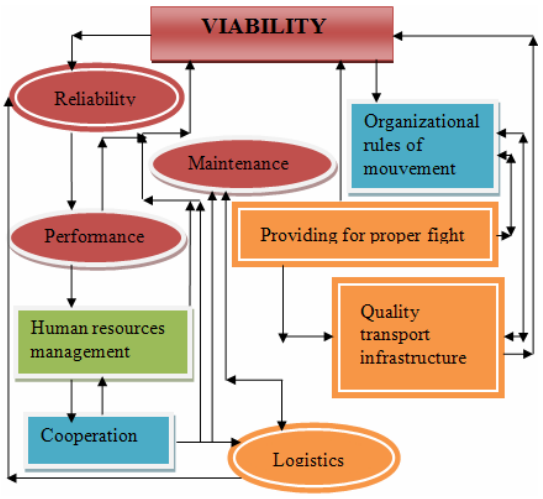

Fig.1 Interdependency of viability factors [1]

Analyzing the expenses incurred, the reliability of a device can be represented according to the schedule:

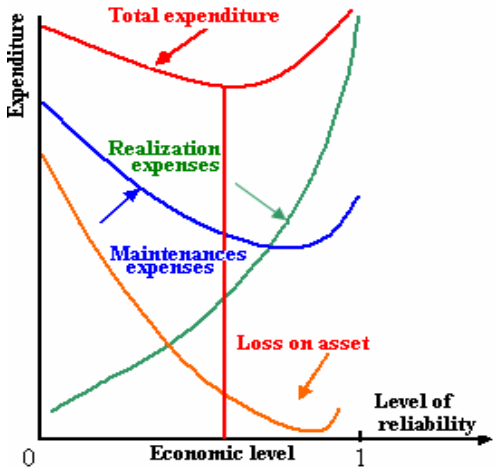

Fig. 2 Economic level of reliability[2]

Characteristic situations:

* the technical criteria prevail $\Rightarrow R \rightarrow 1$;

* the prevailing economic criteria $\Rightarrow R_{economic.}$

Take account of: the destination vehicle, the user possibilities.

The viability factors of military vehicles:

1. reliability;
2. vehicles performance;
3. efficiency of the maintainability and maintenance works;
4. rules providing the movement;
5. combat service;
6. combat service support;
7. the quality of transport infrastructure;
8. human resources management;
9. cooperation and collaboration for support.

From the qualitative point of view, *reliability* is the ability of a device found in given conditions of use, to perform specific functions for a certain period of time [2].

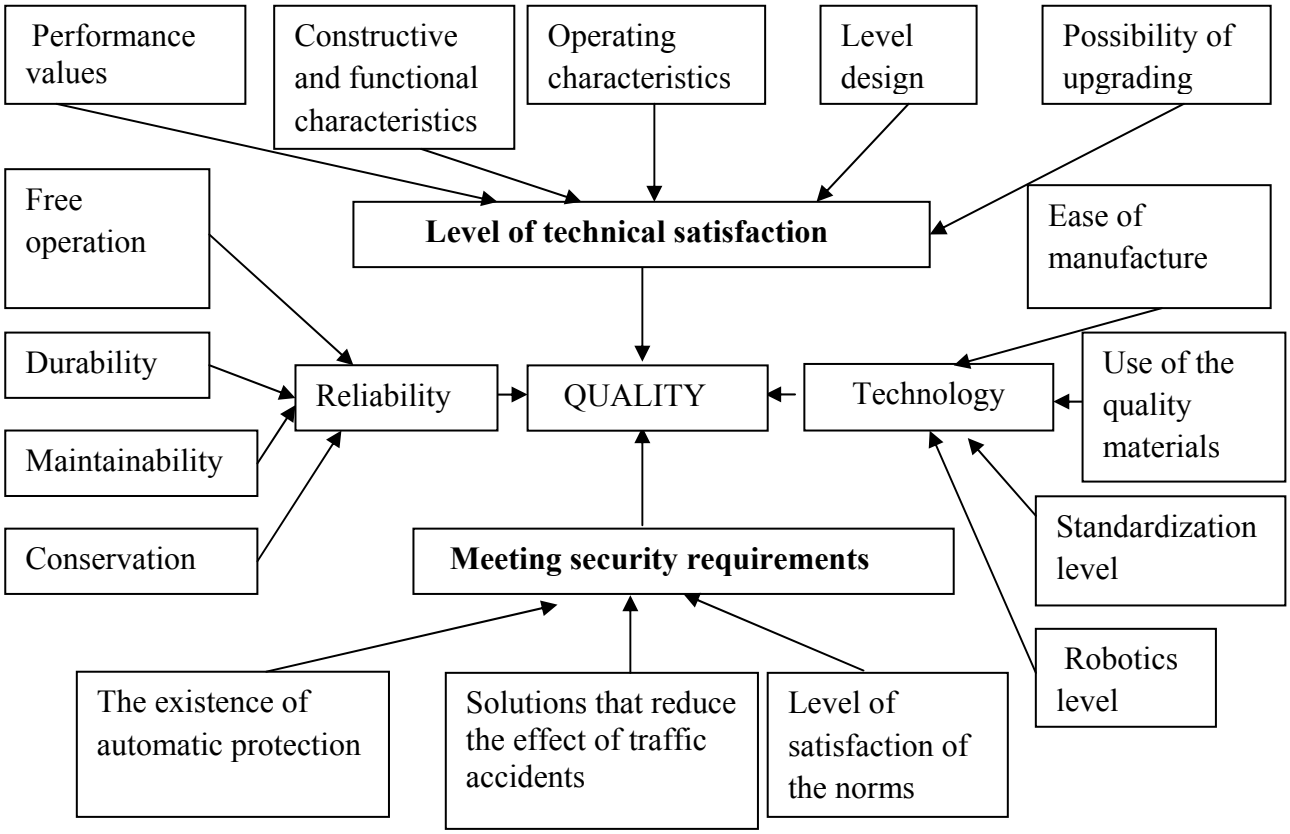

Fig. 3 Report of reliability, quality and technology[2]

The approach of reliability, maintenance motor performance as well as human resources management, is mostly similar in military and civil field.

The reliability and durability of engines, as well as the other assemblies, depend largely on the quality of maintenance work carried out for every season, as well as the quality of materials and supplies used for this purpose. Also, the time and the quality of intervention, how this takes place has a special role.

Maintenance represents all the organizational and technical activities done in order to maintain and re-establish the technical state of a product so that this product could fulfill all the functions it was created foră[3].

Depending on the technical condition and the time they are performed, maintenance can be:

- predictive;
- preventive;
- corrective;
- planned;
- based on diagnosis;
- based on state.

In the current conditions of military actions, when the reaction rate has an important role, and the possibilities of unannounced interventions taken to the extreme are also present, the use of viable vehicles that meet successfully the imposed requirements is impetuously needed.

The ability of technical systems of patrol and intervention cars to function optimally can decrease from a mission to another by the occurrence of abnormal functioning. They are found stored as codes in the vehicle management system.

Errors generated on computer boards about the engine system operation, broken security, as well as ABS or ESP, can be managed using electronic "On-Board" Diagnosis (OBD).

Diagnostic work currently occupies a very important position within the terotechnical system. Early detection of any malfunction during operation could reduce the consequences arising from their timely remedy as well as the subsequent intervention cost.

Pattern of asset maintenance system design vehicles may be shown as follows:

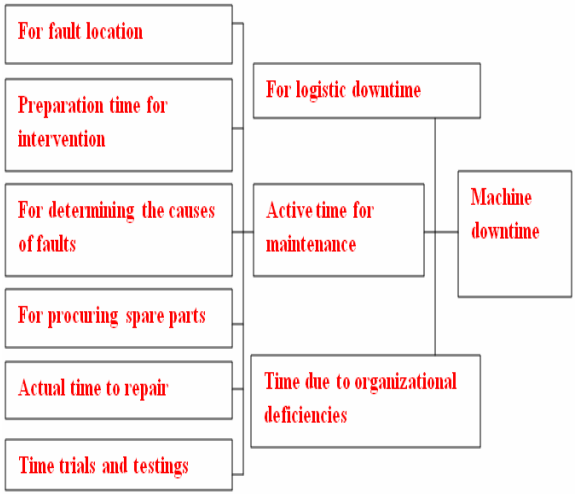

Fig. 4 Pattern of maintenance[3]

The diagnosis in vehicles can monitor in real time, but it can also identify in useful time the problems which occur to the entire management system of the vehicle.

The exploitation and the operation optimization are very important problems and need to maintain focus on the responsible factors because this is the key to maintain a high level for a good intervention and combat capacity.

2. DIAGNOSIS EQUIPMENT

The equipment for diagnosis are designed to optimize maintenance activity for

different electric, electronic, electromechanic or hydraulic systems existing in each vehicle component by reducing the time allocated to intervention on their operations.

An example of OBD system is shown in the following figure:

Fig. 5 ELM327 BLUETOOTH MICRO [6]

Very small size: 5 x 4.5 x 2.5 cm

Weight: 32 g

High baud rate: 38400 bps

Bluetooth 3.0

Reads:

- engine parameters;
- probes;
- flowmeters ;
- fuel intake : l/h and l/100km ;
- power calculation ;
- time calculation from /to 100km ;
- clear the error message.

It supports the following communication protocols:

ISO15765-4 (CAN)

ISO14230-4 (KWP2000)

ISO 9141-2

J1850 VPW

J1850 PWM

It can diagnose almost any type of car mode after 1996 which plug s type is OBD II.

It supports the functional operating systems:

- Windows XP, Vista, Windows 7;
- Mac;
- Symbian;
- ANDROID[6].

Because its operating system is ANDROID, this device is very practical and it can easily be used before every mission by all the drivers by simply using a cellphone soft named: "**Torque**".

Fig.6 Display of program [6]

A part of technical fault codes which can be read by this OBD system is presented on the point 2.1 and the understanding of them on the 2.2 point.

2.1 Technical fault code (DTC)

17965 – Overload control – positive deviation:
P1557 - 35-10 - - - intermittent;
01039 – Temperature transducer-G2-
30-10 – open or short circuit to plus – intermittent;
00930 – Closing overall - F222- block left
27-00 - implausible signal;
01312 - Bus date drivetrain
37-10 - Defect – intermittent;
00778 – Steering angle sensor -G85-
49-10 – No communication-intermittent;
00516 - Contact closed throttle idle-F60-
30-10 - Open or short circuit to B+ – intermittent;
01249 - Cylinder injector 1.-N30-
31-10 – Open circuit or short to ground – intermittent;
00532 – Power supply B+
- low signal – intermittent;
1316 - Control module ABS
49-10 –No communication
intermittent [5].

2.2 The understanding of fault codes

Positive deviation load: the signal comes from the air inlet circuit. It can be a problem at the pressure regulator or at the valve that makes the turbine not to work property;

Open circuit or short to plus (B+)- intermittent: sensor fault occur after cooling circuit located on the cylinder head;
Implausible Signal: error occurs when closing door system detects continuity in the electrical signal;
Bus date drivetrain: failure occurs due to lock of electrical signal on one of the relay that sends tension to the ECU;
Open or short circuit to ground – intermittent: the code is generated due to a short circuit to ground or to the control circuit of the given circuit;
Low signal– intermittent: in this case it is a low voltage on the positive < 11,5v;
No communication –intermittent: due to an inappropriate tension, the command mode of the system can not send date to ECU.

3. EXPERIMENTAL DETERMINATIONS

Monday, 25th , February, 2014,15:12:19:55062
Data version: 20100326
Addresses scanned: 01 02 03 08 15 16 17 19 35 36 37 46 47 55 56 57 58 75 76 77
Controlled composition: 1,9l R4 EDC G000AG 1464
Workshop: WSC 02410

Determinations were made on intervention and patrol vehicles type VW Transporter Syncro. The diagnose equipment used was: ELM 327 Blue Tooth, VCDS 12.12, and software Torque, Vital Scan, Vag-Com ROJ 12.12.

3.1. Functional parameters

Group 001: Quantity Injection
882 /min Engine Speed (G28)
8.2 mg/race Quantity Injection
7.1*KW Injection Duration Magnetic Valve
62.1*C Antifreeze - Temperature (G62)
Group 003: Gas Recirculation (EGR)
861 /min Engine Speed (G28)
285.0 mg/race Air Mass Absorbed (req.)
416.5mg/race Air Mass Absorbed (meas.)
4.8 % Activity EGR-Valve
Group 004: Aquator Valve for Pump/Duse
861 /min Engine Speed (G28)
-0.0 *DPMS Start Injection TEOR-Wert
7.7*KW Duration Injection TEOR-Wert
1.7*KW Sync - Angle
Group 005: Start Conditions (last start)
4641 /min Engine Speed (G28)
9.1 mg/race Quantity Start
48.0 Start - Sync
52.2*C Antifreeze - Temperature (G62)
Group 007: Sensor Temperature (engine warm)
69.3*C Energy - Temperature (G81)
0.0 % Fuel cooling status
49.5*C Manifold Admission-Temperature (G42)
62.1*C Antifreeze - Temperature (G62)
Group 010: Mass air
426.3 mg/race Absorbed - Mass air
999.6 mbar Atmospheric Pressure
994.5 Pressure Adm.
0.0 % Accelerator Position Pedal
Group 011: Turbo Pressure Control
882 /min Engine Speed (G28)
1091.4 mbar Turbo Pressure (pres.)
994.5 Turbo Pressure (meas.)
19.9 % Activity Solenoid Valve
Group 013: Idle Adjustment
0.71 mg/race Cylinder 1
-0.26 mg/race Cylinder 2
0.05 mg/race Cylinder 3
-0.54 mg/race Cylinder 4
Group 015: Fuel Consumption
882 /min Engine Speed
8.2 mg/race Quantity Injection (meas.)

1.00 l/h Fuel - Consumer

0.0 mg/race Injection Quantity (desire) [7].

3.2. Diagnostic interpretation

Group 003

It can be seen the fault of the air received by the engine. This is mainly due to the peacemaker valve which does not come back to the normal position after leaving the circuit in order to open the admission circuit.

Group 004

Injection occurs immediately after TDC and creates a mismatch between the angle of camshaft timing that normally has a value up to 1,5 KW. Situation occurs due to the change of distribution or some operation where the camshaft sprocket was at the beginning.

Group 011

The lock of adequate pressure on the blower at a small value creates a negative deviation and it is caused by some air leakage on the hoses path or connections, but it can also be generated by the malfunction of the turbocharger geometry.

Group 013

The injectors from the 1-st and/or 3-rd cylinder work on unsuitable parameters. The 1-st injector shows a light un-calibration distributing a larger amount of diesel fuel or it compensates the 3-rd injector that seems to be stifled.

Group 015

It can be noticed that although the vehicle is running at idle and the consumption is above normal. This is due to the function of the injection above normal parameters.

4. CONCLUSIONS

A simple On-Board Diagnosis**,** which usually takes between 7-10 minutes, may highlight certain aspects of operation of military vehicles patrol on response, manager issues that can make it hard or impossible to accomplish the mission given. The On-Board Diagnosis operation significantly reduces maintenance time spent from the military vehicles without being operational and it can improve their viability.

So, we can say that the possibility of a vehicle to execute the mission in the best conditions can be expressed best by viability factors and a lot of them are directly and significantly influenced by OBD systems.

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