

OPERATIONAL STRATEGY OF MILITARY MOTOR VEHICLES

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Abstract

The paper presents an outline of a new strategy to improve operational system of military motor vehicles. Technical diagnostics method is a tool for controlling the motor vehicles maintenance in the state of their functional and professional operability.

Three criteria have been assumed to control and maintain vehicles in the state of their technical operability, effectiveness and safety. It was found that the safety of military vehicles is controllable by board-external diagnostic systems as well as diagnostic systems as part of their operating systems. An algorithm is presented for diagnosing, maintaining, and assessing vehicles security in combat. It was found necessary to develop an improved technology for vehicles maintenance, including technological processes, organization of the processes implementation progress and their infrastructure. The organizational chart has been presented of the motor vehicles technological diagnostics and maintenance process.

The paper also includes the concept for assessment of the vehicles operational effectiveness based on criteria of the static and dynamic coefficient of technical readiness and costs.

Keywords: *motor vehicles, control, operation, diagnostics, maintenance*

1. Introduction

It is important to realize the nature and significance of motor vehicles operations in the army. Without understanding of the vehicles operations-related issues by direct and indirect decision-makers, there is no point discussing and expecting high technical readiness of armaments and military equipment (UiSW), including the combat readiness of troops.

At present, the operating effectiveness of Polish Army motor vehicles maintenance system is not high. This is due, inter alia, to the following facts [1, 2]:

- unsatisfactory quality, reliability, and age structure of vehicles,
- a considerable number of makes, types with a low total of vehicles,
- no time at Military Units to perform maintenance services,
- many outdated basic normative standards and manuals related to vehicles operations,
- obsolete and excessively worn out equipment of servicing and diagnostic stations,
- low standard of vehicles storage and maintenance,
- poor material and technical support of the vehicles servicing process.

The present vehicles operations system that is used today in Polish Armed Forces is incompatible with operational systems binding at NATO armies.

The objectives of motor vehicles operational system at Military Units can be defined as follows:

- 1) rational use of vehicles in compliance with their intended purpose,
- 2) maintenance of vehicles in states of their functional and task-oriented operability, enabling their correct operation with respect to execution of their combat missions that Military Unit

faces having the existing resources, limitations, and interferences in given conditions and time,

3) rational management of vehicle use.

The motor vehicles operational system will be considered in terms of control, that is, a deliberate impact on the system input, so that a completion of some predetermined tasks at its output can be achieved.

2. Military motor vehicles diagnosing, servicing, and security assessing algorithm

Three criteria have been assumed to control and maintain motor vehicles in state of their functional and task-oriented operability (Fig. 1, 2):

- technical condition,
- effectiveness,
- security.

The basis of operation in the vehicles servicing process is their diagnosing in line with the A1 algorithm. If the vehicle is operable, a date of its subsequent diagnosing is set for using the A2 algorithm. The required servicing operations are carried out (B1 algorithm) upon fixing the date of the subsequent diagnosing. Upon their completion and depending on the needs, the vehicle may get to the operational subsystem or the storage subsystem where it will go through a short-term or long-term maintenance undertaken by separate algorithms A8 and A9 and for servicing B8 and B9.

Before using the vehicle in the operational subsystem one should make an assessment of its operational effectiveness based on the C1 algorithm. If the assessment is positive, the operational process of the vehicle is carried out, namely: its diagnosing and servicing in compliance with A3, A4, B2 and B3 algorithms.

An important element in controlling the condition of vehicles is their diagnosing and servicing upon completion of their tasks and following the A5, B4 and B5 algorithms.

The procedures set forth in the algorithms: A6 and ÷ A12 and B6 ÷ B11 must be followed if a vehicle is inoperable.

Attention should be paid to the security assessment of military motor vehicles, the clue of which is illustrated in Fig. 2.

3. Algorithm for diagnosing, servicing, and assessing motor vehicles security in combat

The operating conditions of the military motor vehicles shrink drastically at the battlefield, therefore, their usage criteria also change. The criteria are as follows [2]:

- technical condition,
- security.
- The technical condition criterion does not change and is used similarly to the algorithm illustrated in Fig 1. The security criterion is a new element in the diagnosing and servicing process (Fig. 2 and 3). Threats to the security of vehicles may be generated by:
 - damages,
 - crew status,
 - impact of the enemy,
 - improper organization of the operational system functioning.

The security of military motor vehicles is controllable by deck-external diagnostic systems and diagnostic systems as elements of their operational system.

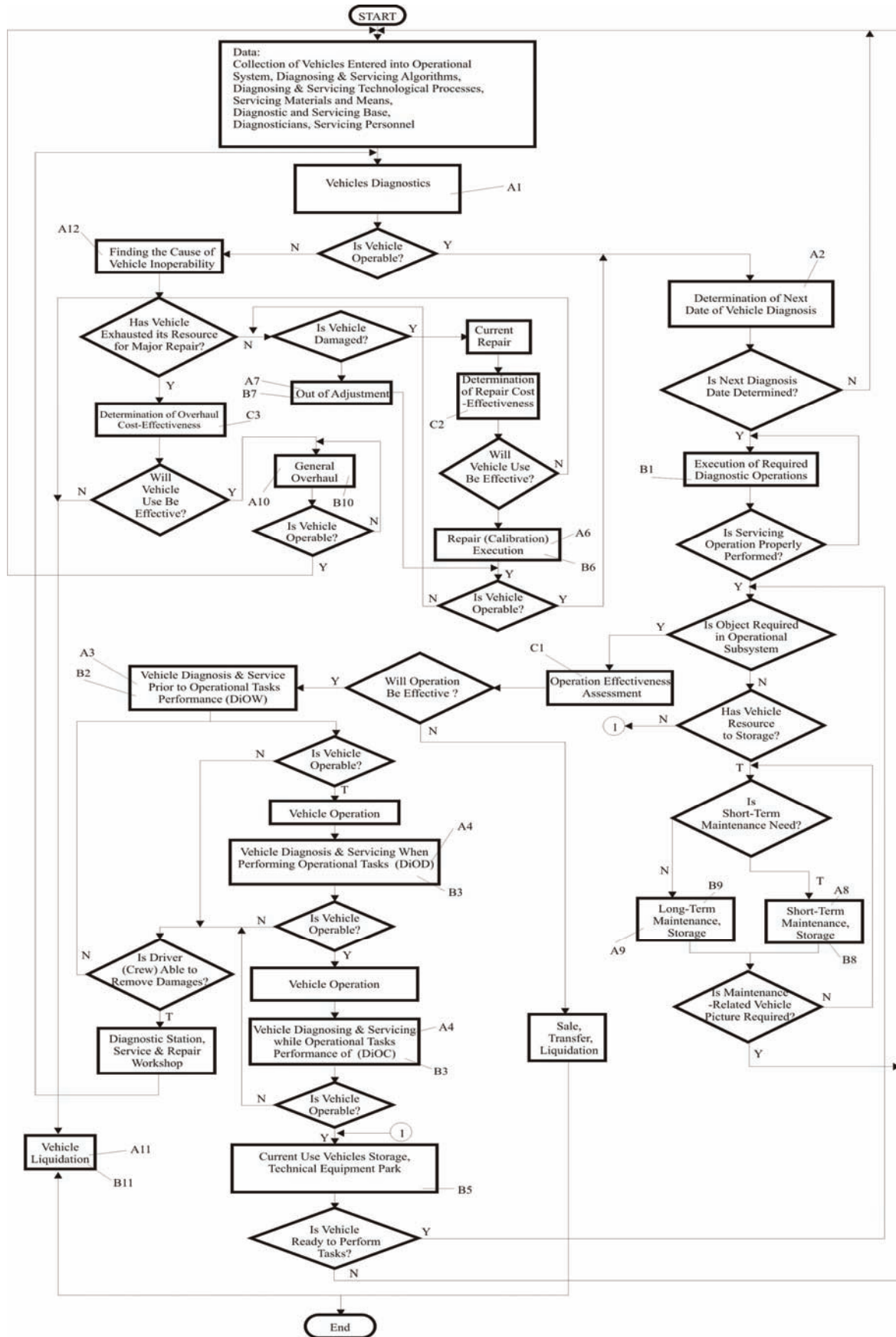


Fig. 1. The algorithm of control and maintenance of motor vehicles in state of their functional and task-oriented operability, including the criterion of technical condition and effectiveness: A – algorithm of tests and assessment of states; B- servicing algorithm; C – effectiveness assessment algorithm

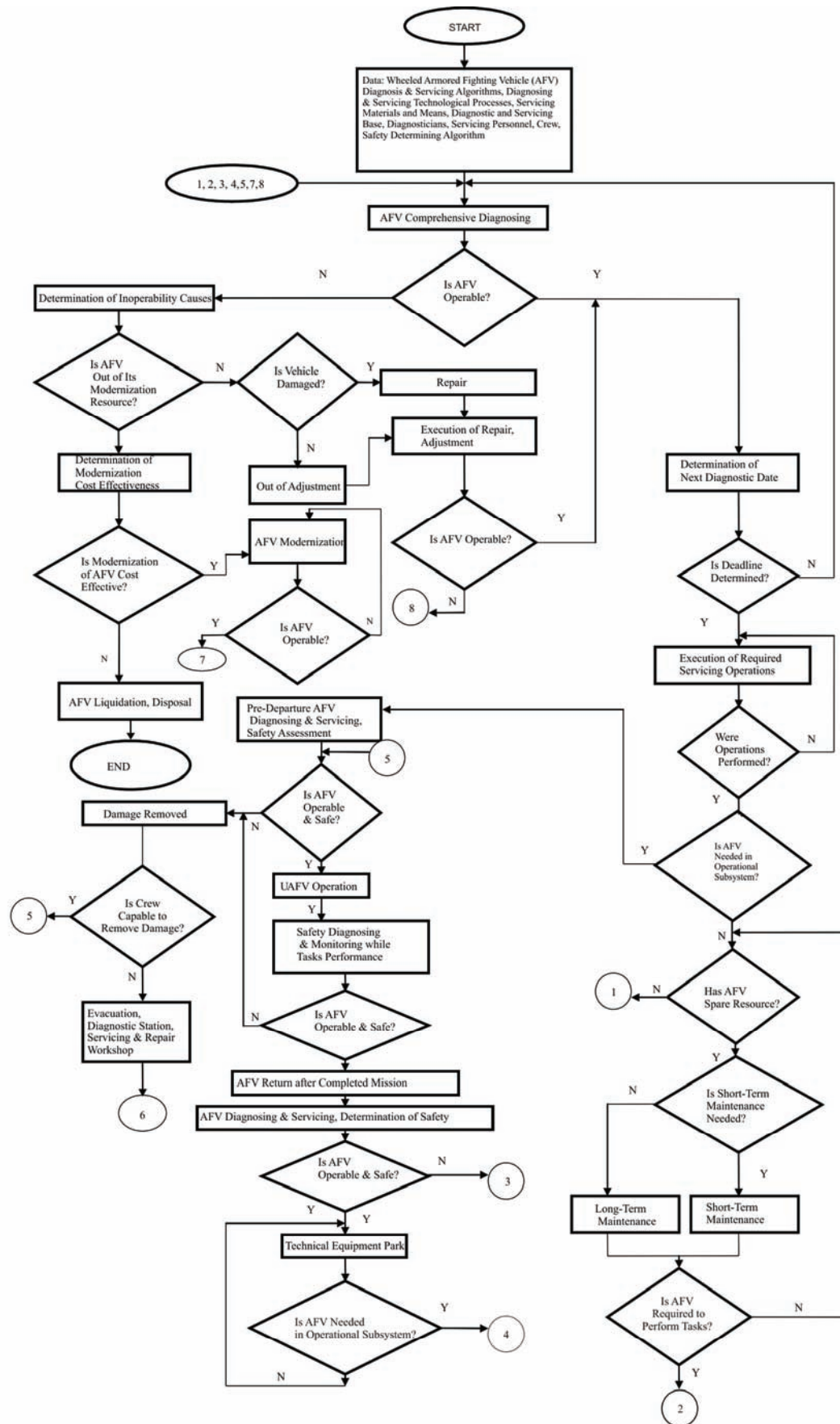


Fig. 2. Graphic illustration of the vehicle security control system, using the diagnostic subsystem based on AFV example

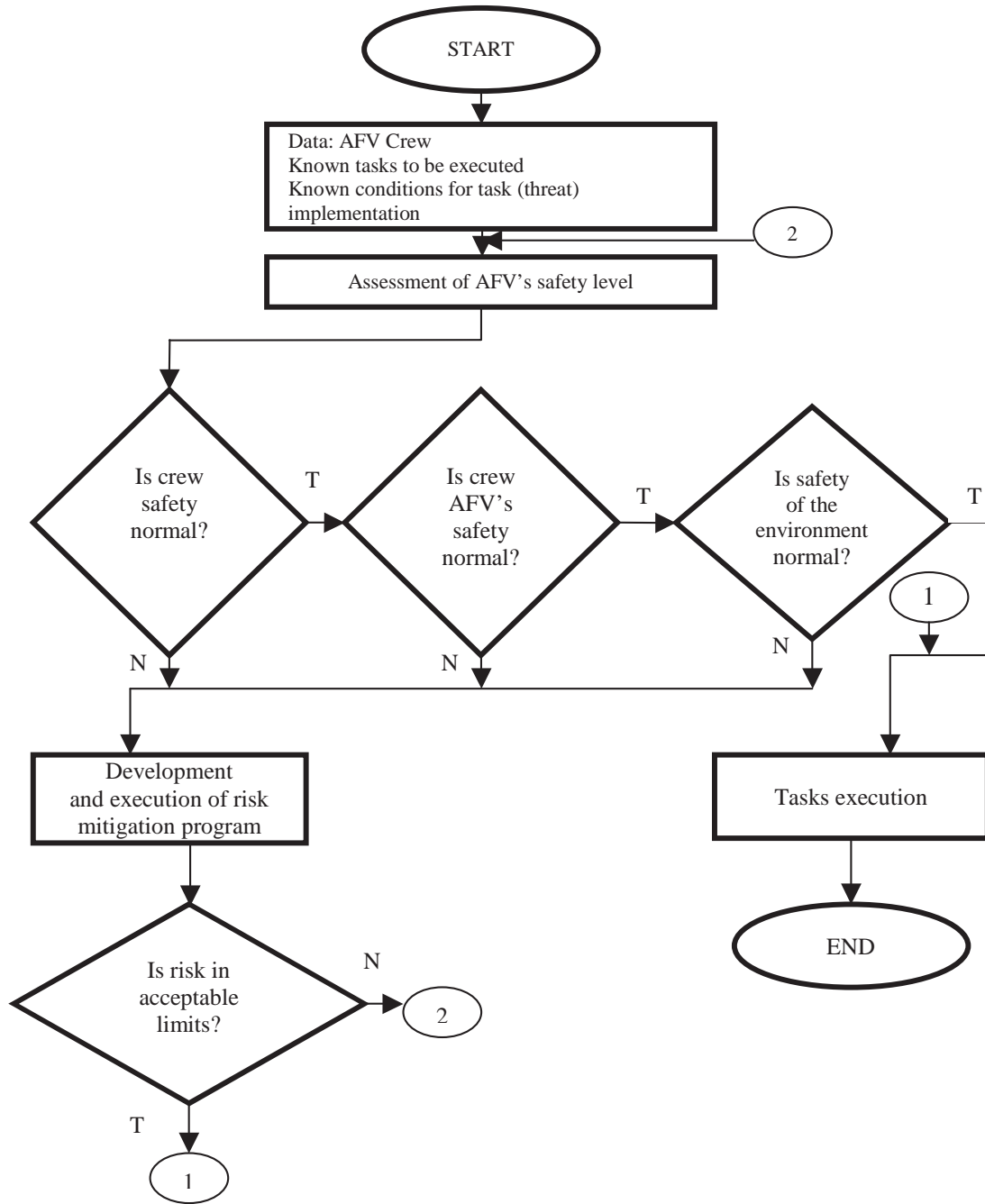


Fig. 3. Diagram of simplified algorithm for assessment of the security system: vehicle-crew-environment before their tasks execution based on the AFV example

4. Motor vehicles servicing technology

Proper operation of the military motor vehicles servicing subsystem requires a good technology for their maintenance, including [3]:

- technological processes,
- organization of the course of the technological process implementation,
- infrastructure,
- team of staff.

Fig. 4 illustrates the simplified algorithm for testing and assessment of states as well as the security as the basis for the functioning of the improved operational system of military motor vehicles, while the Figure 5 presents their technological process organizational chart.

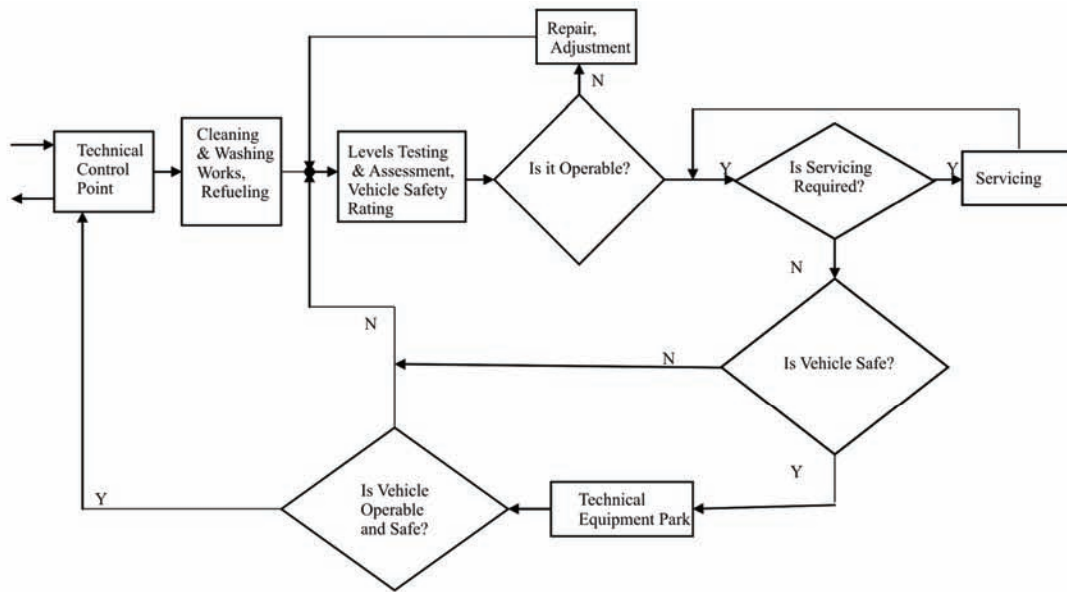


Fig. 4. Graphic illustration of the simplified algorithm for testing and assessment of states as well as the security as the basis for the functioning of the improved operational system of military motor vehicles

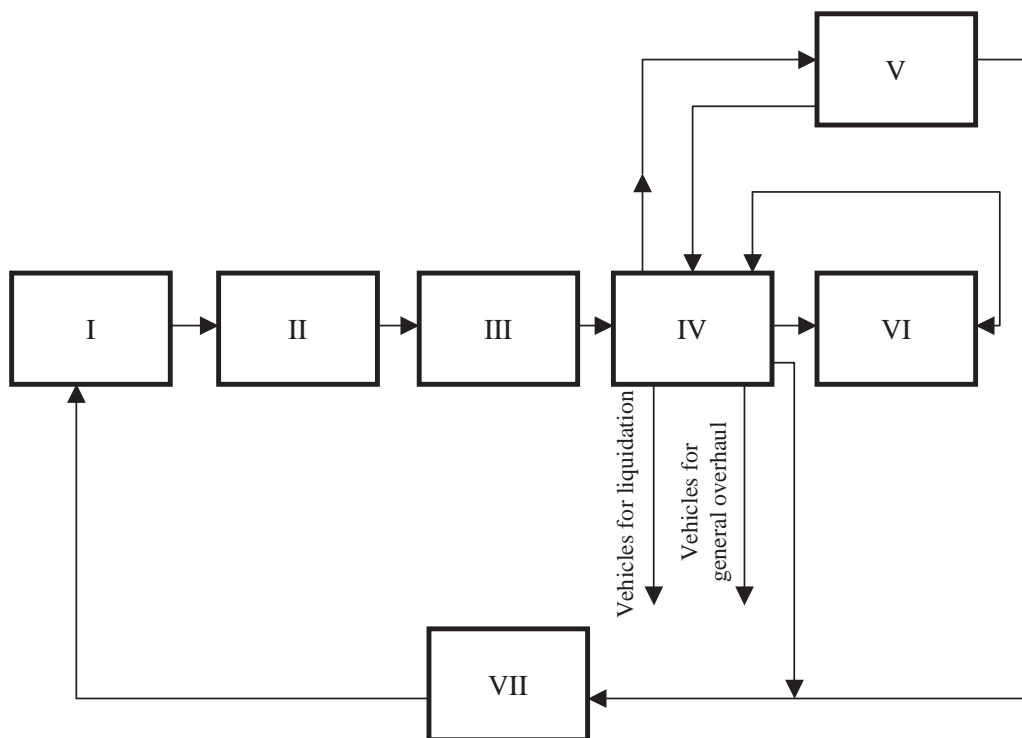


Fig. 5. Organizational chart of the military motor vehicles diagnosing and servicing technological process. Zones respectively: I - PKT; II – washing and cleaning; III – driving and lubricating materials extra supplies; IV – diagnosing and security assessment; V - servicings; VI - repairs; VII – technical equipment park

5. Assessment of vehicles operational system functioning effectiveness

Assessment of the Military Unit vehicles operational system functioning effectiveness includes the following issues [3]:

- 1) execution of combat mission by Military Unit. It should be assumed that if the Military Unit defeated the enemy, then its logistical subsystem was operating properly,

- 2) positive evaluation of the servicing subsystem performance is obtained under the partial and complex controls conducted according to the established criteria and procedures,
- 3) high value of the Military Unit combat readiness coefficient as defined by the formula:

$$\eta_{GB} = \frac{T_{rz}}{T_{dop}} > 0.9, \quad (1)$$

where:

T_{rz} - the actual time achieved when performing tasks as defined by a given state of combat readiness (e.g. capture of the emergency areas by the Military Unit),

T_{dop} - time allowed for execution of tasks determined by the state of combat readiness, as defined in the plans to achieve increased states of the Military Unit combat readiness.

There are two main operational strategies of the Military Unit Commander:

$$\begin{aligned} \eta_{GB} &\rightarrow \max \eta_{GB}, \\ \text{Military Unit operating costs} &\rightarrow C_{CW} \text{ fixed}, \end{aligned} \quad (2)$$

or

$$\begin{aligned} \eta_{GB} &\rightarrow \text{fixed at not less than } 0.9 \\ C_{CW} &\rightarrow \min, \end{aligned} \quad (3)$$

- 4) high value of the vehicles technical readiness coefficient, defined as follows:

$$K_{qs} = \frac{N_z}{N_{rz}}. \quad (4)$$

$$K_{qd}(t) = \frac{N_z^I}{N_{rz}} > 0.9, \quad (5)$$

where:

K_{qs} - static coefficient of the vehicles technical readiness coefficient in place of permanent dislocation of the Military Unit,

$K_{qd}(t)$ - a dynamic coefficient of the technical readiness of vehicles in combat,

N_z, N_z^I - number of operable vehicles in the garrison and in combat,

N_{rz} - the actual number of motor vehicles.

It should be noted that the Military Unit Commander's main task is its maintenance in defined states of combat readiness, which are conditioned by the vehicles operability, and thus their operating costs. The high values of K_{qs} and $K_{qd}(t)$ coefficients require to bear certain expenses that are denominated in the operational costs C_{ER} of objects. Therefore, the Commander's operational strategies are as follows:

- 1)

$$\begin{aligned} K_{qs} &\rightarrow \max K_{qs}, \\ K_{qd}(t) &\rightarrow \max K_{qd}(t), \\ C_{ER} &\rightarrow \text{fixed}. \end{aligned} \quad (6)$$

This means that at fixed costs one should act so as to obtain the maximum values of the technical readiness coefficient.

- 2)

$$\begin{aligned} C_{ER} &\rightarrow \min C_{ER}, \\ K_{qs} &\rightarrow \text{determined}, \\ K_{qd}(t) &\rightarrow \text{determined}, \end{aligned} \quad (7)$$

that is, the fixed high value of the equipment technical readiness coefficients should be maintained, using the minimum effort and resources.

6. Summary and conclusions

It is high time to take care of the underinvested operational system of military motor vehicles, as the basis for maintaining high reliability, security and technical readiness of the equipment, and thus the combat readiness of troops. The action plan should include the following stages:

- to identify and assess the condition of motor vehicles,
- to prepare a concept of the vehicles improved operational system,
- to develop a design of the vehicles improved operational system,
- to implement the vehicles improved operational system,
- to assess the functioning readiness of the vehicles improved operational system.

An outline of the concept to improve the operational system includes the following key issues:

- 1) a compulsory identification of the condition of the motor vehicles operational system in the armed forces;
- 2) presentation of the substance of the vehicles operational system, in their control aspect;
- 3) differentiation of subsystems within the servicing system:
 - current and periodic servicing,
 - repairs (overhauls),
 - storage,
 - identification and evacuation,
 - diagnostic;
- 4) central positioning of the diagnostic system in the vehicles operating system, with differentiation of the following subsystems:
 - identification of states that are directly related to vehicles,
 - to control the states of vehicles as the element of the servicing subsystem;
- 5) vehicles diagnosing and servicing algorithms:
 - in time of peace they are based on the criteria: technical condition, effectiveness and security,
 - in time of war they are based on the criteria: technical condition and security;
- 6) concepts of vehicles diagnosing and servicing technology;
- 7) the operational system infrastructure;
- 8) organization and command (directing, managing) of the vehicles operations by means of IT management systems, in the telematic networks system.

References

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