Functional Requirements for Decision Support System of Ground Forces Recognition on Battlefield According to NATO Standards

Volodymyr Korolov[1], Olha Korolova[1], Ivan-Pavlo Milkovych [2], Yaroslav Zaiets[1], Viacheslav Zhyvchuk[1], Halyna Batyshcheva[1], Vasyl Lytvyn[2], and Myroslava Bublyk[2]

[1] *Hetman Petro Sahaidachnyi National Army Academy, 32 Heroes of Maidan street, Lviv, 79026, Ukraine*
[2] *Lviv Polytechnic National University, 12 Bandera street, Lviv, 79013, Ukraine*

Abstract

The problem of recognizing combat units of the ground forces is interdisciplinary. Today, this combines both the need to take into account the physical properties of the devices used for combat identification, and the rapidly growing amount of information generated for its implementation. The urgency of the research is due to the long-term aggravation of the military-political situation on the territory of Ukraine. One of the solutions to this problem is the formation of a military coalition, which is relevant to the development of a system to support effective decision-making for the rapid identification of coalition troops on the battlefield according to NATO standards. In addition to increasing combat effectiveness in the management of coalition forces, the key task was to minimize the occurrence of combat units under "friendly fire" on the battlefield according to NATO standards. The proposed functional requirements for the decision support system (DSS) provide prompt access to information and include in accordance with NATO standards: 1) the appointment of DSS; 2) regulatory documents of DSS; 3) terminology, symbols and abbreviations used in DSS; 4) methods and requirements for identification; 5) forms of security surveys; 6) standard methods, devices and identification procedures; 7) information database on samples of equipment, weapons, uniforms of coalition troops. The proposed open structure of the system allows you to exclude old tasks and introduce new ones, update and expand its information arrays. Functional requirements for DSS hardware and software are also proposed.

Keywords 1

Information system, battlefield, NATO-standard, Decision Support System

1. Introduction

In modern conditions of limited time and lack of situational awareness during hostilities, the possibility of falling under the fire of their firearms, called "Friendly Fire", increases, according to the authors [1-7] due to the unpredictability of the situation, rapid raids, opening fire from long distances on "closed targets". According to military experts [1-3, 5-7], one of the main reasons for this is the "error of identification", when the fire is deliberate and aimed at their people, who were mistaken for the enemy. During the war, such mistakes were caused by a lack of reliable information or erroneous orders from headquarters. It is most typical of mobile combat operations conducted by coalition forces. Here, commanders simply do not have enough time to make a decision due to the rapid change in the combat situation, a large number of fire contacts, and so on.

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EMAIL: kvn_lviv@ukr.net (V. Korolov); ok_im2@ukr.net (O. Korolova); ivan_m_2021@ukr.net (I.-P. Milkovych); yarkorso@gmail.com (Y. Zaiets); sz-nc@ukr.net (V. Zhyvchuk); lektorin@i.ua (H. Batyshcheva); vasyl.v.lytvyn@lpnu.ua (V. Lytvyn); my.bublyk@gmail.com (M. Bublyk)
ORCID: 0000-0001-8421-584X (V. Korolov); 0000-0002-9265-8445 (O. Korolova); 0000-0002-6816-9094 (I.-P. Milkovych); 0000-0002-2697- 3658 (Y. Zaiets); 0000-0001-6980-9914 (V. Zhyvchuk); 0000-0001-5299-4068 (H. Batyshcheva); 0000-0002-9676-0180 (V. Lytvyn); 0000-0003-2403-0784 (M. Bublyk)

Mutual identification of ground forces on the battlefield is achieved through the use of many devices and control systems and the use of some organizational measures, namely:

- Devices and control systems for the configuration of troops and weapons, the dynamics of their actions, time parameters, electromagnetic radiation, etc.
- sequence of organizational measures for the management of combat units on the battlefield, the use of automatic and manual systems "question-answer", training of military personnel.

According to military experts [1-3, 5-7], reducing the level of losses from "Fiendly fire" can be achieved by comprehensive actions aimed at developing automated decision support systems to identify units of the tactical unit of both coalition forces and enemy forces during fighting. This will be a powerful help to unit commanders and will save the lives of the military.

The relevance of research is due to the rapid growth of information collected, analyzed and processed by devices for combat identification, and technical differences in the physical characteristics of these devices in the armed forces of different countries that are members of the military coalition. This highlights the development of an effective decision support system for the rapid identification of coalition forces on the battlefield according to NATO standards. In addition to increasing combat effectiveness in the management of coalition forces, the key task was to minimize the occurrence of combat units under "friendly fire" on the battlefield according to NATO standards.

Recent military conflicts in eastern Ukraine, especially during Operation Allied Forces (OAF), have exacerbated unresolved issues in modern combat. Characteristic features of modern combat are the opening of fire from long distances on "closed targets", rapid raids, time constraints on decision-making by commanders, the uncertainty of the battle situation, lack of situational awareness of where the enemy finds and where the ally. Due to objective and subjective factors, there is a high probability of falling under the fire of their firearms.

There are two key reasons why armed units fall under the "Friendly Fire" [1-3, 5-7]: "identification error" and "position error". Identification error, according to [1-3, 5-7], is defined as fire that is purposefully conducted for their own purposes, which were credited to enemy targets by mistake. There are many reasons for this error, among which the most common are command errors in the headquarters, false and late information, and so on. This is due to the high speed of modern combat, high mobility of firing points, lack of sufficient time for the commander to make a decision. Position error, according to [1-3, 5-7], is due to reduced quality of weapons, ammunition and errors during aiming.

In accordance with the fundamental provisions of the doctrine of avoidance "Friendly fire", which are set out in [1-3, 5-7, 16-20, 26-34], it is advisable in high-intensity fire to invariably control the movement of their forces through the work of monitoring points for their forces, to position the enemy in real time, to divide into one's own and another's by means of surveillance and aiming complexes or other additional special means, invariably to hit enemy targets immediately after confirmation of their identification. Despite such a simple list of actions in the face of rapid combat, they are difficult to follow due to the constant movement of troops at high speeds, often in unknown terrain and in low visibility. The short duration of battles, considerable distances to targets and their high mobility also have a significant impact. This is further complicated by technical restrictions on the range of weapons in combat, the skill of commanders to navigate in combat for a limited time. All these shortcomings cannot be eliminated only by the presence of high-precision, innovative equipment or innovative labeling technologies and a set of applicators. Adequate accuracy in recognizing military forces on the battlefield or in the area of operations is achieved only by a clear interaction and correlation between combat intelligence, the use of technical means, coordinated actions in the process of controlling the combat situation, and, most importantly, high training of commanders to navigate low visibility, high terrain complexity, increasing distances to targets, etc. Invariably important is the skill of commanders to navigate the terrain unmistakably, to manage the fighting of their military units and to effectively identify enemy units.

Thus, this necessitates the development of a conceptual framework for a decision support system for the recognition of ground forces on the battlefield in accordance with NATO standards and the definition of their functional requirements. It should be borne in mind that the existing "self-alien" recognition complex is now known as the "hardware and software complex of automated distinction of their troops from enemy troops." This highlights the purpose of this study in the direction of building the structure of DSS and determining the sequence of its work in accordance with NATO's international standards for the identification of ground forces in modern combat.

2. NATO-standard battlefield decision support system tasks

Classical DSS in well-known scientific sources [8-9, 40, 41] is defined as a computerized system that through the collection and analysis of large amounts of information has an impact on the management decision-making process. Automated decision support systems (ADSS) are automated information systems designed to collect, store, search and issue reference information to consumers in the required form. It was an electronic file for computer search of the necessary information. For storage and processing of reference information, specialized databases are used computer reference systems.

It is reference systems that solve all the tasks of providing consumers with regulatory information. Help systems have several unique advantages and capabilities. First of all, it is providing an opportunity:

- Compactly store large amounts of information;
- Structure and display stored information;
- Quick search of the necessary documents or even their fragments in huge data sets.

Decision support system, which implements the principle of open technology, allows you to actively system develop, fill it with new documents, and store and view photos and various computer files. This approach allows to save the texts of documents and add new records and images.

It is known that currently, special attention is paid to the issues of reliable and efficient management. The best option is one in which this process is implemented in real-time, which can be provided only with integrated automation of management of special purpose information systems (SPIS), i.e., the necessary elements of such management at all levels combined into a single system.

The relevance of this material is due to the need to reduce the complexity of the processes of using information resources and increase the efficiency of users to perform standard actions to identify troops on the battlefield using computer technology, in particular, decision support system (DSS). One of the most important ways to achieve reliable and efficient management of complex systems is their partial automation, which must be used in storage, retrieval and processing of information and when working with relevant organizational resources (human, technical, financial, etc.). Disseminate information. Automation of some components of such systems through computer technology can reduce the complexity of using information resources and increase users' efficiency to perform standard actions with them. The paper considers one of the components of unique purpose information systems - the decision support system for recognizing ground forces on the battlefield according to NATO standards.

This DSS should provide prompt access to the necessary information, namely:

1. Purpose of DSS;
2. Normative documents on DSS;
3. Terms and definitions used in the DSS;
4. Symbols and abbreviations used in the DSS;
5. Requirements for identification and its methods;
6. Forms of security surveys;
7. Standard methods, devices and identification procedures;
8. Information database on samples of equipment, weapons, uniforms, etc., for different countries.

3. The work of the commander to ensure timely and reliable identification

According to international standards and the experience of military specialists [10-36], the key factor in combat is the strict identification of ground forces. It is achieved by building a reliable relationship between the participants in the battle with the help of standardized means and methods of control over the location of their own and coalition armed forces. For completeness, we present the information declared in the guidelines and scientific publications on this issue [16 - 20, 26-35, 37]. Having conducted a thorough analysis of known scientific research and publications [1, 3, 5, 7-9, 27], we structure the stages of the DSS development process as follows:

1. Automated and manual query and response systems. [28, 30, 33, 34]
2. Staff training [1, 3, 5, 7-9, 13, 24, 27, 35, 36].
3. Combat space management system [38-41].
4. Electronic systems [2, 4, 6, 7-9, 23, 38-41].

5. Sign and signal identification system [1-3, 5-9, 25, 35-41].
6. A set of prohibitions and restrictions on the use of appropriate signals [16 - 20, 26-35, 38-39].
7. A set of norms and procedures for the recognition of identification [7, 16 - 20, 26-35].
8. Standardized requirements for the actions of the commander, aimed at timely and reliable identification [7, 16 - 20, 26-35, 38-41]

Methodology of the department commander is the following. To ensure that identification issues are taken into account during the order formation, such a sub-item should be included in a separate section, for example, entitled "Instructions for the Coordination of Combat Identification Measures".

It is the responsibility of unit commanders to establish the form of inquiries and responses and the set of identification tools and devices that will be used for both operations and training. Commanders are responsible for implementing the directives of the high command during joint operations. Decisions on the configuration of identification means, verbal and non-verbal requests are made at the highest operation-command level and are communicated in advance to lower formations and units. Neighbours and senior subordinates should also be informed of established inquiries and protocol responses.

4. The structure of the decision support system

To determine the DSS structure, and taking into account the tasks it must perform, it is necessary to specify the following:

1. DSS is a hardware-software product that contains communication equipment, conjugation, computer complex with appropriate databases (command, headquarters, subordinates, attached units, neighbours, etc.), equipment for visualization of tactical information on a background topographic map, reference information, etc.), governing bodies.

2. Equipment, particularly built-in computers, must be operated in harsh (low or high temperatures, shaking, shock, humidity, dust, etc.) operation.

It is desirable to consider the possibility of developing DSS options for carrying and transportation. In fig. 1 presents a block diagram of the hardware component of the DSS, which contains the following blocks: computer complex means of displaying information, coupling device, equipment for receiving and transmitting data, control panel. The block diagram of the functional software of the DSS is presented in Fig. 2 (a) and 2 (b). The first column presents the tasks to ensure prompt access to the relevant information clusters.

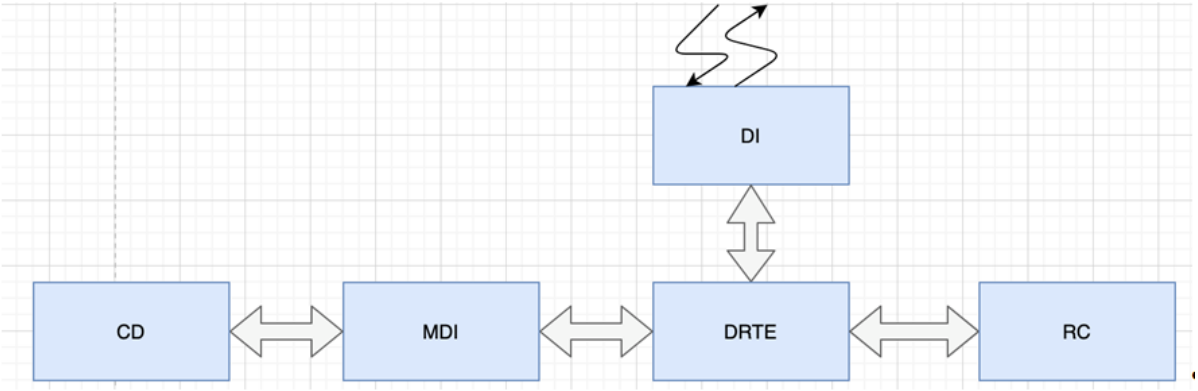

Figure 1: Block diagram of the hardware component of the DSS

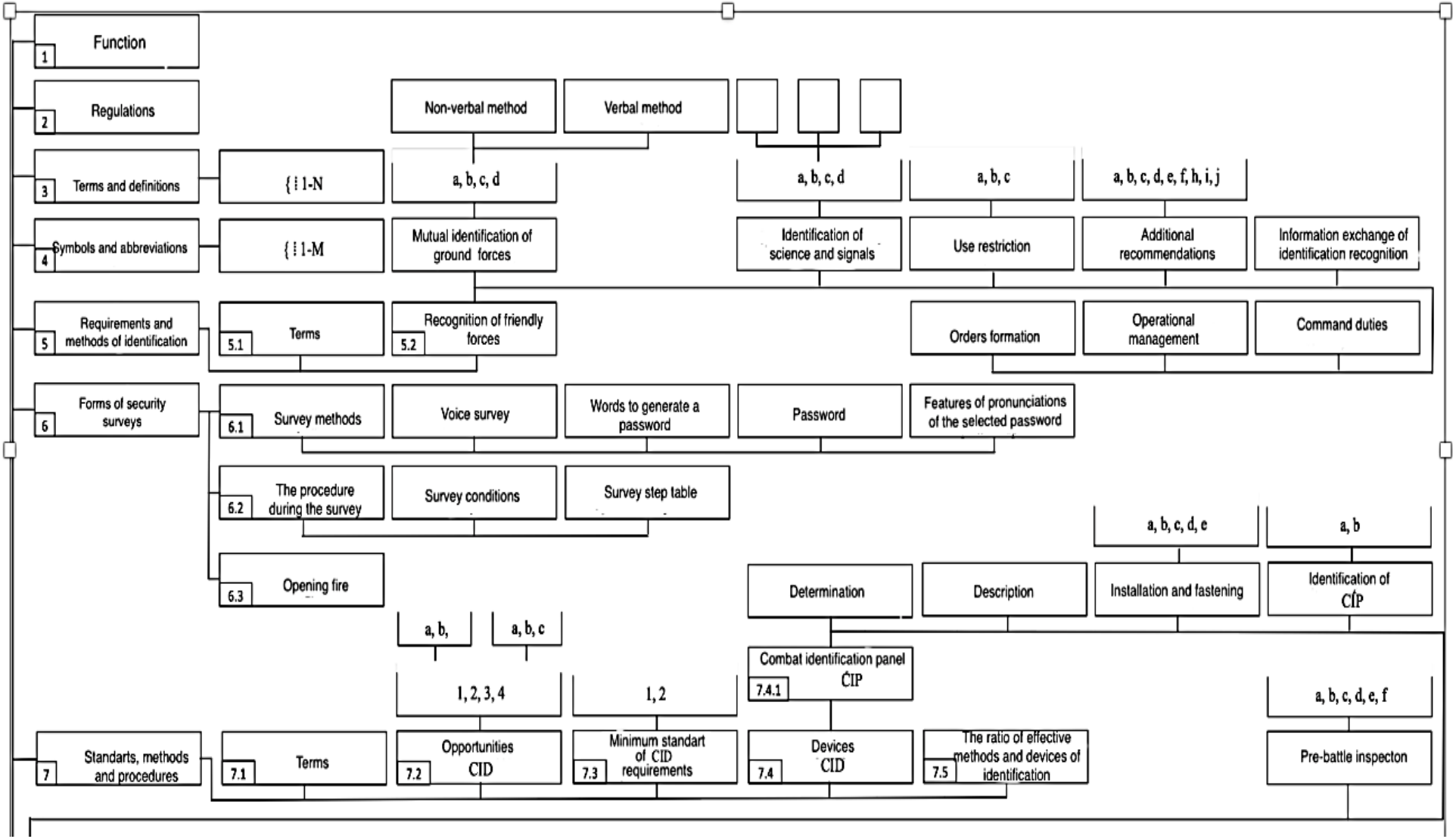

Figure 2 (a): Block diagram of the functional software of the decision support system for the recognition of ground forces on the battlefield according to NATO standards

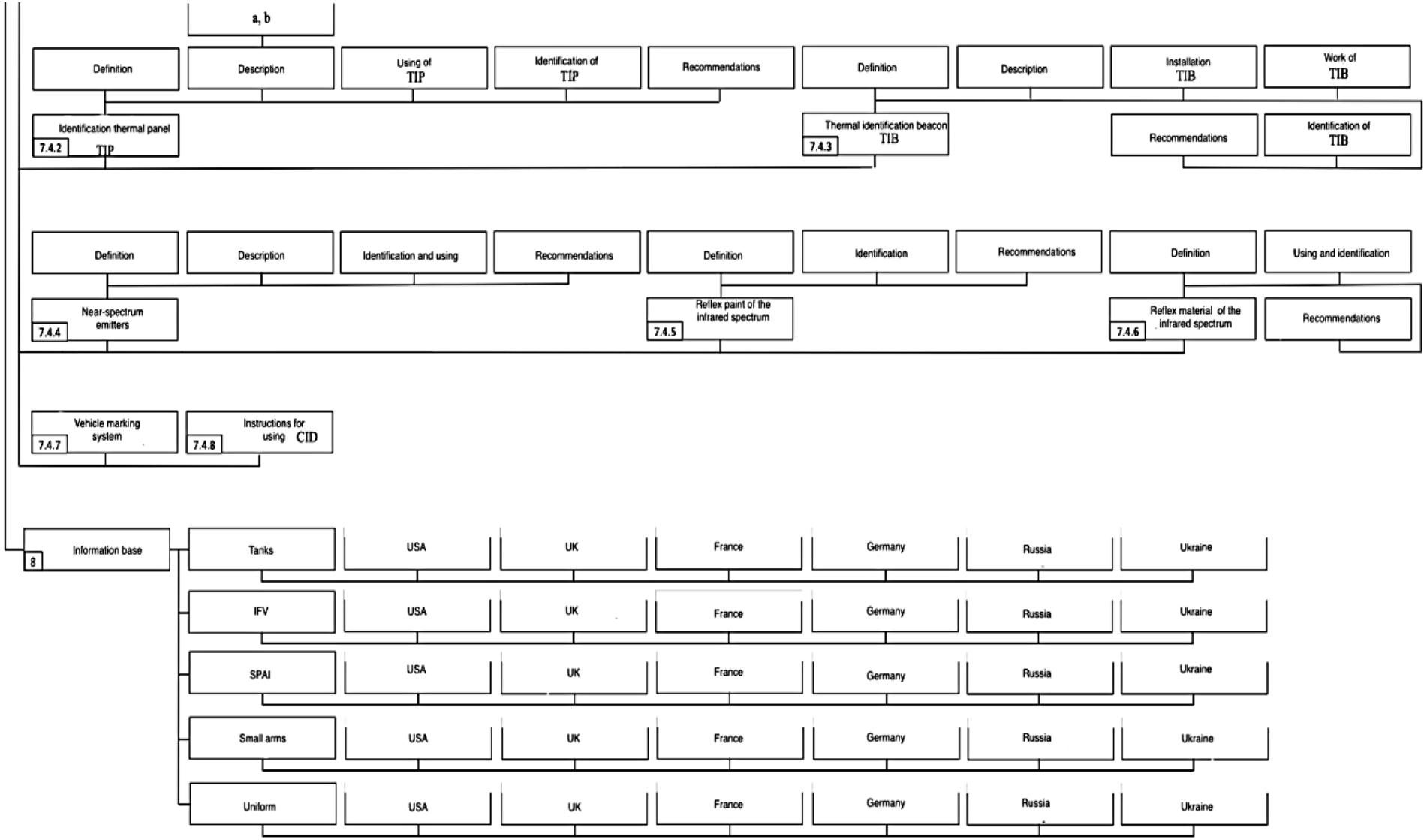

Figure 2 (b): Block diagram of the functional software of the decision support system for the recognition of ground forces on the battlefield according to NATO standards

In each chain, when selecting a specific information cluster, access to the relevant blocks of information is provided, which is regulated by the requirements of paragraph 3. The procedure is described in more detail in the next paragraph.

5. Experiments, results and discussion

This work is based on the principle of "nested menus". Let's consider the order of its work on the example of searching for information on the information cluster "Ground/air panels of combat identification" - one of the typical tasks.

The system starts working when the Main Menu appears in the dialogue box.

1. Purpose
2. Regulatory documents
3. Terms and definitions
4. Symbols and abbreviations
5. Requirements and methods of identification
6. Forms of security surveys
7. Standards, methods and procedures
8. Information base

Figure 3: The main menu in the dialogue box

The user selects the desired information block by "clicking" the left mouse button on the appropriate line. In our examples, this will be the 5th line. The "Requirements and identification methods" menu appears in the dialogue box.

Requirements and methods of identification
1. General provisions
2. Recognition of "friendly forces."

Figure 4: Menu "Requirements and methods of identification" in the dialogue box Example figure

When you select an option from the 2nd line in the dialogue box, the menu "Recognition of friendly forces" appears.

Recognition of "friendly forces."
1. Mutual identification
2. Identification of signs and signals
3. Restrictions on use
4. Additional recommendations
5. Exchange of information on identification and recognition
6. Responsibilities of the command
7. Formation of orders
8. Operational management

Figure 5: Friendly Forces Recognition menu in the dialogue box

When you select an option from line 2, the "Sign and Signal Identification" menu appears in the dialogue box.

When selecting an option from line 9, information about "Ground/Air Combat Identification Panels" appears in the dialogue box.

Ground/air combat identification panels (CIP) is a medium and long-range IR radiation device. According to [1-3, 5-7] CIP is a solid surface, which acts as a thermal mirror, reflecting the contrasting cold temperature of the atmosphere. Installation and fastening of CIP depends from color, visibility, reflection angle, strength, uniformity of characteristics and ways of fastening. The most effective fastening system is a metal frame that allows you to turn the CIP upside down or mask. The masked or inverted panel goes into idle mode. Metal frames are attached with brackets, hooks and hinges. Identification of CIP has a range limit, training in the use of CIP. Upon arrival at the theatre of

operations and before the operation, training (training) should be conducted to confirm the effectiveness of the CIP.

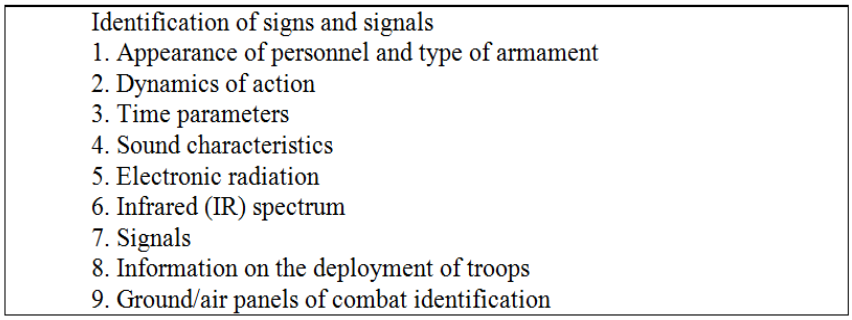

Figure 6: Menu "Identification of signs and signals" in the dialogue box

Training should also include identifying possible CIP placement options on platforms that help the shooter query the target. Recognition training in "white-hot" and "black hot" modes should be conducted before the action starts. Thermal hazard profile libraries can also be developed and used during training.

Recommendations for the use of the combat identification panel (CIP) have a general instructions, cases of reduced efficiency CIP, safety measures and misleading. The adversary can use CIPs to mislead, as they can be imitated, purposefully or involuntarily. In any case, the identification is carried out on the basis of thermal or visual recognition of the object using all recognition procedures and means.

Purposeful imitation. In intentional fabrication, the enemy deliberately copies the panels to disrupt the effectiveness of their use. Countermeasures are to put the panels of their troops out of order.

Unintentional imitation. In involuntary imitation, the characteristics of the object form a picture of a "cold area" similar to the CIP image. This effect can be observed on some vehicles in the presence of windshields, toolboxes, luggage racks, tracks, etc. The means of counteraction is the necessary training to detect the thermal signature of the target. Particular attention is paid to the use of image signals of the whole object, not just CIP.

1. Pre-battle review. Verification of the established CIP should be carried out during the pre-battle inspection and preventive maintenance. Checking the status of the CIP includes the following basic steps:

- checking the correct location (installation) of all CIP;
- check for damage or unreliable fastening;
- replacement or repair of all loose, damaged or lost CIP;
- cleaning from dust, dirt, sand, snow and other elements that may interfere with the CIP. For cleaning, use a soft cloth that is not contaminated with oil, grease, fuel, etc.;
- check of reliability of fixing of a thermal tape, in case of its application;
- check the visualization of each CIP in the thermal imager.

The information displayed on the monitor is scrolled in Page Up / Down mode. The search for other necessary information clusters is similar. The structure of IDS allows entering new tasks at all levels of hierarchy to supplement and modify its information bases.

6. Conclusions

The urgency of the research is due to the long-term aggravation of the military-political situation on the territory of Ukraine. One of the solutions to this problem is the formation of a military coalition, which is relevant to the development of a system to support effective decision-making for the rapid identification of coalition troops on the battlefield according to NATO standards. In addition to increasing combat effectiveness in the management of coalition forces, the key task was to minimize the occurrence of combat units under "friendly fire" on the battlefield according to NATO standards. The proposed functional requirements for the decision support system (DSS) provide prompt access to

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