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IMPROVING THE METHOD FOR ASSESSING THE CAPABILITIES OF SCIENTIFIC UNITS IN THE ARMED FORCES OF UKRAINE

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The capability assessment process plays a key role in ensuring the effectiveness and readiness of the armed forces to meet national defense objectives. The conditions for the development of the Armed Forces (AF) of Ukraine currently require improvement of the defense planning system, which would allow for effective adaptation to changes in the geopolitical environment. This will improve the efficiency and readiness of the armed forces for modern challenges. As a result, there is a need to objectively compare the level of capabilities acquired by scientific units with the capabilities established in the Unified list (Catalog) of capabilities of the Ministry of Defense of Ukraine, the Armed Forces of Ukraine, and other components of the defense forces. The object of the study is the process of assessing the capabilities of scientific divisions of scientific institutions. The task that was solved is the objectivity of assessment and development of the capabilities of scientific units. Since the capabilities of scientific units are multi-criteria, it is advisable to combine their requirements into functional modules. For each carrier of capabilities, a set of modules is determined by functional directions in accordance with the assigned tasks. The method of assessing the capabilities of scientific units of the Armed Forces of Ukraine has been improved, quantitative assessments of deficiencies in the capabilities of scientific units and recommendations for their elimination have been obtained in accordance with the DOTMLPFI (Doctrine, Organization, Training, Material, Leadership, Personal, Facilities, and Interoperability) methodology. Based on the results of the evaluation, 30 recommendations were formed when defining 10 scenarios. The scope of application of the method is the implementation of scientific and scientific-technical activities, capacity building of scientific divisions of the Armed Forces of Ukraine. The method is the basis for the creation of an automated capability assessment system – an element of the automated system of military management bodies

Keywords: defense planning, capability assessment, scientific units, armed forces, activity diagram

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1. Introduction

According to the Strategic Defense Bulletin of Ukraine [1], the purpose of the defense reform in Ukraine is to acquire and maintain the necessary level of combat readiness and ability to perform state defense tasks by the defense forces, increase the level of operational interoperability of the Armed Forces of Ukraine and the armed forces of NATO countries (hereinafter North Atlantic Treaty Organization – NATO). One of the ways to achieve the defined goal is the implementation of an effective policy of planning and resource management in the defense sector using Euro-Atlantic capabilities-based defense planning approaches. Assessing the capabilities of the Armed Forces of Ukraine is an integral part of capability-based defense planning and the requirement for Ukraine to join NATO. Capability is the primary indicator of a military unit's ability to perform its assigned tasks.

The presence of valid state documents makes it possible to partially assess the capabilities of weapons and military equipment (WME), in contrast to the assessment of the capabilities of the scientific units of the Armed Forces of Ukraine in Scientific and Scientific-Technical Activities (SSTA). The assessment of the capabilities of the SSTA, due to its specific structure, causes difficulties and needs to be developed and systematized in the general structure of the assessment of the capabilities of the scientific units of the Armed Forces of Ukraine with SSTA.

The urgency of improving the method of assessing the capabilities of the scientific units of the Armed Forces (hereinafter the Armed Forces) of Ukraine is as follows:

– assessment of SSTA capabilities is a specific type of activity, unlike WME;

– the possibility of capacity planning in conjunction with NATO member countries to achieve interoperability;

– ensuring the development of SSTA planning based on the capabilities of scientific potentials.

2. Literature review and problem statement

Defense planning is used to implement the effective construction of optimal organizational structures, personnel policy, and the development of appropriate procedures [2]. Most modern states have one or another form of organization of external, collective defense. These procedures and processes shape the future character of the state's defense forces and are a reflection of the success of defense planning [3]. In NATO, defense planning is a fundamental element of agreements that allow its member countries to enjoy the most important advantages of collective defense [4]. It is implemented in accordance with the procedure for assessing the capabilities of units. Assessment of the capabilities of combat units has permanent procedures defined by the guiding documents adopted by NATO member countries.

Assessment of the capabilities of military units is a strategic tool that helps ensure optimal readiness and effectiveness of the armed forces under modern conditions. Such procedures have not been established for scientific units (units that perform creative work). This is due to a number of objective reasons – a significant number of units work on outsourcing and grant support, and a subjective reason – the difficulty in assessing the ability to perform creative tasks. The Armed Forces of Ukraine have developed a number of documents for assessing the capabilities of units [5–7]. Organizational and methodical principles for the review of capabilities and force planning within the framework of the defense review are defined in [5]. Recommendations [6] regulate the procedure for using uniform terminology, principles and tasks, the procedure for applying defined procedures, monitoring, and development of capabilities in the process of gradual transition to the appropriate methodology of defense planning based on capabilities. Assessment of capabilities in the Armed Forces of Ukraine differs from assessment of capabilities in NATO member states. This is also due to a number of objective and subjective reasons. Objective reasons – the inability to ensure the interoperability of capabilities due to resource limitations, subjective reasons – the superiority of traditional approaches to the assessment of personnel, weapons and military equipment, reserves, over new approaches that expand the set of assessment indicators. The unified list of capabilities of the Ministry of Defense [7] defines the list of capabilities according to which the sequence of actions is carried out during the organization of the process and the implementation of defense planning procedures in the defense forces.

Paper [8] examines two common aspects of defense planning. The historical connection between defense planning and the state is determined, the peculiarities of defense planning are formed as a separate case of general planning.

Paper [9] analyzes the characteristics and consequences of defense planning in the political, administrative, and strategic context. The impact of defense planning on changes in the strategic position of the country is determined. The basics of defense planning and assessment methods are provided, but there is no assessment method for the scientific units of the armed forces.

In study [10], problematic issues of the concept of military potential are considered for assessing the capabilities of units. The analysis of models for assessing the capabilities of the armed forces of different countries was carried out, it was proved that they should be flexible and more integrated, and the process of strategic defense planning should be properly adapted to the conditions of the development of the armed forces. Additional patterns have been proposed to improve capability assessment models, such as: doctrine and concepts, organization, training, logistics and modularity, leadership and education, personnel, facilities, information and knowledge, adaptability, and interoperability, interagency and policy.

Paper [11] developed a planning method based on scenarios and a performance measurement model. The method is used for a period of four years. The model is intended for planning the activities of combat units and has been tested on units of the Norwegian Armed Forces. The results of the experiment show that the model is significantly dependent on the input data.

Work [12] addresses the consideration of the DOTMLPFI approach to the evaluation of units of the US Army. The indicators that should be adapted under the influence of external factors are determined; the capacity assessment system is analyzed.

In paper [13], an analysis of the process of evaluating the productivity and efficiency of the combat units of the Norwegian Armed Forces was carried out on the basis of Data Envelopment Analysis (DEA).

The methodology developed in works [11–13] corresponds to combat units for which a typical catalog of tasks is defined. At the same time, scientific activity is a weakly formalized (creative) activity, for which assessment of abilities is a difficult (unsolved) task.

Paper [14] presents the methodology for assessing the knowledge management capacity to determine the levels of the organization's capacity in various fields of knowledge. The results of the empirical research carried out in the work show that the method makes it possible to correctly assess the capabilities of the areas of knowledge for which it was developed to measure. However, the possibility of evaluating the capabilities of an organization that contains various components, for example, combat capability, creative activity, which is required by the process of evaluating the capabilities of scientific units, is not specified

Paper [15] developed a procedure for improving the system of decision-making in defense planning based on capabilities. The basis of the approach is the formation of criteria and evaluation of alternative options by building an ontology using directed graphs. The method of expert assessment is used, which affects the objectivity of the procedure.

A number of works prove the need for the development and creation of automated systems in the defense sector. In particular, paper [16] built a model of the test system, as a scientific activity, with priority applications, which can be implemented in an automated information system for supporting WME tests. As a test management module, a model has been developed that will help increase the productivity of the organization's test system.

Paper [17] developed a mechanism for the automated formation of a list of test units based on the analysis of text documents that accompany the test sample at the preparatory stage of tests.

However, those papers do not consider the methodology of capacity assessment but are aimed only at personnel selection procedures.

Having analyzed papers [15, 16], it is possible to propose an automated assessment of SSTA capabilities at the level of military administration bodies that organize and plan SSTA, which will allow solving the following issues:

– analysis of the development of SSTA based on the assessment of existing capabilities;

– assessment of capacity inadequacies in SSTA;

– assessment and comparison with already existing assessments of SSTA capabilities;

– the concept of assessing the capabilities of scientific units to perform creative tasks in the SSTA system;

– use of evaluation results by the military management bodies of the Armed Forces of Ukraine to determine the priority of financing the latest developments.

Automation of the process of assessing the capabilities of the scientific unit will reduce time, reduce the possibility of calculation errors caused by the human factor, and increase the objectivity of the results.

Summarizing the literature review, we can conclude that this topic is addressed in detail for typical tasks, while:

– the main processes and elements in the direction of capabilities within the framework of the SSTA are not sufficiently studied;

– there are unresolved issues regarding the methodical approach to assessing the capabilities of scientific units of the Armed Forces of Ukraine;

– the specifics of creative work when performing the tasks of SSTA within the capabilities assessment procedure require taking into account these features when creating a methodical approach to automated assessment;

– the methodology for assessing the capabilities of the scientific units of the Armed Forces of Ukraine is still imperfect and needs to be optimized in terms of specifying the indicators for evaluating the capabilities of the scientific units of the Armed Forces of Ukraine.

Thus, the assessment of the capabilities of military units should be considered as a systematic process aimed at determining the effectiveness and readiness of the troops. In addition, the scientific units of the Armed Forces of Ukraine play a key role in the development and implementation of the latest technologies, maintaining a high level of scientific and scientific-technical expertise, as well as in ensuring effective interaction between military formations. But the issue related to the assessment of the capabilities of scientific units remained unresolved. The reason for this is the poorly formalized task since the creative component is an element of the ability of the scientific unit. Separately, it is worth paying attention to the interchangeability of indicator values, which leads to a false assessment result. An option to overcome the relevant difficulties may be the introduction into the practice of the Armed Forces of Ukraine of modular evaluation of the functioning of scientific units using the principles of multi-criteria optimization.

3. The aim and objectives of the study

The purpose of our study is to improve the method of assessing the capabilities of the scientific units of the Armed Forces of Ukraine based on a modular approach, which will make it possible to increase the objectivity of the assessment and to formulate recommendations for the development and increase of capabilities.

To achieve the goal, the following tasks were set:

– to conduct an analysis of the task performance process by the scientific units of the Armed Forces of Ukraine;

– to build a capability assessment model based on the DOTMLPFI methodology;

– to construct a diagram of the activity of assessing the capacity of the scientific unit of the Armed Forces of Ukraine;

– to conduct an experiment to assess the capabilities of a research department.

4. The study materials and methods

The object of research is the process of assessing the capabilities of scientific units at scientific institutions.

The main hypothesis of the research assumes that the evaluation of the capabilities of the scientific units of the Armed Forces of Ukraine differs from the qualitative evaluation according to the DOTMLPFI methodology and should ensure a qualitative evaluation of the capabilities, avoiding the compensation of weak indicators with the high value of others.

Assumptions and simplifications: the number of the scientific unit is known, its tasks in accordance with the regulations, personnel tasks in accordance with functional duties, scenarios for the execution of tasks by the unit. The time horizon over which the results are spread is five years.

The experiment was conducted at the laboratory of the State Research Institute for Testing and Certification of Weapons and Military Equipment using standard Microsoft Office software. MS Excel was used to analyze statistical data and derive the results of a scientific experiment. Visualization of the method and construction of the UML diagram – the activity diagram of the assessment of the capacity of the scientific unit of the Armed Forces of Ukraine was carried out in the MS Visio environment.

Implementation of the method does not require special hardware and software and can be implemented by a standard MS Office package under MS Windows.

The main theoretical methods used in the paper:

a) DOTMLPFI capabilities assessment methodology for evaluating each element of the scientific unit's capabilities and formulating recommendations for eliminating identified deficiencies;

b) methods of expert assessment to determine the requirements for the modules, taking into account the functionality of the unit and criteria, the required indicators, or the optimal range for them;

c) methods of designing information systems for modeling an automated system for assessing the capabilities of a scientific unit.

Existing approaches to the assessment of capabilities are regulated by the doctrine on assessment and methodical recommendations on assessment (certification) and a number of additional orders and resolutions that are of a recommendatory nature. Accordingly, the assessment is understood as a comparison of the capabilities (operational, combat, special) approved by the «Unified list of capabilities of the Ministry of Defense of Ukraine, the Armed Forces of Ukraine, and other components of the defense forces» (Catalog), for the performance of tasks under each possible scenario of the development of crisis situations and the available capabilities of the forces and means [3–6].

5. The results of research on the development of a method for assessing the capabilities of the scientific units of the Armed Forces of Ukraine

5. 1. Analysis of the task performance process by scientific units of the Armed Forces of Ukraine

The purpose of the functioning of the field of scientific research and development is achieved by the fulfillment of a set of tasks, for the solution of which there are scientific units, institutions, and bodies for managing scientific activity. There is a need to define such tasks that would be realistic to perform under the influence of external and internal factors, and on the other hand, guarantee the necessary level of scientific support. Since the provision of SSTA is a multi-component system with a multitude of criteria and indicators, a problem arises in objectively comparing the level of capabilities acquired by scientific units with the required ones. The practice of countries that have introduced defense planning based on capabilities shows that the standardization of modular construction of units and assessment of capabilities according to the elements of the DOTMLPFI system ensures high readiness of units. A high-quality, justified, and standardized assessment of capabilities will make it possible to identify risks, minimize the subjective interpretation of requirements for capabilities and bring closer the functional, organizational and resource compatibility of the scientific units of the Armed Forces of Ukraine and the countries of the North Atlantic Alliance. The above predetermines the need to devise a methodology for assessing the capabilities of scientific units of the Armed Forces of Ukraine close to NATO standards.

In the system of the Ministry of Defense (MoD) of Ukraine and the Armed Forces of Ukraine, in particular, the carrier of capability is both a separate unit (module, division, equipment unit, system, etc.) and a collection of forces and means. Each unit has its own expected effect on the result of the task under the given conditions and in the set time. In accordance with the Recommendations on defense planning based on capabilities (hereinafter DPBC) [5, 6], the Ministry of Defense of Ukraine and the Armed Forces of Ukraine created a description of capabilities in the form of a Catalog. The requirements for capabilities are formed in accordance with the functions that rely on the carrier of the capability.

According to the NATO Science and Technology Organization (STO), one of the strategic goals of the NATO scientific service is to increase the level of interoperability of its components and greater cooperation between partners. The interoperability of divisions and cooperation is achieved due to multinationalism and standardization [2, 3].

Since capabilities are multi-criteria, it is advisable to combine requirements for them in functional modules.

Modular structure of the carrier. The modular approach is aimed at increasing the efficiency and adaptability of scientific support, due to the unification and exchange of standardized modules of capabilities. Modules can be changed, combined, and replaced according to needs.

For each carrier of capabilities, a set of modules is determined by functional directions in accordance with the assigned tasks.

The DOTMLPFI capability publications of NATO and the Science and Technology Council, as well as the STO Tier 2 and 3 communities for the effective operation of science support, include the development of modular capabilities.

Therefore, in accordance with NATO standards and documents [4, 18], the following are distinguished: basic, reinforcement modules, and additional modules of scientific divisions, as given in Table 1.

As a result of the expert assessment, the working groups determine the requirements for the modules, taking into account the functionality of the unit and the criteria, the necessary indicators, or their optimal range.

Table 1

NATO science unit modules according to the STO structure

<table>
<tr><td colspan="4">Modules</td></tr>
<tr><td colspan="4">Core Modules Type 1 (Science and Technology Council).</td></tr>
<tr><td>Subdivision in direction No. 1. 1 (Representatives of NATO member countries)</td><td>Subdivision in direction No. 1. 2 (MC Military Committee)</td><td>Subdivision in direction No. 1. 3 (Conference of National Armaments Directors «CNAD»)</td><td>Subdivision in direction No. 1. 4 (NATO's Strategic Command Transformation (ACT))</td></tr>
<tr><td>Subdivision in direction No. 1. 5 (Council for Consultation, Command and Control «NWC»)</td><td>Subdivision in direction No. 1. 6 (PPC Policy and Partnership Committee)</td><td>Subdivision in direction No. 1. 7 (Emerging Security Challenges Department (ESC) of NATO International Headquarters (IS))</td><td></td></tr>
<tr><td colspan="4">Command, Control, Communications</td></tr>
<tr><td colspan="4">Type 2 Amplification Modules (Level 2 Scientific Community)</td></tr>
<tr><td>Subdivision in direction No. 2. 1 (Applied Vehicle Technology Panel (AVT) – Vehicle Application Technology Panel)</td><td>Subdivision in direction No. 2. 2 (Human Factors and Medicine Panel (HFM))</td><td>Subdivision in direction No. 2. 3 (Information Systems Technology Panel (IST))</td><td>Subdivision in direction No. 2. 4 (Systems Analysis and Studies Panel (SAS))</td></tr>
<tr><td>Subdivision in direction No. 2. 5 (Systems Concept and Integration Panel (SCI))</td><td>Subdivision in direction No. 2. 6 (Sensors and Electronics Technology Panel (SET))</td><td>Subdivision in direction No. 2. 7 (NATO Modelling and Simulation Group (NMSG))</td><td>Subdivision in direction No. 2. 8 Center for Marine Research and Experimentation</td></tr>
<tr><td colspan="4">Scientific support</td></tr>
<tr><td colspan="4">Type 3 Add-on Modules (Level 3 Groups)</td></tr>
<tr><td colspan="4">Research Target Groups</td></tr>
<tr><td>Subdivision in direction No. 3. 1 (Research Task Forces for Research)</td><td>Subdivision in direction No. 3. 2 (special teams for research)</td><td>Subdivision in direction No. 3. 3 (expert focus groups for research)</td><td></td></tr>
<tr><td colspan="4">Additional Research Specialists</td></tr>
</table>

5. 2. Model for assessing the capabilities of the scientific unit of the Armed Forces of Ukraine based on the DOTMLPFI methodology

The capabilities of the Armed Forces of Ukraine are evaluated according to the main criteria: «personnel», «supplies», «infrastructure», and «training», however it is advisable to divide the criteria in accordance with the components of NATO's DOTMLPFI capability development. The capacity component has its own properties and criteria, and the indicators should be both quantitative and qualitative.

Quantification of components is determined by calculation, such as scientific costs, or by measurement using a military mobile laboratory.

Qualitative indicators are determined in absolute terms or by an expert method in accordance with the requirements of approved methods of their determination (these include motivation of personnel, leadership qualities of the unit commander). The heterogeneity of indicators makes it impossible to assess the capacity of the scientific unit. As a result, there is a need to objectively compare different capability requirements.

The model for assessing the capabilities of scientific units should be carried out according to the principles of quantitative assessment of processes on a scale of points. The principle of this method is to summarize various indicators that characterize individual criteria of the object to a generalized indicator.

To compare the properties of capacities that have different units of measurement, it is advisable to normalize them to an integral indicator, which will make it possible to obtain a quantitative assessment of the capacity of the scientific unit and to determine the degree of approximation of the capacity to the required level.

The first step in comparing the values of the indicators of the capabilities of the scientific units of the Armed Forces of Ukraine is to transform these values of the indicators into the dimensionless form R_{hi}. Provided that the value of the indicator (the requirements of the Catalog or the technical assessment task) is known, then:

$$R_{hi} = \frac{R_i}{R_{im}}, \tag{1}$$

where R_{hi} is the property indicator; R_i is the absolute property indicator; R_{im} is the required property indicator ($R_{im} \to \max$); $i=1, 2, \ldots n$; measurement range $0 \le R_{hi} \le 1$.

If the range of changes in $R^{\min}$–$R^{\max}$ values is known, then:

$$R_{hi} = \frac{R_i}{R_i^{\max} - R_i^{\min}}, \tag{2}$$

or:

$$R_{hi} = \frac{R_i - R_i^{\min}}{R_i^{\max} - R_i^{\min}}, \tag{3}$$

where R_{hi} is the value of the property indicator; R_i is the absolute property indicator; $R^{\min}$ to $R^{\max}$ – the minimum and maximum value of the property indicator, respectively; $i=1, 2, \ldots, n$.

The main feature of modular assessment is the inability to compensate weak indicators with high values of others. For example, low staffing cannot be compensated by a high level of qualification or a developed leadership system. As a result, it is advisable to apply the geometric mean, which is a safeguard against compensation of some values of the indicators by others. If one of the indicators takes the value 0, then according to the criterion, the subdivision is automatically evaluated as «unsuitable» regardless of the values of the other indicators.

Since the proposed system has a modular approach, the module evaluation function is defined as follows:

$$S_{hn} = \sqrt[n]{\prod_{i=1}^{n} R_{hi}}, \tag{4}$$

where S_{hn} is the assessment of the functional module of the capacity of the scientific unit; R_{hi} is the value of the indicator of the i-th subdivision; n is the number of subdivisions.

According to the regulatory framework, the criteria by which capabilities are assessed are «personnel», «armament», «supplies», and «training».

However, they are not complete and should be supplemented according to the DOTMLPFI methodology (Doctrine, Organization, Training, Material, Leadership, Personnel, Facilities, Interoperability), which defines the basic components (constituents) of the units' capabilities.

The DOTMLPFI methodology involves evaluation according to the following criteria (indicators) [12]:

– D – guiding documents (current doctrinal documents);

– O – organization (organizational structure);

– T – training (the level of preparation of personnel to perform assigned tasks);

– M – resource support (provision of the necessary samples of material and technical means for the performance of tasks);

– L – management quality and education;

– P – personnel (availability of qualified and motivated personnel);

– F – facilities (the availability of appropriate infrastructure and the ability to ensure the fulfillment of tasks as intended);

– I – interoperability.

Then the function of evaluating the capacity module of the scientific unit will take the form:

$$M_{hn} = \sqrt[8]{\mathrm{D} \times \mathrm{O} \times \mathrm{T} \times \mathrm{M} \times \mathrm{L} \times \mathrm{P} \times \mathrm{F} \times \mathrm{I}}, \tag{5}$$

where M_{hn} is the assessment of the functional module of the capacity of the scientific unit.

The modularity of the scientific unit is universal and does not change under different application scenarios. The exception is changes in the conditions of use, in which case the impact on the final result may change. As a result, it is advisable to introduce weighting coefficients to the modules (for different scenarios of the use of units of the Armed Forces of Ukraine, a coefficient is determined).

The capacity rating is a set of capacity module ratings and can be expressed through the weighted geometric mean (6):

$$F_{hn} = \left(\prod_{i=1}^{n} Mi^{ki}\right)^{1/\sum_{i=1}^{n} ki}, \tag{6}$$

where F_{hn} is the assessment of the capacity of the scientific unit; M_i – evaluation of the i-th capacity module; ki – weight factor of the i-th capacity module; n is the number of modules.

The results of the quantitative calculation of the capability can be translated into the generally accepted scale of NATO capability assessments using Harrington's verbal-numerical scale [19].

5. 3. Diagram of activity assessment of the scientific unit of the Armed Forces of Ukraine

Since «low» and «very low» values do not meet the needs of the Armed Forces of Ukraine, it is advisable to combine these values into one category – «not capable». The «average» level with indicators from 0.37 to 0.64 also does not meet the needs of the Armed Forces of Ukraine. According to some evaluation criteria, the lowest acceptable level of indicators is determined at the level of 0.7* (or 70 %), so it is suggested to use the following intervals (Table 2).

The values of the «Criterion» column are obtained on the basis of statistical analysis of a sufficient amount of data. However, they can be changed in accordance with the increase in statistical data and should be contained in the appropriate calculation methodology for general use in the structure of the Ministry of Defense of Ukraine.

Since the procedure for assessing the capacity of a scientific unit has a clear sequence, an activity diagram was chosen for the design of information technology, which allows modeling the process of performing the procedure (Fig. 1).

The activity diagram reflects the logic and sequence of the transition from one activity to another, focusing on the result of the action (calculation) and plays an important role in understanding the processes of implementation of algorithms for performing class operations and procedural control flows in the system being designed.

Fig. 2 shows the implementation scheme of the method for assessing the capability of the scientific unit of the Armed Forces of Ukraine.

The first step is capability identification, management search, and capability carrier module search (according to the principle of decomposition). If the capability exists but no department has the obligations and authority to implement it, the inspection body provides suggestions and recommendations to eliminate the deficiency.

As a rule, the capability is provided by a set of modules, which collectively provide the capability of the scientific and research management, which, in turn, is an element of the scientific and research institution, and therefore is an element of the system of implementation of its capability.

5. 4. An experiment to assess capabilities of the research department

In the study, an experiment was conducted, the input data are:

Subdivision: «Scientific-research department (hereinafter SRD) for testing information and measurement systems and complexes of high-tech weapons and military equipment».

The main tasks of the SRD are:

– organization and conduct of fundamental and applied research aimed at scientific and scientific-technical support of military-technical policy measures in the field of testing, formation of methodological foundations of testing activities, improvement of normative and organizational-methodical support for testing, substantiation of directions for development and improvement of the laboratory-testing base of the Armed Forces of Ukraine of information and measurement systems, control complexes, analytical systems (processing and analysis of information), participation in the work on the continuation of the designated indicators of WME, organization and conducting of field experiments with WME (component parts of WME) at designated bases (testing sites, airfields, laboratories);

– organization and conduct of interdepartmental, certification, special and control tests of experimental and modernized ones;

– systems of objective and automated control, management, and diagnostics of the performance of WME samples;

– on-board and object measurement systems;

– on-board systems of uniform time and synchronization of information;

– systems of collection, distribution, transmission, display, analysis, storage, and organization of information exchange;

– optical surveillance, scanning and registration systems;

– information processing systems and arrays of databases;

– information and analytical systems;

– specialized programs and software modules, functional software and hardware models of systems and samples of WME, simulators;

– primary converters, sensors and normalizers of speed, linear and angular movements, pressure, temperature, forces, vibration, rotation frequency, overloads, accelerations, volume, etc.;

– scientific and technical support of research and development works on the creation (modernization) of information and measurement systems and control complexes, systems of objective and automated control;

– implementation of flight test work in terms of assessment and use of on-board measurement and photo-video recording systems;

– development of normative legal acts, regulatory documents, national (military) standards, orders (regulations, instructions) regarding the procedure for conducting tests of information and measurement systems and control complexes, proposals for their harmonization and adaptation to EU and NATO standards.

Load for 2023: operational tasks – 2, tests – 23.

Non-typical loads: serving daily duty – 29; fire training – 16 hours/person; physical training – 168 hours/person.

Number of personnel (hereinafter o/s): 10 (ten) persons:

– 7 (seven) – military personnel;

– 3 (three) – employees of the Armed Forces of Ukraine.

Table 2

Verbal and numerical assessment of the capabilities of scientific departments

No. of entry	NATO's assessment	Assessment of the Armed Forces of Ukraine	Criterion
1	(–)	Redundant capacity	>1.0
2	Fully functioning (very high)	Capable	0.8–1.0
3	Functioning, minor risks present (high)	Limited capacity	0.7*–0.79
4	Functioning with risks (medium)	Not capable	0.37–0.63 (0.69*)
5	(low+very low)		<0.36

*Note: * – the lowest acceptable level of indicators is defined at 0.7*

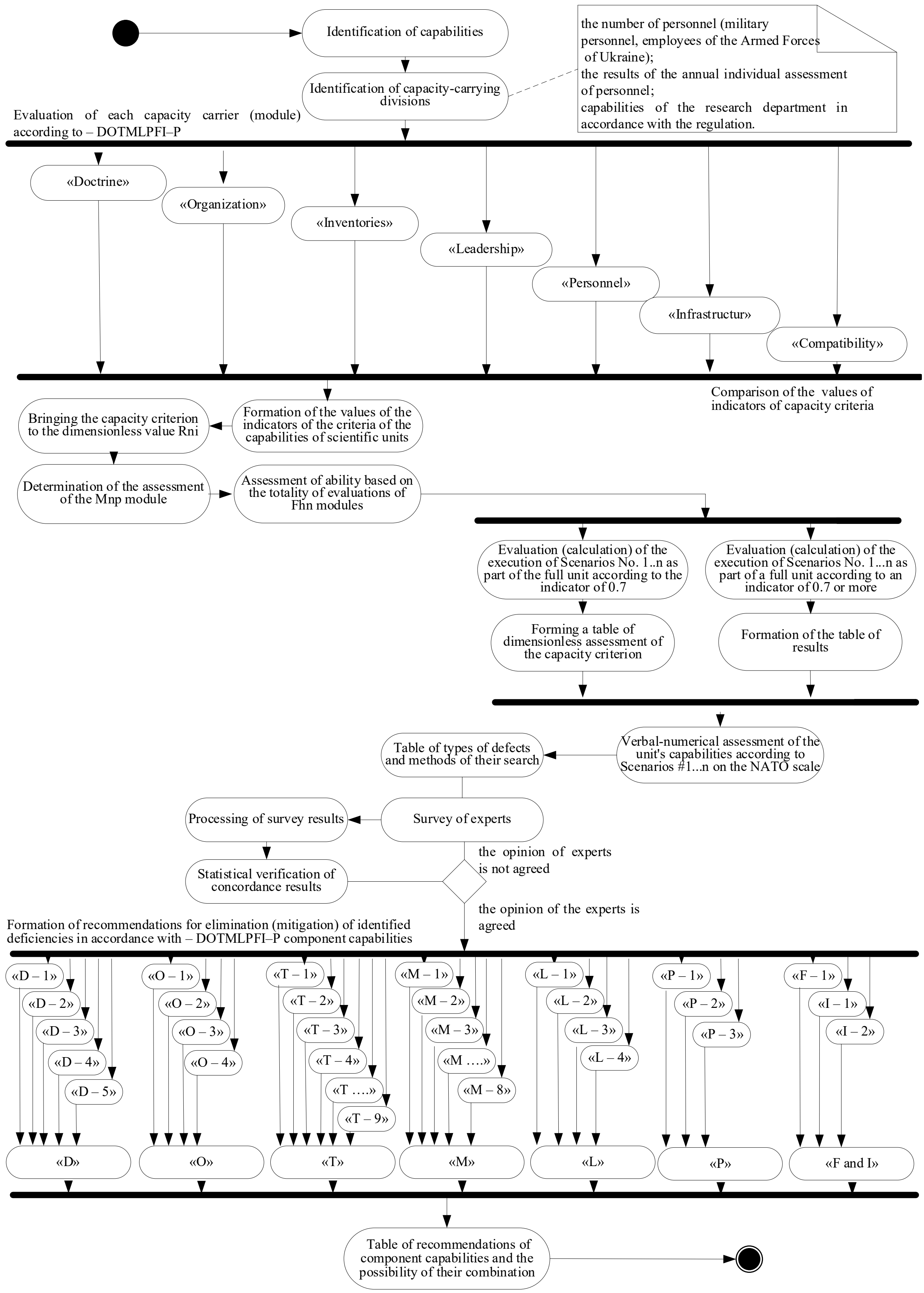

Fig. 1. Activity diagram for assessing the capacity of the scientific unit of the Armed Forces of Ukraine according to the modular approach

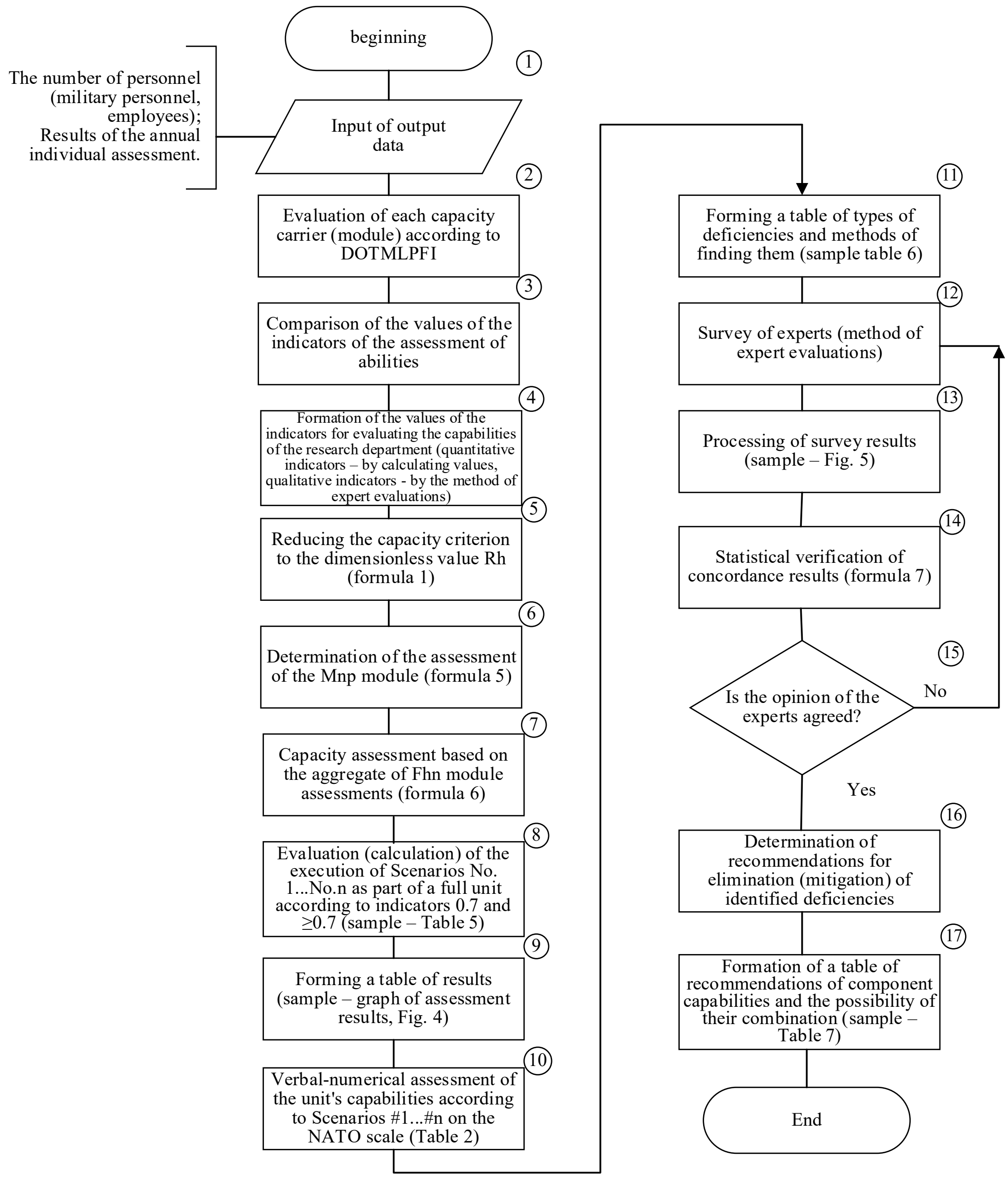

Fig. 2. Scheme of implementation of the method for assessing the capability of the scientific unit of the Armed Forces of Ukraine

Results of the annual individual assessment of SRD personnel:

The inspection point is evaluated from 0 to 100 % (points). The inspection point is the inspection carried out in accordance with the provisions on SRD and knowledge of personnel in accordance with:

– structure of SRD;

– tasks of SRD;

– duties of officials of SRD and the scientific research laboratory.

Forces and means.

The general system of capabilities (set of systems) consists of specific components:

– organizational and staff structure;

– equipping with laboratory and measuring equipment;

– preparation of the application of laboratory and measuring means;

– material and technical support and infrastructure.

The activity of SRD is regulated by normative legal acts (statutes, laws, instructions, guidelines, etc.).

The object of assessment is the ability of the scientific unit at the Institute to perform tests (tasks).

Research framework (limits). The time horizon over which the research results are spread is 3–5 years (2023–2027).

Typical Scenarios (scientific tasks) that correspond to the capabilities:

Scenario No. 1 – Capability of SRD No. 1 in terms of initial data.

Scenario No. 2 – Capability of SRD No. 2 in terms of initial data, etc.

Capabilities of SRD No. 1...10. For example, the development of requirements for tactical and technical tasks for the development and participation in scientific and technical support for the creation of promising samples and systems in the direction of the department's activities and their algorithms and work programs.

Tasks:

– conduct an analysis of what percentage of SRD personnel is capable of completing the tasks under Scenario No. 1... No. 10 (evaluation) in accordance with DOTMLPFI;

– perform a verbal-numerical assessment of the capabilities of SRD according to Scenario No. 1...No. 10;

– search for and identify shortcomings (weak and problem areas) regarding the capability of SRD under Scenario No. 1...No. 10 in accordance with DOTMLPFI;

– form recommendations regarding measures to take into account the basic components (constituents, factors) of capabilities in the direction of development of capabilities and defense planning potentials in accordance with DOTMLPFI;

– conduct a concordance of expert assessments.

Experimental research consists of a number of stages that correspond to the procedure of assessment of a scientific unit.

A list of typical measures (actions) that must be performed to ensure the functioning of the capability.

Activities: planning, preparation, implementation, evaluation:

1. 1. Planning.

1. 1. 1. Clarification of the initial data of the work (event):

– clarification of data on the test object and its probable characteristics (tactical and technical characteristics);

– clarification of data on other technical characteristics similar to the test object;

– specification of data on the possibilities of laboratory potential;

– clarification of the factors affecting the test environment.

1. 1. 2. Analysis of the test task:

– determination of the task of testing by specialists;

– determination of test capabilities;

– clarification of the specifics of conducting tests in the interests of a specific task.

1. 1. 3. Inclusion of test measures in the work plan:

– development of possible test scenarios;

– analysis of possible test scenarios in the interests of the purpose of the tests;

– development of a plan-schedule of tests (program/Methodology);

– development and refining of directive documents.

2. 2. Preparation.

2. 2. 1. Deployment of the test object in the test part:

– «deployment» of scientific specialists and organization of their work;

– organization of work of testing units (laboratories);

– adjustment of the logistics system (repair, maintenance, etc.);

– organization of the testing system and information management.

2. 2. 2. Interaction with other testing (providing) units;

– organization of interaction before and during the tests;

– clarifying the order of tasks.

2. 2. 3. Preparation for testing by the scientific unit:

– material and technical support of personnel (subdivisions);

– conducting individual (collective) training for tasks.

3. 3. Execution.

3. 3. 1. Test management:

– control of forces and means of the test facility during the tests;

– adjustment of the obtained characteristics (parameters) with those proposed by the developer before the beginning of the tests.

3. 3. 2. Collection of test information received:

– collection of primary information;

– distribution of information depending on the task (goal) of the tests.

3. 3. 3. Processing of received information:

– primary processing of received information;

– generalization of test data;

– documentation (express bulletins, protocols, schedules, etc.).

3. 3. 4. Transfer of information to consumers (specialists, analysts, commanders) and other interested persons:

– entering test data to the test manager;

– test data and information management;

– transfer of test information to consumers.

4. 4. Evaluation.

4. 4. 1. Assessment of test situational awareness.

4. 4. 2. Evaluation of test works (stages):

– assessment of test results;

– development of efficiency and effectiveness indicators;

– determination of test efficiency.

4. 4. 3. Experience management:

– evaluation of the experience gained;

– dissemination of acquired experience;

– improvement of testing planning;

– improving the training cycle of testers (specialists);

– systematic improvement of testing processes.

Purpose and order of development of the logical and hierarchical structure of capability.

The development of a logical and hierarchical structure of capability is formed on the basis of typical measures (actions).

Each measure (action) is assigned (determined, formed) in accordance with:

– the desired effect (result);

– conditions affecting the success of achieving the effect (result);

– indicators of success in achieving the effect (result).

Factors and conditions affecting the performance of a typical test task (work) include:

– qualification requirements for the tester (analyst);

– operating environment (test area);

– restrictions on the exchange of information and data;

– classification (complexity) of test processes and test data management system (information);

– time;

– features of the test (information) environment;

– priority;

– restrictions on test works (missions, tasks);

– accuracy, timeliness, reachability, adaptability, interoperability, availability; dexterity, speed.

Determination of the number of units capable of performing tasks according to Scenarios No. 1...No. 10.

The percent performance of the task of SRD personnel under Scenarios No. 1...No. 10, according to the results of the annual individual assessment for the past year, is given in Table 3.

The results of the quantitative calculation of the capability can be translated into the generally accepted scale of NATO capability assessments using Harrington's verbal-numerical scale [19].

Taking into account the fact that at 70 % and above the task will be completely completed, we have the following data:

1) according to Scenario No. 1, 7 people will complete the given task in full;

2) according to Scenario No. 2, 7 people will complete the given task;

3) according to Scenario No. 3, 8 people will complete the given task in full;

4) according to Scenario No. 4, 9 people will complete the given task in full;

5) according to Scenario No. 5, 8 people will complete the given task in full;

6) according to Scenario No. 6, 5 people will complete the given task;

7) according to Scenario No. 7, 10 people will complete the given task in full;

8) according to Scenario No. 8, 6 people will complete the given task;

9) according to Scenario No. 9, 9 people will complete the given task in full;

10) according to Scenario No. 10, 9 people will complete the given task.

Fig. 3 shows the chart of dependence of the number of personnel that will or will not perform the task according to the defined Scenarios No. 1...No. 10. Bringing the criterion of SRD capability to a dimensionless value (Table 4).

Table 3

Summary table of the annual individual assessment

No.	Scenario, personnel	Military No. 1	Military No. 2	Military No. 3	Military No. 4	Military No. 5	Military No. 6	Military No. 7	Official No. 8	Official No. 9	Official No. 10
1	Scenario No. 1	60	80	55	100	80	80	75	75	40	75
2	Scenario No. 2	80	80	60	95	55	75	80	75	50	80
3	Scenario No. 3	70	100	80	85	65	75	75	80	30	80
4	Scenario No. 4	60	100	70	90	70	90	80	70	80	100
5	Scenario No. 5	80	100	30	90	40	95	90	100	75	100
6	Scenario No. 6	73	70	80	80	65	65	95	65	65	65
7	Scenario No. 7	87	75	85	75	80	70	100	70	70	75
8	Scenario No. 8	90	75	75	60	80	60	100	60	70	60
9	Scenario No. 9	90	80	75	80	90	60	70	80	95	70
10	Scenario No. 10	100	90	100	85	90	50	80	90	80	70

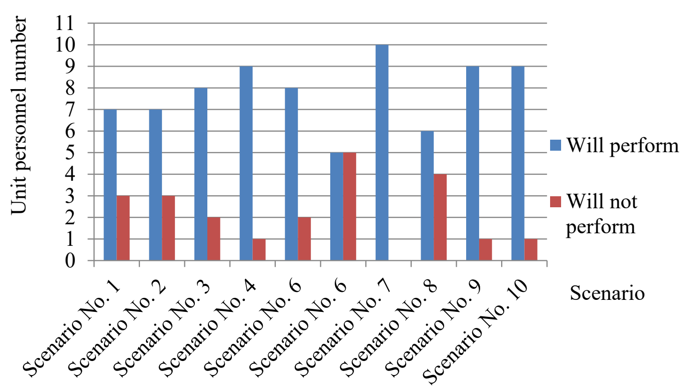

Fig. 3. Dependence on the number of personnel that will or will not perform the task according to the defined Scenarios No. 1...No. 10

Table 4

Dimensionless assessment of the capability criterion

No.	Scenario, personnel	Military No. 1	Military No. 2	Military No. 3	Military No. 4	Military No. 5	Military No. 6	Military No. 7	Official No. 8	Official No. 9	Official No. 10
1	Scenario No. 1	0.60	0.80	0.55	0.10	0.80	0.80	0.75	0.75	0.40	0.75
2	Scenario No. 2	0.80	0.80	0.60	0.95	0.55	0.75	0.80	0.75	0.50	0.80
3	Scenario No. 3	0.70	0.10	0.80	0.85	0.65	0.75	0.75	0.80	0.30	0.80
4	Scenario No. 4	0.60	0.10	0.70	0.90	0.70	0.90	0.80	0.70	0.80	0.10
5	Scenario No. 5	0.80	0.10	0.30	0.90	0.40	0.95	0.90	0.10	0.75	0.10
6	Scenario No. 6	0.73	0.70	0.80	0.80	0.65	0.65	0.95	0.65	0.65	0.65
7	Scenario No. 7	0.87	0.75	0.85	0.75	0.80	0.70	0.10	0.70	0.70	0.75
8	Scenario No. 8	0.90	0.75	0.75	0.60	0.80	0.60	0.10	0.60	0.70	0.60
9	Scenario No. 9	0.90	0.80	0.75	0.80	0.90	0.60	0.70	0.80	0.95	0.70
10	Scenario No. 10	0.10	0.90	0.10	0.85	0.90	0.50	0.80	0.90	0.80	0.70

The calculation of the performance of the task in which the capability indicator is equal to 0.7 or more is given in Table 5.

Table 5

Results of evaluating the implementation of Scenarios No. 1...No. 10 as a part of the full division of SRD and with a capability indicator equal to 0.7 or higher

No.	Scenario, personnel	Full division	personnel ≥0.7	Δ
1	Scenario No. 1	0.7006	0.8033	0.1027
2	Scenario No. 2	0.7174	0.8049	0.0875
3	Scenario No. 3	0.7118	0.8021	0.0903
4	Scenario No. 4	0.7994	0.8254	0.026
5	Scenario No. 5	0.7487	0.9079	0.1592
6	Scenario No. 6	0.7172	0.7915	0.0743
7	Scenario No. 7	0.7820	0.7820	0
8	Scenario No. 8	0.7187	0.8105	0.0919
9	Scenario No. 9	0.7832	0.8067	0.0235
10	Scenario No. 10	0.8208	0.8672	0.0464

Note: the Δ indicator is an indicator that takes into account the difference between the full SRD division and the personnel with an indicator of 0.7 and above

Fig. 4 shows the chart of dependence of the results of the evaluation of the implementation of Scenarios No. 1...No. 10 by full subdivision of SRD and with a capability indicator equal to 0.7 or higher.

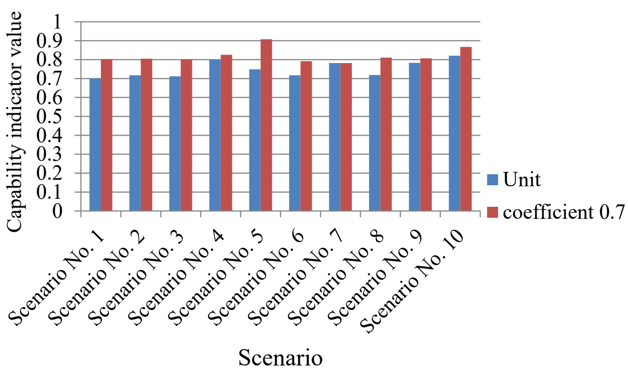

Fig. 4. The chart of results of evaluating the execution of Scenarios No. 1...No. 10 in terms of the capability indicator

According to the results of the calculations of the assessment of the capabilities of SRD under Scenarios No. 1...No. 10 and data on the annual individual assessment and Table No. 3 of the main paper, we have the following results:

1. 1) Scenario No. 1. As a part of the subdivision, an estimate of 0.7006 was obtained:

– according to the NATO scale. The unit is functioning, there are minor risks; the functionality of the unit is high;

– according to the scale of the Armed Forces of Ukraine. The unit has limited capability.

1. 2) Scenario No. 1. As part of the subdivision, an estimate of 0.8033 was obtained:

– according to the NATO scale. The unit is fully functional; the functionality of the unit is very high;

– according to the scale of the Armed Forces of Ukraine. The unit is fully capable.

The results of Scenarios No. 2...No. 10 are identical to the results of Scenario No. 1.

After analyzing and summarizing the results of the implementation of Scenarios No. 1...No. 10, it is possible to compile a table of types of deficiencies and methods for their search (Table 6).

After further analysis of each type of deficiency, a survey of experts and concordance was conducted.

Experts are natural persons who have high qualifications, special knowledge, and directly carry out scientific or scientific and technical expertise. Experts bear personal responsibility for the reliability and completeness of the analysis, the validity of the recommendations in accordance with the requirements of the task of conducting the examination.

The concordance assessment of experts and the results of their survey are given below. The concordance of the results of the experts' answers was carried out according to formula (7):

$$W = \frac{\sum_{i=1}^{n} d_j^2}{\frac{1}{12}\left[m^2\left(n^3 - n\right) - m\sum_{i=1}^{m} T_i\right]}, \tag{7}$$

where n is the number of factors; m – number of experts; $T_i = \sum_{i=1}^{L}(t_j^3 - t_l)$ – deviation of the amount from the average amount; T_i – results of intermediate calculations:

$$d_j = S_j - \frac{\sum_{j=1}^{n} S_j}{n}, \tag{8}$$

where S_j – sum of ranks:

$$S_j = \sum_{i=1}^{m} R_{ij}, \tag{9}$$

where R_{ij} – matrix of factor assessments by experts:

$$T_i = \sum_{i=1}^{L}\left(t_j^3 - t_l\right), \tag{10}$$

where L is the number of groups of connected (same) ranks; t_l is the number of connected ranks in each group.

The concordance factor takes values from 0.0 to 1.0. The greater the value of the concordance coefficient, the greater the degree of consistency of experts' opinions. When $W=1$, there is complete agreement of experts' opinions; if $W=0$, then consistency is practically absent.

Table 6

Methods for finding deficiencies depending on the type of flaws

Type of disadvantage	Methods for finding flaws				
	Polling	Execution of scenarios (tasks)	Interview	Study of documents and literature	Examining reports
1. Inability to implement the Scenario	+	+	+	–	+
2. Limited resources	–	–	–	+	–
3. Limited operation element resource	–	–	–	+	+
4. Regulatory restrictions	–	+		+	–
5. Other types of disadvantages	–	–	–	–	–

Statistical verification of concordance results.

The same intermediate values W can have different values depending on m and n. The random variable $m(n-1)W$ with $n>7$ is subject to the χ^2 distribution, and therefore the hypothesis of the presence of expert agreement can be checked using the Pearson test, namely according to formula (11):

$$\chi_p^2 = \frac{\sum_{i=1}^{n} d_j^2}{\frac{1}{12}\left[nm(n+n) - \frac{1}{n-1}\sum_{i=1}^{m} T_i\right]}. \quad (11)$$

If χ_p^2 is larger than χ_{kp}^2 with the number of degrees of freedom $n-1$. Then the concordance coefficient W is considered significant. In the case when $n<7$, they use the F-distribution for a random variable:

$$\frac{1}{2}\ln\frac{(m-1)W}{1-W}$$

with the number of degrees of freedom $f_1 = n - l - lm$ and $f_2 = (m-1)/f_1$.

The influence of the expert on the coherence of the group during the concordance.

When assessing the consensus of experts' opinions, it is important to determine to what extent each expert influences the overall consensus of the group. To this end, one expert is successively excluded from the calculations and the concordance coefficient is calculated without taking into account the opinions of the excluded expert. It is necessary to exclude from the calculations individual experts who have an original point of view. In the process of a multi-round examination, there may be cases when such experts will win a significant part of the group to their side.

Each expert provided an answer of the following type:

1 – completely disagree;
2 – do not agree;
3 – difficult to answer;
4 – agree;
5 – completely agree;
6 – out of my field of competence or I have no experience.

According to the results of the survey, column or circular charts are built, such as the example shown in Fig. 5. Transition from the identification of shortcomings and their causes to the formulation of recommendations.

Fig. 6 shows a diagram of the stages of the transition from the identification of shortcomings and their causes to the formation of recommendations.

Transition stages:
– shortcomings;
– initial reasons;
– valid «root» causes;
– recommendations and factors;
– recommendations are final;
– implementation.

Recommendations for elimination (mitigation) of identified deficiencies in accordance with DOTMLPFI – component capabilities are listed in Table 7.

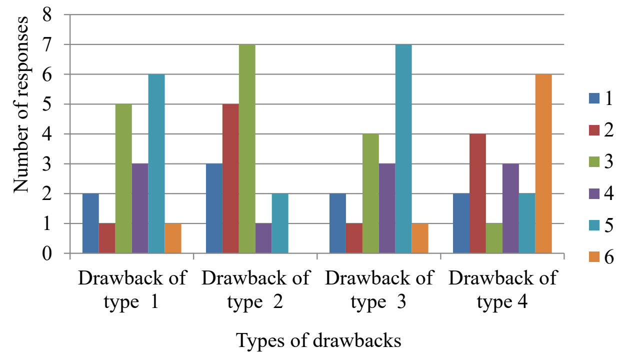

Fig. 5. Results of a multiple-choice survey of 18 experts

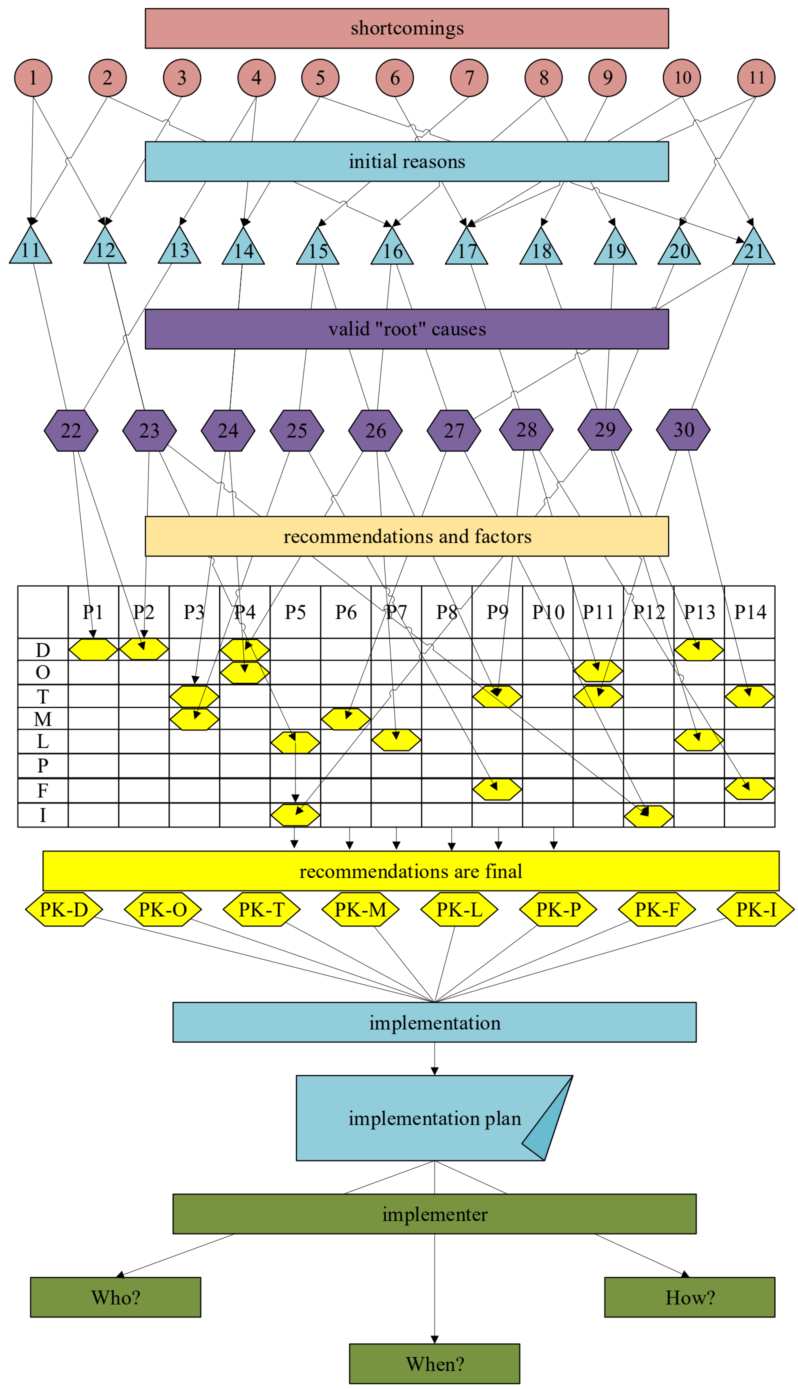

Fig. 6. Stages of transition from identifying deficiencies and their causes to formulating recommendations

Table 7

Capability components recommendations in accordance with DOTMLPFI

D			O			T					M				L		P		F	I		
Recommendations																						
Component	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
D	+	+	+	+	+	–	–	–	–	–	–	–	–	+	–	–	–	–	–	+	–	–
O	–	–	+	+	–	+	+	+	+	–	–	–	–	+	–	–	–	–	–	–	+	–
T	–	–	+	+	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–
M	–	–	+	+	–	–	–	–	–	–	–	–	–	+	–	–	–	–	+	+	+	–
L	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–
P	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
F	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–
I	–	–	+	–	+	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	+

For example, «D-1» Improve the current doctrinal framework for planning the use of scientific units (scientific specialists) in conducting tests in accordance with the requirements and test procedures, taking into account the principles and approaches of NATO (instructions, orders, etc.).

From the above, it is possible to highlight the main mandatory principles and directions of policy implementation:

– professionalism and professionalization;
– combat and economic efficiency;
– innovativeness and continuous improvement;
– project organization of activities;
– demand for results in the entire defense sector;
– life cycle management.

Table 7 provides recommendations in accordance with DOTMLPFI – component capabilities and the possibility of their combination.

The substantiation of the characteristics of quantitative and qualitative changes in the carriers of capabilities and their combination in the organizational structure of the military formation is the content of the functioning of various systems of defense planning, which are adopted in the armies of the countries of the world.

In order to move on to substantiating the parameters of the development of military formations of the Armed Forces of Ukraine based on capabilities, the strategy of using the ready-made planning system for the development of capabilities of one of the NATO member countries – the US Armed Forces – has been chosen. Among its positive features (it is functional, has a developed justification system, ensures a high level of satisfaction of the needs of the Armed Forces in terms of resources), it also has unattainable medium- and short-term prospects for implementation in Ukraine, namely:

– it is not adapted to function under conditions of significant resource limitations;

– it is focused on the developed domestic and access to foreign markets of defense technologies and defense products;

– it requires a strong and numerical structure of justification, planning, and implementation of concepts, programs, and plans (structures of scientific research institutions, laboratories, bureaus, agencies, educational, civil, and private science, to solve national security and defense tasks);

– it relies on the relevant structures of NATO and the EU, which significantly exceed Ukraine's in terms of resources and intellectual capabilities.

6. Discussion of results of investigating the method for assessing the capabilities of the scientific units in the Armed Forces of Ukraine

The proposed approach, in contrast to [10], expands the capability assessment procedure using the DOTMLPFI methodology.

In studies [11, 13], only the procedure for forming temporary scientific units for the performance of creative tasks is revealed, but a general assessment of the capabilities of scientific units is not given.

Works [12–14] contain an assessment of the capabilities of units that operate according to standardized procedures for the performance of combat tasks (combat statutes, manuals, advisors, other thematic publications). However, the method of such evaluation does not correspond to weakly formalized, creative tasks. This determines the specifics of the application of the developed method.

The transition of the Armed Forces of Ukraine to NATO standards requires an increase in mutual understanding regarding the assessment of the capabilities of units. Assessing the capabilities of scientific units is a poorly formalized task since scientific activity belongs to the creative activity of a person. However, a quantitative assessment close to the DOTMLPFI methodology is needed.

The constructed capability assessment model (method implementation scheme – Fig. 2) allows obtaining quantitative values of indicators (5), which, when applying the introduced criteria, made it possible to objectively assess the capability of the scientific unit using a modular approach. Thanks to which the weak indicators of the scientific unit are not compensated by the high value of others.

A diagram of the activities for assessing the capabilities of the scientific unit of the Armed Forces of Ukraine according to the modular approach (Fig. 1) was built, which makes it possible to increase the objectivity of the assessment and to formulate recommendations for the development of capabilities.

The experiment on the assessment of the capabilities of the research department proved that it is possible to obtain an objective assessment of the capabilities of the unit, avoiding the mutual compensation of weak indicators with the high value of others, to formulate recommendations for the elimination of identified shortcomings in accordance with DOTMLPFI (sample – Table 7).

The improved method, in contrast to those used in the Armed Forces of Ukraine, allowed us to develop a system for evaluating the capabilities of the scientific unit, to switch to the evaluation system adopted by NATO in general, and will improve the quality of planning the scientific load on the unit.

The prospects of this study are the solution of the weakly formalized task of assessing the capabilities of the scientific units of the Armed Forces of Ukraine, which, unlike the accepted ones, is based on the DOTMLPFI methodology and ensures the compatibility of the units' assessment with NATO standards.

Our method makes it possible to evaluate the scientific units in the Armed Forces of Ukraine, which is a weakly formalized task of human creative activity, and to receive recommendations on the development of capabilities.

Restrictions are introduced in the work – time and scenario restrictions of the scientific units of the Armed Forces of Ukraine.

The disadvantage of the study is the significant use of expert evaluations, which can introduce subjectivity in the evaluation of recommendations for their development.

The area of further research is:

– optimization of the procedure for modular quantitative assessment of the capabilities of scientific units in the Armed Forces of Ukraine;

– application of the theory of fuzzy sets and elements of artificial intelligence to obtain estimates when applying the method;

– development of information technology for assessing the capabilities of scientific units of the Armed Forces of Ukraine, to automate the process of determining the degree of approximation of the capability to the required level.

7. Conclusions

1. We have analyzed the defense planning system in general and assessed the capabilities of the scientific unit in the Armed Forces of Ukraine in particular. It was determined that assessing the capabilities of military units is a poorly formalized task and should be considered as a systematic process aimed at determining the effectiveness and readiness of the troops.

2. A model for evaluating the capabilities of the scientific unit was built, based on the DOTMLPFI methodology using a modular approach. A modular approach to building a scientific support system contributes to increasing the functional capabilities of scientific units, interdepartmental compatibility of scientific units, as well as with the scientific services of the armed forces of NATO member states. Therefore, assessing the capabilities of the scientific units in the Armed Forces of Ukraine according to the modular principle is an integral requirement of an effective DPBC and achieving compatibility with the multinational units of NATO and the UN.

3. The activity diagram of the assessment of the capabilities of scientific units was formed in the work. The specifics of this diagram are the formalization of the process of assessing the capabilities of a scientific unit, which will allow the development of appropriate information technology for automating the process of assessing the capabilities of units in the Armed Forces of Ukraine.

4. Our experiment on the assessment of the capabilities of the scientific unit proved that the modular approach is aimed at eliminating the compensation of weak indicators by the high value of others, and the DOTMLPFI methodology allows for the formation of shortcomings and recommendations for their elimination. Based on the results of the evaluation, 30 recommendations were formed when defining 10 scenarios.

Conflicts of interest

The authors declare that they have no conflicts of interest in relation to the current study, including financial, personal, authorship, or any other, that could affect the study and the results reported in this paper.

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Data availability

The data will be provided upon reasonable request.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the current work.

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