

The study results have made it possible to devise a methodology for the formation and adjustment of the Defense Forces Capabilities Catalog using cluster analysis and the developed tree-like system of basic indicators characterizing groups and subgroups (clusters). That enables stakeholders to form and adjust the Defense Force Capabilities Catalog with the proper quality, according to the uniform developed algorithm and defined identifiers (features).

The methodology is intended for use by members of the Inter-Departmental Working Group on Defense Review, as well as working groups in the course of a separate review or capacity assessment.

The Defense Force Capabilities Catalog was deconstructed into five levels of hierarchy, each of which contains interdependent typical tasks, organizational structures, and means (systems, complexes).

The procedure is to analyze and clearly cluster individual capabilities of the defense forces according to certain features (requirements, characteristics) to group them and include them in the relevant groups, subgroups, and functional capabilities groups.

A system of the indicators for the formation and adjustment of the Defense Forces Capabilities Catalog has been proposed, as well as a conformity criterion based on the generalized indicator, which defines the level of formation (adjustment) of the Defense Forces Capabilities Catalog.

Seven steps of the procedure have been defined: from identifying individual capabilities based on their description (step 1) to verifying the acceptability of the results obtained (step 7) using the evaluation criterion and specially designed tables.

The methodology was tested during a passive experiment in 2020 on the analysis of the current Defense Forces Capabilities Catalog, which made it possible to identify a series of significant shortcomings in its structure and content

Keywords: *capabilities catalog, Armed Forces, Defense Force, defense planning, defense review*

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DEVELOPMENT OF A METHODOLOGY FOR THE FORMATION AND ADJUSTMENT OF THE CATALOG OF DEFENSE FORCES CAPABILITIES

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1. Introduction

The Ministry of Defense (hereinafter referred to as the Ministry of Defense) and the General Staff of the Armed Forces of Ukraine are underway to implement capabilities-based defense planning in the Defense Force.

Thus, the formation of a Unified List (Catalog) of capabilities of the Ministry of Defense, the Armed Forces, and other components of the Defense Forces (hereinafter referred to as the Defense Forces Capabilities Catalog) is defined as one of the tasks of the defense review [1].

To fulfill this and other tasks, based on the decision by the Minister of Defense of Ukraine, an Inter-Agency Working Group on Defense Review (hereinafter referred to as the Inter-Departmental Working Group) was formed [2]. If necessary, a separate review of the capabilities of the defense forces or assessment of capabilities in the Armed Forces by specially created temporary working groups [3, 4] may be carried out.

Working groups should develop a Catalog of capabilities of the defense forces and functional capabilities groups (clarify, amend it). The implementation of this task requires scientific support because this document is decisive in the course of planning the development, evaluation, and use of the armed forces.

The defense force capabilities catalog is a list of available and detailed requirements for the capabilities of the defense

forces, which provides a single conceptual apparatus when planning the development of capabilities (defense planning) of the Armed Forces, and other components of the defense forces in the interests of their strategic application [5].

To ensure the implementation of the tasks of forming and adjusting the Defense Force Capabilities Catalog, logical methods (analysis, synthesis, abstraction, etc.) are used, and capabilities codes and capabilities requirements by NATO are taken into consideration.

The capabilities codes and capabilities requirements (hereinafter referred to as the NATO Capabilities Catalog) were approved by the Joint Chiefs of Staff of NATO Strategic Command Operations and Strategic Command Transformation as of 26 January 2016 [6].

NATO's capabilities catalog provides a unified understanding of the capabilities of forces in defense planning and operations planning. It provides for the use of a step-by-step (hierarchical) structure (division by 3 levels). This Catalog has been significantly improved compared to the previous version developed in 2011, owing to the considerable efforts of a wide range of key Alliance experts [6].

Based on the analysis of the NATO Capabilities Catalog, the Ministry of Defense first developed the Defense Capabilities Catalog in 2017, and, in 2019, updated it as a result of the defense review [5].

At the same time, in the course of the formation and use of these catalogs, a series of significant shortcomings were identified in their logical and hierarchical construction, the lack of an effective mechanism for the formation and addition of new capabilities, etc. These shortcomings need to be eliminated.

Given this, the improvement of mechanisms and procedures for ensuring the planning of the development of the capabilities of the Armed Forces and other components of the defense forces in the interests of their strategic application [7] remains a relevant scientific and applied task.

2. Literature review and problem statement

Many publications [8–31] address improving capabilities defense planning procedures.

Thus, work [8] reports the results of research on the problems of transition to capacity-based planning and emphasizes the need to ensure the creation, deployment, and support of defense planning information systems in Ukraine. The main problems are considered to be the lack of development of the normative (doctrinal) base, insufficient awareness of the relevant processes, and the lack of tools for information and analytical support for the new type of defense planning for the Armed Forces of Ukraine. The researchers view capability-based defense planning as a separate capability (process) [8]. At the same time, the concept of «capability» is characterized only as the ability of the structural unit (element) of the armed forces, which is not quite correct.

Paper [9] drew attention to the peculiarities of defense planning on the basis of capabilities and the prospects for its implementation in the process of development of the state defense forces. The authors emphasize the need to ensure the proper functioning of working groups during the formation of a Unified List (catalog) of capabilities of the Ministry of Defense and the Armed Forces of Ukraine [9]. However, this requires appropriate methodological support.

Article [10] analyzed the existing scientific and organizational-legal approaches to the strategic planning of the capabilities of troops (forces). It is noted that in order to ensure the formation of catalogs of capabilities of troops (forces), it is necessary to develop appropriate procedures and ensure automated data processing [10]. At the same time, the researchers did not establish the interdependence of the lists of typical tasks, organizational structures, and means of the defense forces, which ensure the consistency of the necessary initial data for the formation of catalogs of capabilities of troops (forces).

Work [11] reports the results of studying the experience of France in the creation of the National Body for coordination of activities and the use of anti-terrorist units. It has been clarified that the tasks of this body, in particular, are to create a Catalog of capabilities of France's anti-terrorist units and to check whether they have the capabilities provided for in this Catalog. However, the authors ignored the issue of creating a Catalog and checking the availability of capabilities.

Article [12] describes a series of practical procedures on the basis of which it is recommended to plan the development of capabilities of the defense forces, as well as certain components of capabilities. In particular, the authors drew the attention of scientists to the need for further research on the formation of a standard catalog of capabilities of typical organizational structures of troops (forces) [12]. At the same time, no method or methodology has been considered to en-

sure the implementation of the task of forming and adjusting the Defense Forces Capabilities Catalog.

Article [13] analyzes methodological and methodical approaches and the best practices of NATO Member States on capabilities-based defense planning. However, approaches to the procedure for the formation and adjustment of the Catalog of capabilities of troops (forces) are not paid attention to at all.

Paper [14] describes differences in the structure of the Defense Force Capabilities Catalog of 28 November 2017 and the NATO Capabilities Catalog, in particular the number of functional groups. In addition, it is noted that the effective implementation of the Defense Forces Capabilities Catalog is possible only based on the design, implementation, and use of the relevant database, which does not exclude obtaining a text document [14]. At the same time, no comparison was made with the new Defense Forces Capabilities Catalog as of 09.12.2019 [5], the structure and content of which was updated as a result of the defense review.

Study [15] concluded that the functional capabilities groups identified in the Catalog could be divided into three classes (technical equipment, training levels, and institutional capabilities). It is also proposed to group functional capability groups into a specific integrated capability using regression analysis methods. However, regression analysis should be used when it is necessary to establish a quantitative relationship between variables (for example, to assess the properties of individual capabilities of the defense forces).

Work [16] clarified the essence of the concept of «capacity» and its relationship with the concepts of «capability» and «ability» of the defense forces to eliminate existing differences in the views of military specialists. It is proposed to give these concepts the following key meanings:

- *desired capability* – a standard or requirement to achieve the desired result, ... (main, basic, additional definitions of requirement/properties);

- *actual capability* – actual/available from the need/requirement to achieve the desired result, ... (compliance with the main, basic, additional capacity definition);

- *evaluated ability* – a criterion or evaluation/final state of achievement of the desired result, ... (the level of achievement of the main, basic, additional requirements/properties of capacity to determine the necessary measures).

In work [17], the discovered pattern refers to the interdependence between typical tasks (functional capabilities), typical organizational structures, and typical means (capabilities carriers) of troops (forces). Based on the revealed pattern, as well as other research results, recommendations were made on scientific and technical support for the development of promising means (capabilities carriers) of troops (forces).

Work [18] examines existing approaches to the assessment and analysis of capabilities for determining development measures of the Armed Forces of Ukraine. However, no analysis or comparison of the NATO Capabilities Catalog with the Defense Force Capabilities Catalog has been carried out.

The report before congressional committees [19] emphasized that the U.S. Department of Defense lacks analytical capabilities to assess the structure of troops (forces) and make informed decisions by senior leaders. It also defines the importance of some services in providing analytical support to senior managers, proposes to develop and use analytical products. At the same time, the stages (steps) of the force planning procedure, as well as the analytical capabilities of the services for the formation and adjustment of lists of available, necessary and insufficient capabilities of troops (forces) have not been disclosed.

Article [20] examines capability-based assessment and planning processes in the U.S. Air Force, including the use of portfolios and a portfolio of foundations for collecting, analyzing, and managing diverse information. The problems of portfolio management through budgeting are analyzed, as well as some approaches to portfolio analysis with the use of methods based on expert judgment. The issue of collecting, analyzing, and managing information with capabilities codes and requirements for Air Force capabilities has not been highlighted.

The annual report [21] disclosed the results of the implementation of measures by the Australian Ministry of Defense for 2019–2020 on adjusting the defense policy of the state, solving the problems of defense planning, developing the capabilities of organizational structures of troops (forces), etc. It is noted that the Defense Ministry seeks to coordinate the military strategy, capabilities of troops (forces), and resources improved in the course of the reform. The disadvantage of reform is that in 2019–2020 there was no defense review, which could reduce the effectiveness of decisions made and increase resource risks.

Paper [22] discusses an experiment to test a new approach to developing requirements for military capabilities within a computer war game. The participants of the experiment confirmed the effectiveness of the new approach to comparing variants of decisions on determining the requirements for capabilities using a high-quality expert system. It is noted that the input data of the expert system is a structured catalog of capabilities by functional capabilities groups («Training», «Command and Control», «Intelligence», «Collateral», «Protection» and others), typical of Ukraine. At the same time, the procedure and conditions for amendments to the capability catalog data by expert groups have not been proposed.

Work [23] examines organizational models and approaches to capability-based planning in the field of business. Capabilities are grouped and structured into three levels depending on the functions of companies. However, this approach does not make it possible to group typical tasks (functional capabilities), typical organizational structures, and typical capabilities (capabilities carriers) of troops (forces).

The policy note [24] examines NATO's long-term defense planning, using the Best Practice model as an example, which includes six types of approaches (top-down planning, capabilities-based planning, and others). It also describes the problems identified at the national level by NATO member states, which are also characteristic of Ukraine.

The manual [25] emphasizes the need for mandatory training of personnel involved in managing capability requirements portfolios, capability identification, and related capacity development gaps, etc. It is indicated that the data required for scheduling can be structured as spreadsheets for creating documents related to capability requirements.

Work [26] proposes a decision-making mechanism in the system of ensuring the military security of the state, which makes it possible to carry out calculations and compare the levels of military security of the state. The criterion for assessing the degree of implementation of national interests in the field of military security is determined, according to which decision-making can be justified and evaluate already implemented. A large number of indicators for evaluation (32) were chosen, the values of which should be calculated on the basis of statistical data, and, in their absence, determined by an expert survey. However, the Defense Force Capabilities Catalog [5] was not used as the initial data for the assessment.

Work [27] examines the issues of distributing scarce resources for their rational use, planning of military policy, and

ensuring the defense of the state. At the same time, the information-analytical software of the capabilities-based defense planning process is not paid attention to.

The DyFMCapA methodical apparatus proposed in [28] is convenient for determining the compliance of the capabilities of the defense forces with various requirements for the operation. It can also be used to improve the methodological bases of planning the development of the Armed Forces' capabilities for the long term. However, it is impossible, with its help, to form and adjust the Catalog of capabilities of the defense forces.

Study [29] improved the force planning procedure for operations using a new capability-based planning approach. The authors created an information system that contains «critically-important» data using Excel spreadsheets. However, this information system cannot be used to form and adjust the Defense Force Capabilities Catalog because it solves other tasks.

Article [30] covers the experience and problems of defense planning in European post-communist defense institutions to clarify causal relationships and make appropriate decisions. The problems raised and the negative experience of decentralization in making financial decisions when planning the development of capabilities of troops (forces) are also typical of Ukraine. An urgent problem for defense institutions is to achieve effective information and analytical support for the capabilities-based defense planning process.

Work [31] presents a methodology for the process of formation and decision-making during defense planning using the capabilities of the NCS network computer system. However, today in Ukraine there is no possibility to try the NCS and analyze the effectiveness of its use for the needs of the defense ministry.

The above analysis of literary data suggests that it is expedient to conduct a study addressing the development of a methodology for the formation and correction of the Defense Forces Capabilities Catalog, necessary to improve the quality of this task by working groups.

3. The aim and objectives of the study

The purpose of this study is to develop a methodology for the formation and adjustment of the Defense Force Capabilities Catalog for use by working groups during a defense review, a separate capabilities review, or capabilities assessment.

To accomplish the aim, the following particular tasks have been set:

- to form a logical and hierarchical structure of the Defense Forces Capabilities Catalog;
- to determine the necessary input for the methodology;
- to choose methods, indicators, and a criterion for the formation and adjustment of the Defense Force Capabilities Catalog;
- to develop an algorithm for the formation and adjustment of the Defense Forces Capabilities Catalog;
- to determine the peculiarities of formation and adjustment of the Defense Forces Capabilities Catalog.

4. Development of methodology for the formation and adjustment of the Defense Forces Capabilities Catalog

4.1. The logical and hierarchical structure of the Defense Forces Capabilities Catalog

The defense force's capabilities catalog covers eight functional capabilities groups (hereinafter referred to as FCG),

which contain 35 typical capabilities groups, which include 164 subgroups and 472 capacity description codes [5].

According to the results of a comparative analysis of the Defense Forces Capabilities Catalog with the NATO Capabilities Catalog, it was established that the names of FCG in these catalogs are generally identical, except for «1. Governance in the Defense Sector» (Fig. 1).

This is explained by the fact that FCG «1. Governance in the defense sector» (Fig. 1) includes the capabilities of Ukraine’s Ministry of Defense to ensure the formation and implementation of state policy in the field of national defense.

The capability is understood as the ability of military administration, formations, military units, military educational institutions, institutions and organizations of the Armed Forces, or a set of defense forces, to implement the specified military objectives. Tasks can be completed with appropriate resource support and according to established standards [2].

Decomposing of the Defense Forces Capabilities Catalog will be held according to the levels of hierarchy (Fig. 2):

- level I – for FCG, for example: «1. Governance in the defense sector – DG», «2. Planning for development and ensuring the readiness of troops (forces) – FDR», ..., «8. Protection and survivability – P»;

- level II – according to typical groups in FCG, taking into consideration the lists of typical tasks that will be performed by the defense forces according to scenarios of the occurrence and development of military situations (at the strategic, operational, and tactical levels). For example: typical groups «DG.1 – Formation of public policy», «DG.2 – Implementation of state policy»;

- level III – by subgroups, which are typically formed by the types of troops (forces). For example: subgroups «FDR-1.1 – Organization of Planning for the Development of the Army», «FDR-1.2 – Organization of Planning for the Development of the Air Force»;

- level 4 – by variative groups and individual capacities that do not belong to the variative groups. For example: the typical variative group «Naval Logistics Ship» contains three codes of capabilities of logistics ships according to the levels of hierarchy (large, medium, and small);

- level 5 – separate capabilities of the defense forces.

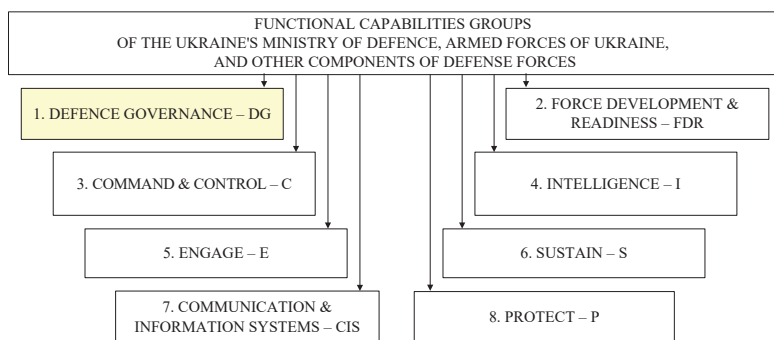


Fig. 1. Structural diagram of functional capabilities groups in the Defense Force Capabilities Catalog

The developed tree-logical-hierarchical structure of the Defense Forces Capabilities Catalog (Fig. 2) is typically used for grouping individual capabilities of all kinds (types) of troops (forces) that are necessary for joint implementation of tasks.

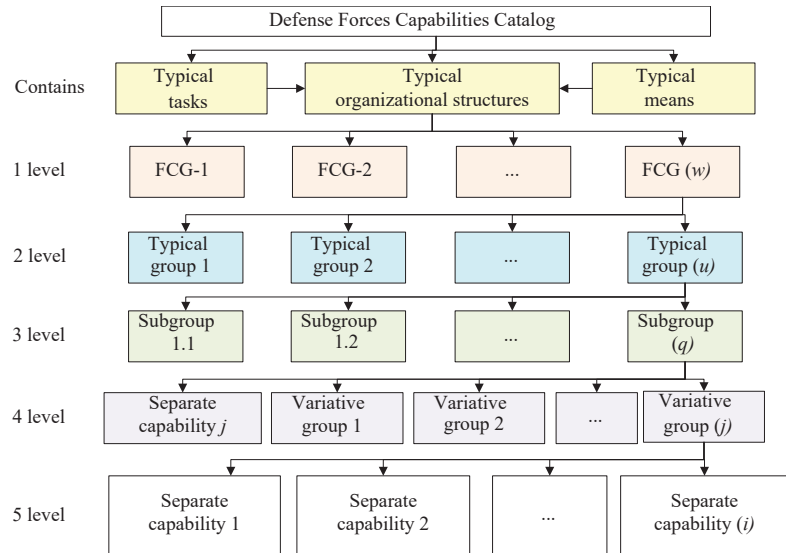


Fig. 2. Logical and hierarchical structure of the Defense Forces Capabilities Catalog. Note: The number of hierarchy levels may be less if the set of individual capabilities in FCG is small

Owing to this, it is possible to draw up an agreed document describing the joint capabilities of the defense forces for their assessment, planning the use of troops (forces), determining development measures for the medium and long term, etc.

4. 2. Required initial data for the procedure

The input data for the formation and adjustment of the Defense Force Capabilities Catalog contain the following lists:

- typical tasks of the Ministry of Defense, the Armed Forces, and other components of the Defense Forces, which will be carried out according to scenarios of the occurrence and development of military situations at the strategic, operational, and tactical levels;

- organizational structures of the Ministry of Defense, the Armed Forces, and other components of the Defense Force;

- typical means (systems, complexes) adopted in the Ministry of Defense, the Armed Forces, and other components of the defense forces (aircraft, helicopters, unmanned aircraft complexes, ships, vessels, missile systems, and air defense systems).

The default organizational structures include [32]:

- formations, military units, and subunits of military units;

- management bodies – General Staff, Joint Operational Headquarters, Command of types of armed forces, Special Operations Forces, Assault Forces, operational, air, naval commands, other bodies of military management of operational and tactical level.

The default means include [32]:

- separate means – aircraft, helicopters, unmanned aircraft complexes, ships, vessels, missile systems, and air defense systems;

- systems – automated management of troops (forces), exchange of intelligence and situation data, alerts, management of defense resources, protection of information, etc., including relevant equipment and software.

They form, clarify, or make changes to the lists during the defense review, review of capabilities, and in the course of daily activities of troops (forces). Changes to the lists can be made in the form of information, tables, or information in computer databases.

The input data for the identification of individual capabilities of the defense forces is also their description according to the basic, main, and additional requirements defined in accordance with the recommendations given in [32].

4. 3. Selection of methods, indicators, and criteria for the formation and adjustment of the Defense Force Capabilities Catalog

Cluster analysis was selected to identify individual capabilities (operational, combat, special) of the defense forces during the formation and correction of the Catalog. It was used to divide the studied set of objects into groups that are clearly or fuzzy similar to each other.

The essence of clustering is that of the individual capabilities of the defense forces, which on these grounds are closest to each other, a separate variative group (subgroup, FCG) is formed – a cluster. The main indicator of engaging a particular capability in a particular group, i.e. clustering, is the submission in a certain way and the measurement of the «distance» between individual capabilities.

The following is meant here:

- clear clustering is carried out provided that individual capabilities are reduced by quantitative sign similarity for the formation of variative groups, subgroups, and FCG that do not belong to other FCGs, subgroups, and variative groups;
- the fuzzy clustering of individual capabilities is carried out provided that some capabilities may belong simultaneously to several clusters (variative groups, subgroups, and FCG) on certain grounds.

Depending on the variant (task), the purpose of cluster analysis may vary, for example:

- to determine the structure of a set of capabilities by dividing it into homogeneous groups (subgroups) in order to simplify the further processing of data for decision-making based on the results of processing each cluster separately;
- to distinguish capabilities that do not belong to any of the clusters (this task is called a single-class classification of atypical or novelty detection);
- in the presence of super-large sampling capabilities, reduce the number of subgroups (variative groups) to leave one characteristic representative from each cluster.

Cluster analysis involves the following steps:

- select individual clustering capabilities (typical tasks, typical organizational structures, typical means);

- determine a set of characteristics by which individual capabilities will be identified in the sample;
- calculate the values of the degree of similarity between individual capabilities;
- apply one of the methods of cluster analysis to create groups of similar capabilities;
- verify the authenticity of clustering results.

The procedure for forming and adjusting the Defense Forces Capabilities Catalog implies analyzing and rigid hierarchical clustering of individual capabilities of the defense forces. This means that an individual capability either belongs to a particular cluster or does not belong, for certain features (requirements, characteristics), to their grouping and inclusion in the respective groups, subgroups, and FCG.

For the formation (adjustment) of FCG and the Catalog of capabilities of the defense forces in general, as well as decomposing based on the levels of hierarchy (subgroups, variative groups, individual capabilities), a system of basic indicators was formed (Fig. 3).

The following main indicators have been chosen (Fig. 3):

- Z – a generalized indicator that determines the level of formation (adjustment) of the Defense Forces Capabilities Catalog;
- W_1 – a partial indicator that determines the level of formation (adjustment) of FCG-1;
- W_2 – a partial indicator, which determines the level of formation (adjustment) of FCG-2;
- W_3 – a partial indicator that determines the level of formation (adjustment) of FCG-3;
- W_4 – a partial indicator that determines the level of formation (adjustment) of FCG-4;
- W_5 – a partial indicator that determines the level of formation (adjustment) of FCG-5;
- W_6 – a partial indicator that determines the level of formation (adjustment) of FCG-6;
- W_7 – a partial indicator that determines the level of formation (adjustment) of FCG-7;
- W_8 – a partial indicator that determines the level of formation (adjustment) of FCG-8;
- Y_k – groups of clusters of relevant FCG.

Each partial indicator contains groups of k clusters (Fig. 3), which characterize it. For example, FCG-1 includes: subgroups (clusters) by task level (strategic, operational, tactical); subgroups by type (kind) of troops (forces); variative groups; individual capabilities.

Each k -th cluster characterizes individual capabilities according to certain identifiers (characteristics) that will determine the order (sequence) of formation and adjustment of the Defense Force Capabilities Catalog.

To complete the procedure for forming and adjusting the Defense Force Capabilities Catalog, it is envisaged to assess the acceptability of the results obtained using a compliance criterion based on a generalized indicator (Z).

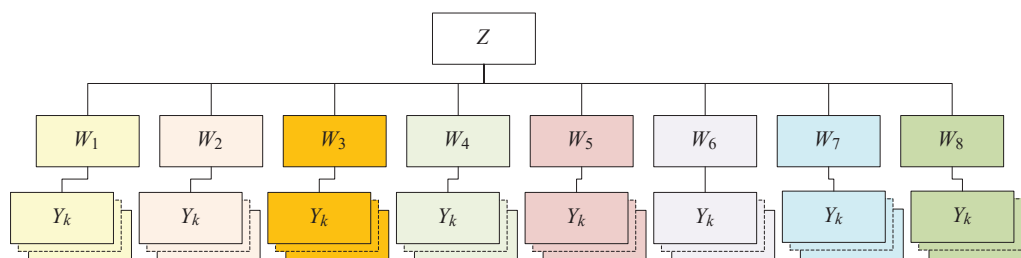


Fig. 3. System of main indicators in the formation and adjustment of the Defense Forces Capabilities Catalog

A compliance criterion is a measure by which the acceptability of the results of identification of individual capabilities of the defense forces is assessed during the formation and adjustment of the Defense Force Capabilities Catalog.

A compliance criterion can accept the following values:

- «consistent» – if a separate capability corresponds to a variative group, subgroup, and functional group according to the predefined classification characteristics. The quantitative value is «1»;

- «not consistent» – if a particular capability does not correspond to the variative group, subgroup, and functional group according to the predefined classification characteristics. The quantitative value is «0».

The compliance criterion will also be used in assessing the acceptability of the results obtained from the formation (adjustment) of the Defense Force Capabilities Catalog in all identified steps.

The results of the procedure are considered acceptable if the generalized assessment «consistent» is obtained for all partial indicators (steps).

4. 4. Algorithm of formation and adjustment of the Defense Forces Capabilities Catalog

The defense force capabilities catalog belongs to the group cluster model, as its elements (individual capabilities of the defense forces) and the links between them are statistical but may change over time. That is why it is advisable to develop an algorithm for the formation and adjustment of the Defense Forces Capabilities Catalog by identifying and describing sequential steps on possible tasks for working groups.

To develop an algorithm for the formation and adjustment of the Defense Forces Capabilities Catalog, three possible variants (tasks) have been selected:

- variant 1 is to amend the Defense Forces Capabilities Catalog by deciding by the Minister of Defense or commander-in-chief of the Armed Forces (except FCG-1) to include a new capability in the Catalog;

- variant 2 is to clarify the Defense Forces Capabilities Catalog, including capabilities requirements based on capabilities review (capabilities assessment), by a decision by the Minister of Defense or com-

mander-in-chief of the Armed Forces (except FCG-1) to clarify the Catalog;

- variant 3 is to develop a new Defense Force Capabilities Catalog based on the results of the defense review (capabilities review, capacity assessment) through the decision of the Minister of Defense to develop a new Catalog.

The developed algorithm for the formation and adjustment of the Defense Forces Capabilities Catalog (Fig. 4) takes into consideration the predefined variants (tasks) and could be used by working groups during the implementation of this procedure.

Based on the results of the acceptability check of the results obtained (Fig. 4), using the compliance criterion, a decision can be made to approve the structure of the Defense Force Capabilities Catalog or make the necessary changes to it.

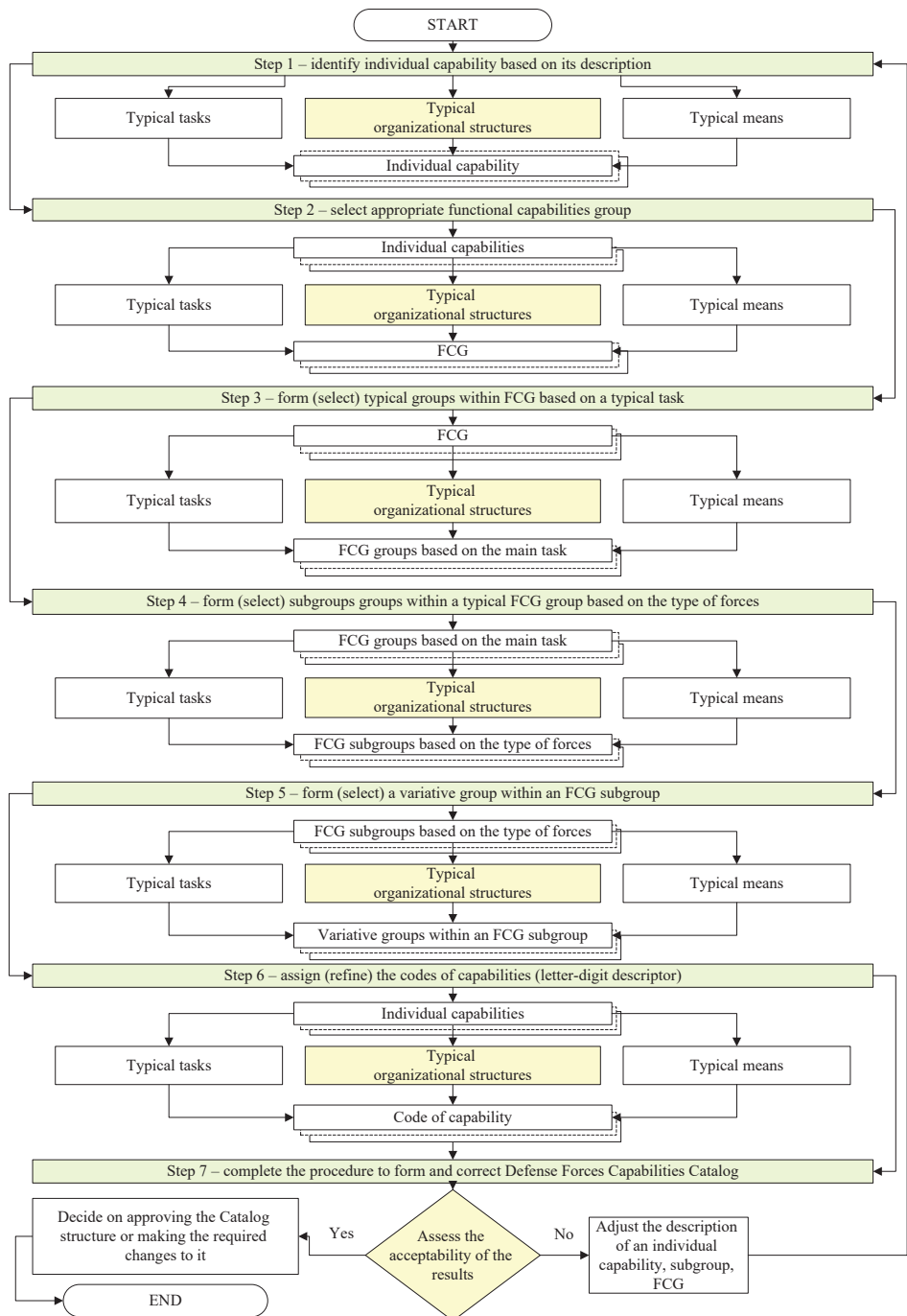


Fig. 4. Algorithm of formation and adjustment of the Defense Forces Capabilities Catalog

If the results do not match the accepted value of the compliance criterion («consistent» for all defined steps), one must review and adjust the description of the individual capability, subgroup, or FCG. Since the Catalog is considered as a group cluster model, it is customary to use the method of rigid hierarchical clustering of individual capabilities of the defense forces in all defined steps for its formation and adjustment. At the same time, it is customary to perform the following measures for each step:

- selection of a sample of individual capabilities of the defense forces (according to typical tasks, organizational structures, and means) for clustering. For example, filling in a table column with the name of the selected capabilities;
- determining a set of characteristics (conditions) by which the similarity of the selected capabilities will be evaluated. For example, to determine the similarity of selected capabilities to a specific FCG, typical group, or subgroup by type (kind) of troops (forces);
- calculation of (determining) the values of the degree of similarity between objects. Value «1» is accepted to be set if the capability belongs to the corresponding column (condition), «0» – if the capability does not belong to the corresponding column (criteria);
- application of a clear method of clustering to create variative groups, subgroups, and functional groups according to certain classification characteristics;
- assessment of the acceptability of the results of clustering on the formation (adjustment) of the Defense Forces Capabilities Catalog in all defined steps according to the compliance criterion.

4. 5. The procedure for forming and adjusting the Defense Forces Capabilities Catalog

It is proposed to simplify the description of all steps on the formation and adjustment of the Defense Forces Capabilities Catalog as this methodology should be used mainly by servicemen and employees of the relevant military administration bodies.

Step 1 – identification of a separate capacity based on its description (Fig. 4) by belonging to a typical task (typical organizational structure, default means). To this end, team members are asked to use Table 1.

It is accepted that the totality of individual capabilities of the defense forces is the fifth level of clusters according to the logical and hierarchical structure of the Defense Forces Capabilities Catalog (Fig. 2).

Identification of a separate capability of the defense forces based on its description (Table 1) is carried out according to the following function:

$$Y_k^1 = \{Y_1, Y_2, Y_3\} \subset Y \text{ at } Y_{1,2,3} \rightarrow [1, 0], \tag{1}$$

where Y_k^1 is the set of k clusters, which are selected to identify capabilities based on their description in the first step; Y_1 – belonging of the i -th capability of the defense forces to cluster 1 (typical task); Y_2 – belonging of the i -th capability of the defense forces to cluster 2 (typical organizational structure); Y_3 – belonging of the i -th capability of the defense forces to cluster 3 (typical means).

For example, a separate capability «Formation of military-technical policy in the field of defense» (Table 1) belongs to cluster 1 (typical task). One must quantify «1» in the «typical task» column and «0» in the remaining columns.

As a result, we obtain three groups of clusters with a set of identified individual capabilities of the defense forces: $Y_1=1$; $Y_2=1$; $Y_3=1$.

The identification is considered complete when all columns are quantified (Table 1).

Step 2 – selecting the appropriate functional capability group (Fig. 4). It is accepted that the totality of FCG is the first level of clusters (partial indicators).

To identify a separate capability based on its belonging to the relevant FCG based on the description, the members of the working group are asked to use Table 2 and a description of the FCG given in the Defense Force Capabilities Catalog [5].

Table 1

Identification of a specific capability based on its description

No. of entry	Capability title	Belonging to			Cluster
		typical task (Y_1)	typical organizational structure (Y_2)	typical means (Y_3)	
1	Formation of military-technical policy in the field of defense	1	0	0	Y_1
2	Department of Military-Technical Policy, Development of Weapons and Military Equipment	0	1	0	Y_2
3	Patrol boat	0	0	1	Y_3
...

Note: Set the value «1» if the capability belongs to the corresponding column (cluster), «0» – if the capability does not belong to the corresponding column (cluster)

Table 2

Identification of a specific capability based on its description of belonging to the relevant functional capability group

No. of entry	Capability title	Belonging to								Cluster
		FCG-1 (W_1)	FCG-2 (W_2)	FCG-3 (W_3)	FCG-4 (W_4)	FCG-5 (W_5)	FCG-6 (W_6)	FCG-7 (W_7)	FCG-8 (W_8)	
1	Formation of military-technical policy in the field of defense	1	0	0	0	0	0	0	0	W_1
2	Department of Military-Technical Policy, Armament Development and Military Equipment	1	0	0	0	0	0	0	0	W_1
3	Patrol boat	0	0	0	0	1	0	0	0	W_5
...

Note: Set the value «1» if the capability belongs to the corresponding column (cluster), «0» – if the capability does not belong to the corresponding column (cluster)

Identification of a separate capability based on its description belonging to the relevant functional capability group (Table 2) is carried out according to the following function:

$$Y_k^2 = \{W_1, W_2, \dots, W_8\} \subset Y \text{ at } W_{1,2,\dots,8} \rightarrow [1,0], \quad (2)$$

where Y_k^2 is the set of k clusters, which are selected to identify capabilities based on their description in the second step; W_1 – belonging to the i -th capability of the defense forces to cluster 1 (FCG-1); W_2 – belonging to the i -th capability of the defense forces to cluster 2 (FCG-2); W_3 – belonging to the i -th capability of the defense forces to cluster 8 (FCG-8).

For example, a separate capability «Formation of military-technical policy in the field of defense» (Table 2) belongs to cluster 1 (FCG-1). It is necessary to set the quantitative value «1» in the column «FCG-1», and in the remaining columns – «0».

As a result, we obtain eight groups of clusters with a set of identified individual capabilities of the defense forces: $W_1=2$; $W_5=1$.

Step 3 – formation (selection) of typical groups in FCG according to the main task. It is accepted that the totality of typical groups according to the main task in the FCG is the second level of clusters (indicators).

If a single capability belongs to a typical task, the next step is to compile, refine, amend the list of common tasks that are known in advance.

When compiling a list of common tasks, be sure to consider the description of the functional group. Here is an example of the identification of a separate capability «Formation of military-technical policy in the field of defense» based on the description of FCG-1 [5] (Table 3).

Table 3

Identification of a separate capability in accordance with the main tasks in the areas of activity (according to the description of FCG-1)

No. of entry	Main tasks (typical groups) by areas	Belonging to	Cluster
1.1	Military and defense policy	0	$U_{1,1}$
1.2	Military personnel policy	0	$U_{1,2}$
1.3	Military-technical policy	1	$U_{1,3}$
1.4	Defense procurement policy	0	$U_{1,4}$
1.5	Organization of defense planning	0	$U_{1,5}$
1.6	Organization of state defense planning	0	$U_{1,6}$
1.7	Organization and implementation of public procurement	0	$U_{1,7}$
1.8	Use of airspace	0	$U_{1,8}$
1.9	Coordination of mine action	0	$U_{1,9}$
1.10	Object and resource management	0	$U_{1,10}$
1.11	Provision of administrative services	0	$U_{1,11}$
1.12	Execution of inspection and supervisory functions	0	$U_{1,12}$

Note: The value «1» is set if the capability belongs to the corresponding task (cluster) in the area, «0» – if not

Identification of a separate capability in accordance with typical groups of FCG-1 (Table 3) is carried out by the following function:

$$Y_k^3 = \{U_{1,1}, U_{1,2}, \dots, U_{1,12}\} \subset Y$$

at

$$U_{1,1}, U_{1,2}, \dots, U_{1,12} \rightarrow [1,0], \quad (3)$$

where Y_k^3 is the set of k clusters, which are chosen for identification to u typical groups (according to the description of FCG-1) in the third step; $U_{1,1}$ – belonging of the i -th capability of the defense forces to cluster 1 of FCG 1; $U_{1,2}$ – belonging of the i -th capability of the defense forces to cluster 2 of FCG 1; $U_{1,12}$ – belonging of the i -th capability of the defense forces to cluster 12 of FCG 1.

For example, a separate capability «Formation of military-technical policy in the field of defense» according to Table 3 belongs to cluster 3 of FCG 1. It is necessary for the line «1.3. Military-technical policy» to set the quantitative value of «1», and in the rest of them – «0».

As a result, we obtain twelve groups of clusters of FCG 1 with a set of identified individual capabilities of the defense forces: $U_{1,3}=1$; the remaining $U_{1,n}=0$.

Step 4 – formation (choice) of subgroups in a typical FCG group by type (kind) of troops (forces). It is accepted that the totality of subgroups by type (kind) of troops (forces) in the typical group of FCG is the third level of clusters (indicators).

If a single capability belongs to an organizational structure, the next step is to identify it according to the lists of typical subgroups of organizational structures that are known in advance.

When clarifying the list of typical subgroups of organizational structures, it is imperative to take into consideration the list of typical tasks, as well as the organizational structures of the defense forces by types (kinds) of troops (forces).

Here is an example of a clear clustering of the organizational structure «Department of military-technical policy, development of weapons and military equipment» based on the list of typical groups of FCG-1, given in Table 3.

Clustering of the organizational structure will be carried out using Table 4.

Table 4

Clear clustering of the typical organizational structure according to the list of typical groups of FCG-1

No. of entry	Typical organizational structure	Typical groups of FCG-1 (based on activity)				Cluster
		1.1	1.2	1.3	...	
1	Department of Military-Technical Policy, Armament Development and Military Equipment	0	0	1	0	$Q_{1,3,1}$
...

Note: the value «1» is set if the capability belongs to the corresponding column (cluster), «0» – if it does not belong

Identification of the organizational structure in accordance with typical groups FCG-1 (Table 4) is carried out by the following function:

$$Y_k^4 = \{Q_{1,3,1}, Q_{1,3,2}, Q_{1,3,3}, \dots, Q_{1,3,n}\} \subset Y$$

at

$$Q_{1,3,1}, Q_{1,3,2}, Q_{1,3,3}, \dots, Q_{1,3,n} \rightarrow [1,0], \quad (4)$$

where Y_k^4 is the set of individual i capabilities of the defense forces, which are chosen for identification to q typical subgroups of FCG-1 in the fourth step; $Q_{1.3.1}$ – belonging of the i -th capability of the defense forces to cluster 1 (UMD) of the 3rd typical group of FCG 1; $Q_{1.3.n}$ – belonging of the i -th capability of the defense forces to another type (kind) of troops (forces) of the 3rd typical group of FCG 1.

For example, the organizational structure «Department of military-technical policy, development of weapons and military equipment» according to Table 4 belongs to cluster 1 (subgroup – UMD) of the 3rd typical group of FCG 1. One must quantify «1» in column «1.3» and «0» in the remaining columns.

As a result, we obtain clearly clustered subgroups by type (kind) of troops (forces) of the 3rd typical group of FCG 1 with a set: $Q_{1.3.1}=1$; the remaining $Q_{1.3.n}=0$.

Thus, the typical organizational structure and typical task are subordinated to (combined), that is, one ensures that the typical organizational structure clearly corresponds to the typical task of the defense forces, and, therefore, a clear clustering was carried out.

If the typical organizational structure can conditionally belong to two or more typical groups of FCG (fuzzy clustering), then it must be identified. Let us give an example of a separate capability «Department of public procurement and supply of material resources» based on the given data (typical groups) in the areas of activity (Table 3).

Clustering of organizational structure will be carried out using Table 5.

Table 5

Fuzzy clustering of the default organizational structure according to the list of typical FCG groups

No. of entry	Typical organizational structure	Typical subgroups of FCG-1 (based on the organizational structure)					Cluster
		...	1.4	...	1.7	...	
1	UMD Department of public procurement and supply of material resources	0	1	0	1	0	$Q_{1.4}, Q_{1.7}$
...

Note: the value «1» is set if the capacity belongs to the corresponding column (cluster), «0» – if it does not belong

In this case, one should additionally analyze the description of the defined basic tasks (typical groups) in the directions given in Table 3. Thus, according to the results of comparative analysis, it was established that the «Department of public procurement and supply of material resources» performs two tasks (two functions), and the task «1.4. Defense Procurement Policy» is broader in essence than «1.7. Organization and implementation of public procurement».

These tasks are proposed to unite, at the same time clarify and amend the description of the organizational structure «Department of public procurement and supply of material resources», namely, the organization and implementation of public procurement. In addition, the description of FCG-1 [5] will be subject to clarification (amendments). This means that it is necessary to remove from the description the sentence «organization and implementation of public procurement», since this requirement (function, task) is assigned directly to the organizational structure (Department).

Consequently, the transition from fuzzy to clear clustering has been made, while refining and amending the list of main tasks (typical groups) in the directions specified in Table 3, and the description of FCG-1. The transition from fuzzy to clear clustering is also possible by clarifying the basic and main requirements for a separate capability of the defense forces.

The results of clustering should also be compared to the NATO Capabilities Catalog to ensure their maximum compatibility.

Step 5 – formation (choice) of a variative group in the FCG subgroup. It is accepted that the totality of variative groups and individual capacities that do not belong to the variative groups constitute the fourth level of clusters (indicators).

If a separate capability (task, organizational structure, or means) is similar to another but differs in the level of management (strategic, operational, tactical), then it is necessary to group them (cluster) into a variative group.

For example, according to the results of the analysis, the members of the working group established that the capability «Patrol Boat» (Table 2) belongs to FCG-5. Another «Warship» capability also belongs to FCG-5, which is similar but more significant (Table 6).

Formation (choice) of a variative group in terms of similarity (level of management) of individual capabilities (Table 6) is carried out according to the following function:

$$Y_k^5 = \{J_{1.1}, J_{1.2}, J_{1.3}\} \subset Y$$

at

$$J_{1.1}, J_{1.2}, J_{1.3} \rightarrow [1, 0], \tag{5}$$

where Y_k^5 is the set of individual i defense force capabilities, which are chosen to group to the j -th variative group in the fifth step; $J_{1.1}$ – belonging of the i -th capability of the defense forces to the 1st level of management (strategic) of the 1st variative group (cluster) FCG-5; $J_{1.2}$ – belonging of the i -th capability of the defense forces to the 2nd level of management (operational) of the 1st variative group (cluster) FCG-5; $J_{1.3}$ – belonging of the i -th capability of the defense forces to the 3rd level of control (tactical) of the 1st variative group (cluster) FCG-5.

Table 6

Formation (choice) of a variative group in terms of similarity (level of management) of individual capacities

No. of entry	Capability title	Variative group name	By level of management during the performance of typical tasks			Cluster
			strategic (1)	operational (2)	tactical (3)	
1	Warship	Capability of surface ships (means)	0	1	0	$J_{1.2}$
2	Patrol boat		0	0	1	$J_{1.3}$
...

Note: the value «1» is set if the capability belongs to the corresponding column (cluster), «0» – if it does not belong

As a result, we obtain a grouped variative group (cluster) «Capability of surface ships (means)» with a set of identified individual capabilities of the defense forces according to the order of placement (levels of management).

A prerequisite is also the grouping of variative groups by the corresponding subgroups of FCG. For example, according to the results of the analysis, it was established that the variative group «Capability of surface ships (means)» (Table 6) belongs to FCG-5 and the «Naval Forces» capability subgroup, so the variation group «Capability of surface ships (means)» must be subordinate to the subgroup of capabilities of the «Naval Forces» due to their similarity for functional purposes.

When clustering variative groups and subgroups of capabilities of the defense forces, it is necessary to adhere to the principle of «construction hierarchy»: the first level should characterize typical tasks, the second – typical organizational structures, the third – typical means. This means that tasks are defined first, then the default organizational structures are selected that have the appropriate default means.

The results of the identification and grouping of variative groups by relevant subgroups are proposed to be summarized in Table 7. Based on the results of identification and grouping of variative groups by the relevant subgroups (Table 7) using functions (1) to (5) we obtain a group cluster model of the Defense Forces Capabilities Catalog.

When compiling a list of default organizational structures, be sure to take into consideration the list of common tasks, as well as the list of common tools. Therefore, it is better to develop (refine) them simultaneously using electronic resources and tables (databases).

In the case of fuzzy clustering of a variative group to higher subgroups by hierarchy levels, the description of the variative group is additionally analyzed (clarified) according to the general description of the variant and the main general characteristics. The results of the clustering of the Defense Force Capabilities Catalog should be compared with the NATO Capabilities Catalog for maximum compatibility.

Step 6 – assigning (refining) capability codes (alphanumeric descriptor). As a code of capability (alphanumeric

descriptor), it is customary to understand a set of Latin letters and Arabic numerals written through a hyphen (for example, AC2C-BD), which identifies capability and is used in the information system. Periods are also used as special characters – «.».

For example: E.2.1 – alphanumeric descriptor of functional group (subgroup) of capability. In it, E is a prefix that denotes the code of the functional capability group (FCG-5). The following are the numerical indexes: 2 – typical group of FCG (E) in order of placement; 1 – subgroups (type, kind of troops and services of the armed forces) of the typical group E.2 FCG (E) in order of deployment.

The capability code is assigned by a working group using conditional reductions in typical tasks, typical organizational structures, types (kinds) of troops (forces) and capabilities, and also in the list of capabilities codes of the NATO Capability Catalog [6].

The number of letters in the capability code is unlimited, for example: INF-H-BDE – capability code. In it, INF – infantry identifies the belonging of the capability to the variative group, is part of the code of capability; H – hheavy classifies capability according to its characteristics; BDE – brigade (brigade) points to a unit (connection).

Step 7 – completion of the procedure for the formation and adjustment of the Defense Force Capabilities Catalog. At the final stage of the procedure for forming and adjusting the Defense Forces Capabilities Catalog, the acceptability of the results obtained is assessed (Table 8).

The acceptability of the results obtained on the formation and adjustment of the Defense Force Capabilities Catalog (Table 8) is assessed by the following function:

$$Z = \{W_1, W_2, \dots, W_8\} \text{ at } W_1, W_2, \dots, W_8 \rightarrow 1, \tag{6}$$

where Z is the generalized indicator characterizing a generalized assessment of the formation (adjustment) of the Defense Forces Capabilities Catalog in the seventh step; W_1, W_2, \dots, W_8 – partial indicators that characterize the obtained estimates for the formation (adjustment) of FCG in 1–6 steps.

Table 7

Identification and grouping of variative groups by relevant subgroups

No. of entry	Capability title	Belonging to			
		FCG-5 (typical groups of level 1)	main tasks (typical groups of level 2)	kind (type) of forces (a subgroup of level 3)	variative group of level 4
1	Capabilities of military units and subunits to perform main tasks on their own and as part of inter-specific groups	1	0	0	0
2	Maritime operations	1	1	0	0
3	Naval Forces of the Armed Forces of Ukraine	1	1	1	0
4	Capacity of surface ships (means)	1	1	1	1

Note: typical organizational structures of the defense forces include: at the tactical level – battalion (division, squadron), brigade (regiment), at the operational – operational command, at the strategic – inter-departmental grouping of troops (forces). Typical support structures include: at the tactical level – platoon, battalion, at the operational – regiment, brigade

Table 8

Results of acceptability assessment of the results

The value of the criterion of compliance	Evaluation by defined partial indicators							Z
	W_1	W_2	W_3	W_4	W_5	W_6	W_7	
Consistent	1	1	1	1	1	1	1	1
Not consistent	0	0	0	0	0	0	0	

Note: the value «1» is obtained provided that all individual capabilities are identified on the basis of their description and grouped into variative groups, subgroups, and FCG, as well as they are clearly clustered according to the appropriate steps, «0» – if unidentified (non-clustered) individual capabilities remain or fuzzy clustering is detected

As a result, we obtain a generalized assessment on the formation (adjustment) of the Defense Forces Capabilities Catalog.

If the assessment is «consistent» («1») on all partial indicators (Table 8), the next task of a working group will be to prepare proposals (report) for a decision by the Minister of Defense or commander-in-chief of the Armed Forces (except FCG-1) on approving the structure of the Catalog or making the necessary changes to it.

That makes it possible to affirm the clear clustering of individual capabilities according to quantitative attribute-based similarity, as well as qualitative support for the formation (adjustment) of the logical and hierarchical structure of the Defense Forces Capabilities Catalog.

If the assessment is «not consistent» («0») according to one of the partial indicators, a working group should adjust the description of the individual capability, subgroup, or FCG, and re-conduct the activities in the specified steps.

Thus, the algorithm of formation and adjustment of the Catalog of capabilities of the defense forces (Fig. 4), which is based on the use of the method of rigid clustering of individual capabilities of the defense forces, has been developed. This algorithm makes it possible to hierarchically group (modify) interdependent typical tasks (functional capabilities), typical organizational structures, and typical means (capability carriers) of troops (forces) into a single list.

5. Discussion of the developed methodology for the formation and adjustment of the Defense Forces Capabilities Catalog

The methodology for forming and adjusting the Defense Forces Capabilities Catalog using the rigid hierarchical clustering method is designed to ensure the qualitative performance of tasks by working groups.

The possibilities of the rigid clustering method when choosing the appropriate method for the methodology were compared to the soft clustering method, the simplex method, and regression analysis. The method of rigid clustering in comparison with others makes it possible to divide the studied set of objects into multiple cluster numbers, which are clearly or vaguely interdependent at a predetermined distance between objects.

Approaches defined in [2–4, 32] were also subject to comparison. It has been clarified that the existing approaches provide general provisions and the general structure of the Capabilities Catalog only for the Armed Forces. At the same time, the algorithm of formation (adjustment) is not specified, the list of typical tasks is not taken into consideration, the procedure for assigning (clarifying) capability codes (alphanumeric descriptor) is not specified, the procedure for assessing the acceptability of the results obtained is not determined, etc.

The developed methodology for forming and adjusting the Defense Forces Capabilities Catalog was tested in 2020 during a passive experiment on assessing the existing structure of the Defense Forces Capabilities Catalog [5].

During a passive experiment, the following main disadvantages were identified:

1) the Defense Force Capabilities Catalog does not include typical organizational structures and model means (capabilities) set out in Recommendations [32], which significantly distinguishes it from the structure of the NATO Capabilities Catalog [6];

2) according to the results of filling in Table 3 according to the description of FCG-1, discrepancies were found with typical groups of the Defense Forces Capabilities Catalog by number and names, as well as other problems;

3) according to the results of filling Table 4 according to the description of FCG-1, we revealed significant differences with the subgroups of the Defense Forces Capabilities Catalog;

4) according to the results of filling Table 5, we found that some organizational structures may belong to several default groups at the same time (e. g. 1.4 and 1.7), etc.

These and other results of the methodology test show that the structure of the current Defense Force Capabilities Catalog [5] is evaluated as «not consistent» with clear clustering according to certain classification characteristics. This is *the first sign of the adequacy of the developed Methodology*, its effectiveness, and correctness of the use of the group cluster model during the implementation of this procedure.

The second sign of the Methodology's adequacy is the ability to identify in the current Catalog [5] the lack of interconnection of typical tasks with typical organizational structures and means (capability carriers) of the defense forces. The codes of individual capabilities of the defense forces (alphanumeric descriptors) are assigned in order of their placement, which means that they will constantly change and are incorrect.

The above results of approximation of the developed Methodology during a passive experiment on the evaluation of the existing structure of the Defense Force Capabilities Catalog have previously confirmed its adequacy, and, therefore, its feasibility.

One of the ways to improve the efficiency of using the Methodology is to improve the quality of development of lists of typical tasks (typical organizational structures, typical means) of the Ministry of Defense, the Armed Forces, and other components of the Defense Forces.

Thus, the developed methodology for the formation and correction of the Defense Forces Capabilities Catalog makes it possible:

1. With the use of cluster analysis, to form, clarify the structure, to introduce new capabilities to the functional capabilities groups and the Catalog of capabilities of the defense forces according to certain identifiers (features). Identifiers (signs) are: description of functional capability groups (Fig. 1); the determined levels of hierarchies of groups (clusters) of capabilities (Fig. 2); capability for tasks, organizational structures, or means (Table 1); management levels, etc.

2. In contrast to the known approaches and provisions of methodological documents, to apply a single algorithm for the formation and adjustment of the Defense Forces Capabilities Catalog (Fig. 4) using the formed system of basic indicators and evaluation criterion.

3. To obtain a reasoned qualitative result of the formation and adjustment of the Defense Forces Capabilities Catalog using the developed logical-hierarchical (tree) structure of the Defense Forces Capabilities Catalog (Fig. 2) and two-sign identification of clusters.

4. With sufficient quality for practical tasks, to form a defense planning document, which can be used in the evaluation, planning of the use of troops (forces), determining of measures for the development of defense forces, etc.

5. It can be used by the Ministry of Defense and other military administration bodies of the Defense Forces to create, deploy, and maintain special software. It is advisable to include Tables 1–8, functions (1) to (6) to identify and group existing capabilities of troops (forces) in the preserved

order of formation and adjustment of the Defense Forces Capabilities Catalog.

During this study, the limitations of the customer and consumers were taken into consideration: a minimum of functions and maximum examples for the formation of a single list (Catalog) of capabilities of the Ministry of Defense, the Armed Forces, and other components of the Defense Forces.

Further research may address improving the methodological basis for strategic decisions on planning the development of the Armed Forces' capabilities for the long term under conditions of partial uncertainty and risks.

6. Conclusions

1. The logical and hierarchical structure of the Defense Forces Capabilities Catalog was formed, which, unlike others, includes five levels of hierarchy, each of which contains interdependence typical tasks, organizational structures, and means (systems, complexes). This makes it possible to more qualitatively draw up a single and coordinated document describing the existing capabilities of the defense forces for their assessment, application planning, determining of development measures for the medium and long term, etc.

2. The input data of the methodology were the selected lists of typical tasks, organizational structures, and means (systems, complexes) as they are specified during the defense review, capabilities review, and in the course of daily activities of troops (forces). To identify individual capabilities of the defense forces, the input data also included their description according to the basic, main, and additional requirements that will allow the transition from fuzzy to clear

clustering. That will increase the degree of mutual coordination of these lists and improve the quality of the description of individual capabilities of the defense forces.

3. To identify the individual capabilities of the defense forces and group them into functional capabilities groups, typical groups, subgroups, and variative groups, cluster analysis was chosen. A system of basic indicators for the formation and adjustment of the Defense Forces Capabilities Catalog has been developed. The criterion of conformity, which has two quantitative and qualitative values and is used to assess the acceptability of the results obtained for the formation and correction of the Defense Force Capabilities Catalog in all defined steps, was chosen.

4. A unified algorithm for the formation and adjustment of the Defense Forces Capabilities Catalog has been developed, which can be used by members of working groups in three variants (during a defense review, separate review, or capability assessment). The special features of the algorithm are its versatility and simplicity, which make it possible to group a large array of hierarchically interdependent objects (typical tasks, organizational structures, and means) into a single requested document and process interdependent information.

5. Based on the developed algorithm, it became possible to describe the order of grouping of individual capabilities of the defense forces using cluster analysis and specially designed tables. This approach has made it possible to identify a series of significant shortcomings in the current Defense Forces Capabilities Catalog regarding its structure and content. During the development of the methodology, it was taken into consideration that it should be used mainly by military authorities rather than researchers (experts); thus, it was simplified as much as possible for use in practice.

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