The solution of problematic issues of substantiating decisions by improving the mechanism and technology for determining the target function in the system of ensuring the military security of the state is proposed. An integral indicator of the degree of realization of national interests in the field of military security – the level of military security is adopted under the target function.

In order to increase the efficiency of the functioning of the system of ensuring the military security of the state, it is proposed to create an effective mechanism for assessing the decisions made. The improved decision-making mechanism involves comparing the values of the obtained value of the level of military security with its permissible (potential) level, which should be adequate to the current situation, the resource capabilities of the state and the level of danger of existing threats. The improved mechanism will also facilitate effective organization of the planning processes for the use of defense forces in emergency situations.

To determine the level of military security, the article substantiates a system of indicators. The above indicators to the greatest extent characterize the degree of realization of national interests in various spheres of military security, taking into account the interrelationships between them. The value of these indicators is determined on the basis of available statistical data, and in their absence – by an expert survey. The implementation of the proposed mechanism for substantiating state decisions in the military security system allows the use of multidimensional comparative qualitative and quantitative measurements. On the basis of these measurements, it becomes possible, practically on a time scale as close to real as possible, to determine priority measures to increase the efficiency of decisions and the level of military security of the state as a whole. The application of the improved mechanism is proposed both at the decision-making stage and after the implementation of decisions by the military security system.

In the following, the conditions, features of the application of the proposed methodology and the prospects for its adaptation for solving problems of control of defense forces during their application are given

Keywords: target function, decision-making mechanism, level of state military security

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DEVELOPMENT AND IMPLEMENTATION OF THE TARGET FUNCTION IN THE DECISION-MAKING PROCESS IN THE SYSTEM OF PROVIDING THE MILITARY SECURITY OF THE STATE

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1. Introduction

The modern security environment is extremely dynamic. At present, there are still unresolved contradictions associated with certain differences in the national interests of many neighboring states, as well as some leading states of the world that have their own interests in specific regions. This is due to many factors, including the subsequent intensification of the struggle for access to natural resources and control over them, which will undoubtedly intensify every year. The architecture of global security is changing, the number of unstable regions is spreading, hotbeds of new military conflicts are flaring up and old ones are thawing.

Ensuring global and regional stability becomes impossible without increasing the military security of the state, maintaining the state of the country's defense capability, which ensures the prevention of armed conflicts and the repulse of possible military aggression. So, for many states, the urgent need has become the reform and development of

the entire security and defense sector in order to increase its readiness to counter modern dangers and threats.

At the present stage of development of states, one of the most dangerous threats to national security is undoubtedly the low level of military security. The level of military security largely depends on the effectiveness of the functioning of the state's military security system. One of the key properties of such a system, of course, is the adoption of well-grounded military-political decisions in the processes of ensuring military security. For certain reasons, making such decisions without proper justification can lead to irreversible huge losses of resources, government, etc. Under these conditions, for each country there is a need to improve the functioning of the military security system to prevent unreasonable decisions. The solution of these issues is impossible without improving the structure of the system itself, namely, the development and implementation of a decision-making mechanism into the system with the provision of all system properties of complex systems. Eliminating these shortcomings in the functioning of the military security system is the subject of this article, in which a representative target function and a proposed decision-making mechanism with its use are developed. In the context of the next global economic crisis, the proposed approach will make it possible to more efficiently spend resources on the maintenance and development of the state's military security system and refrain from unnecessary expenses.

2. Literature review and problem statement

To ensure its own security, each state has its own approaches, its own concept, which may be completely different from each other. This difference in approaches to ensuring the military security of the state significantly affects the mechanisms for making military-political decisions, which is also different in each country. Most European countries are NATO members and, accordingly, rely on a NATO charter to ensure their military security. In such countries, military-political decision-making is carried out on the basis of consensus decisions in the relevant bodies of the executive council based on verbal methods, logic, deduction, induction, and the like. Such methods do not provide sufficient substantiation for making certain military-political decisions, they are devoid of clear mathematical argumentation and are evaluated by the real state of affairs in time [1–3]. The decision to take such approaches does not provide for the use of the target function in the military security system and, as a rule, do not require clear criteria for making decisions and no mechanism for its use is provided.

The work [4] is devoted to the analysis of national security as a complex process. Where the process of ensuring national security in all aspects is considered in detail, but the decision-making mechanism in the process of functioning of this system was left without attention. The paper shows that the top military-political leadership of the country is provided with modulated options for military-political decisions, of which one is selected by the verbal method.

In [5], the analysis of the process of ensuring the state's military security is carried out in even more detail. The functioning of the military security system is considered according to certain modules – information, management and executive. These modules are designed to implement certain of their functions. The process of ensuring military security is divided into two subfunctions – supporting political and military awareness of the situation and neutralizing identified threats. Based on the functioning of these modules, a model of the state's operational activities to achieve and maintain the desired level of military security is proposed (a model of the functioning of the military security system). Along with this, how military-political decisions are made within the military security system and on what basis are not given in the work. Also, having revealed in detail the essence of the category of military security and the general mechanism of functioning of the system for ensuring military security, the work does not define the specific target function of this system together with the criterion for its assessment.

In [6], Western experts proposed an approach that is used in world practice, in which the determination of the state of development of countries is calculated as an average value for ten indicators. But this approach does not consider the process of the functioning of the system, there is no comparative element and feedback, there are no directions for improving decisions taking into account the coefficients of the importance of indicators. In this regard, there is a need to develop a more substantiated approach to assessing options for solutions in the military security system.

The monograph [7] is mainly devoted to conceptual issues of national security, which emphasizes the complexity of the national security system, the subsystem of which is the military security system. Also, the monograph provides the main properties of complex systems and emphasizes the need to comply with them. But the existing systems for ensuring military security lack some properties, and it is precisely the systems that are basically open-ended, do not have an target function and a comparative element, which complicates the process of substantiating decisions.

In the monograph [8], the main emphasis is on the analytical determination of the limit values of national security indicators and the procedures for their use in the decision-making process are not given, and there are no indicators for assessing military security.

In [9], a system of indicators for assessing the level of military security of a state is proposed, but this system does not cover all areas of military security and has a fragmented character. In addition, these indicators are not tied to the military security system and decision-making mechanism. In works [10–12] indicators for individual subsystems of national security are determined, but proposals for their use for decision-making in security systems are not provided.

The monograph [13] proposes a system of indicators for assessing the level of national security, which covers all its spheres and is an analogue of the system of indicators for assessing the level of military security. On the basis of a certain system of indicators, a technology for determining the integral indicator is provided. But the work lacks a decision-making mechanism for a comparative element and an target function.

In [14], taxonomic methods of multivariate comparative analysis are proposed, which are devoid of some important drawbacks and are useful for calculating the target function for the military security system.

The analysis of the above works shows that the issues of studying the theoretical essence of making analytically grounded decisions in the system of ensuring military security in time close to real are not presented in world scientific works. And this indicates that there is no opportunity to

work out predictive solutions and choose the right solution. Consequently, it became necessary to form an target function to substantiate decisions in the military security system and implement it in an appropriate mechanism, and the determination of the coefficients of the importance of indicators makes this process more straightforward.

3. The aim and objectives of research

The aim of research is to solve problematic issues of substantiating decisions in the system of ensuring military security when planning a set of measures to neutralize threats in the field of military security. It is proposed to base the substantiation of these decisions on the degree of implementation of the target function of the state's military security system. At the same time, the target function should be based on the main goal of ensuring military security – the realization of national interests in this area.

To achieve the aim of research, the following objectives are set:

– to develop a decision-making mechanism in the system of ensuring the state's military security;

– to determine indicators for assessing decisions in the system of ensuring the state's military security;

– to develop (improve) the methodology for calculating the integral indicator – the target function for the system of ensuring the military security of the state;

– building a tree of possible trajectories of the state's military security level for various solutions.

4. Development and implementation of the target function for decision-making in the military security system

4. 1. Development of an effective mechanism for making military-political decisions in the system of ensuring the military security of the state

In the context of drastic changes in the military-political situation at the global, regional and subregional levels, as well as internal transformations, each country produces its own military policy, taking into account certain geopolitical guidelines. This policy determines the directions of military development and the use of military force to achieve political goals both within the country and in the international arena. The main goal of the state's military policy is to ensure military security and prevent any military conflicts.

At the same time, military policy must meet the interests of the individual, the security and defense sector, society and the state. To do this, it is necessary to monitor and identify the sources and causes of threats to the national interests of the state in the field of military security and immediately develop and implement measures to neutralize them.

For this, in turn, it becomes necessary to perform a set of basic tasks, such as:

– making effective decisions in the field of military security;

– creation and maintenance in readiness of forces and means of ensuring military security;

– participation in international security events in accordance with international treaties and agreements;

– development of directions of actions (strategies) to achieve the set goals;

– determination of factors and conditions that may interfere with the implementation and protection of national interests in the field of military security, and the like.

To ensure military security are the following functions (tasks, targets) that can't be performed (solved, achieved) within the framework of individual structures. This is due to the lack of mechanisms for the development and adoption of political decisions at the national level in the entire spectrum of issues related to military security.

In this regard, it becomes necessary to create a system for ensuring military security as a complex of organizational structures and forces. In such a system, targeted decisions should be made and coordinated actions and measures should be taken to implement the vital interests of the individual, society and the state, including the security and defense sectors. Such coordinated actions should provide guarantees of the country's defense against military threats and armed aggression and other encroachments with the use of military force.

Given that this system includes several subsystems and differs in components of various levels, it can be attributed to complex hierarchical organizational systems, which have such systemic properties [7]:

– integrity and the possibility of decomposition;

– presence of connections and relationships between individual subsystems;

– internal and external interaction;

– many possible states;

– presence of a complex target function;

– clear nature of behavior;

– new system quality.

Modern systems for ensuring the military security of a state have many components, most of the above properties are inherent in them, however, the target function that should be used to assess the effectiveness of decisions made, unfortunately, is absent. They also lack a comparative element tied to feedback, which, in the absence of an assessment criterion, complicates both the process of substantiating government decisions in real time and the effectiveness of their implementation.

In order to eliminate these shortcomings in the modern system of ensuring the state's military security, it is necessary to provide for the creation of an effective decision-making mechanism, the diagram of which is shown in Fig. 1.

With the introduction of such a mechanism, the state's military security system will undoubtedly enter into all the properties of complex systems. That is, when making government decisions, it will become possible, based on the calculation of the integral indicator (target function), to consider alternative solutions in a time scale that is as close to real as possible. As an integral indicator (target function), it is advisable to choose the level of state military security as a comprehensive criterion for assessing the degree of realization of national interests in the field of military security.

The use of the proposed mechanism involves comparing the values of the obtained value of the level of military security (P_{MS}) with its permissible (potential) level (P_{AMS}), which has the maximum correspondence with the existing situation, the resource capabilities of the state and the level of danger of existing threats. If the value of the integral indicator (target function) decreases with the chosen solution option, then the procedure is repeated in order to find the most appropriate solution, which is ultimately submitted for approval.

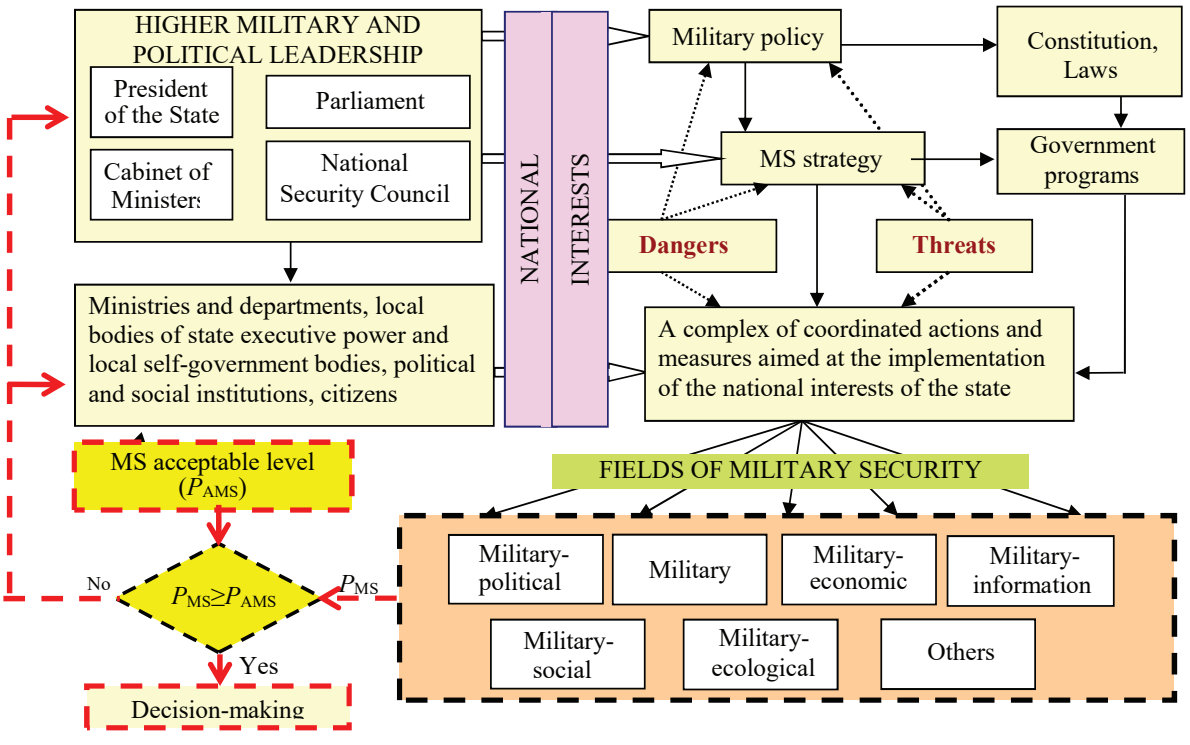

Fig. 1. The mechanism for making military-political decisions

An implementation of this mechanism for substantiating state decisions in the field of military security will also contribute to the effective organization of planning processes for decision options for the use of defense forces in emergency situations.

4. 2. Determination of indicators for assessing decisions in the state military security system

Based on the above, it becomes possible to state that implementation of the proposed mechanism of substantiation government decisions in the military security system allows to apply multidimensional qualitative and quantitative metrics. Those metrics might be a basis for determination top-priority actions to raise decision effectiveness and the level of state military security in general.

It is advisable to implement the proposed mechanism for substantiating government decisions by using multidimensional qualitative and quantitative measurements of indicators characterizing the level of national and military security [13].

To determine the level of military security (target function), it is advisable to use indicators from different areas of military security:

1. Abundance (relative incidence) of defense forces (DF) in the state (dimensionless indicator – *d/i*).
2. Combat potential of DF (*d/i*).
3. Level of combat readiness of DF (*d/i*).
4. Level of mobilization readiness of DF (*d/i*).
5. The degree of personnel (managerial) professional training (*d/i*).
6. Level of DF combat capability (*d/i*).
7. Personnel staffing level of DF (*d/i*).
8. Share of the military budget in the total state budget (%).
9. Capabilities to provide DF with weapons and military equipment as well as their maintenance for combat readiness in peacetime (*d/i*).
10. State capabilities on logistics for DF in exceptional period (*d/i*).
11. Level of satisfaction for defense spending per real needs (*d/i*).
12. Degree of provision DF with strategic reserves (*d/i*).
13. Status of development for military science (*d/i*).
14. Degree of preservation of scientific and technical potential at military industrial sector (MIC) (*d/i*).
15. MIC capabilities for development of modern weapons (*d/i*).
16. Degree of implementation for state security guarantees from the world leading countries (*d/i*).
17. Alert state from neighboring countries (*d/i*).
18. Presence of bilateral agreements on friendship and cooperation with neighboring countries (pcs.).
19. Level of tension in the military-political situation at the region (*d/i*).
20. Degree of provision the DF by military-trained human resources that meet professional requirements (*d/i*).
21. Number of officers who meet the requirements for the level of professional training (%).
22. Number of officers who meet the health requirements (%).
23. Average age of military scientists and teachers of higher qualification (years).
24. Degree of impact of DF activities on the environment (*d/i*).
25. Degree of social and psychological tension in DF (*d/i*).
26. Effectiveness level of moral and psychological support for personnel at DF (*d/i*).
27. Level of patriotism of personnel at DF (*d/i*).
28. Degree of activity (danger) of illegal paramilitary formations in the state (*d/i*).
29. The degree of influence of opposition party leaders on personnel at DF (*d/i*).
30. Level of activity of separatist forces in the state (*d/i*).
31. Average standard of life of servicemen (share of cash income per family member/minimum subsistence level) (%).
32. Status of social security for servicemen (*d/i*), etc.

The values of the indicators are determined on the basis of available statistical data, and in their absence – by an expert survey.

Based on certain initial data, relying on quantitative methods of multidimensional comparative analysis, it becomes possible to calculate the level of military security of the state. To characterize the dynamics of changes in the level of military security of a state, it is advisable to determine its evolution over time.

4. 3. Development (improvement) of the methodology for calculating the integral indicator – the target function for the system of ensuring the military security of the state

The most attractive in this regard are taxonomy methods [14]. They are, in contrast to a number of other possible methods that make it possible to obtain acceptable results in the absence of strict restrictions on the number of indicators chosen to assess the level of military security. They also allow comparing objects in a multidimensional space, and on this basis calculate the degree of importance of particular indicators and the value of an integral indicator characterizing the level of military security of the state.

When using the methods of taxonomy [14], based on the data obtained, a matrix is built that characterizes the set, and the following is investigated:

$$\left[X_{ij}\right](i=1, 2, ..., \omega,\ j=1, 2, ..., n), \tag{1}$$

where i – objects (options for solutions, level of development, degree of danger, etc.); j – indicators; ω – the number of objects under consideration; n – the number of indicators selected to describe the properties of objects.

The quantitative values of the elements of the initial data matrix, as well as the values of the indicators of the degrees of realization of national interests in various sectors of the military security sphere, are also determined on the basis of real statistical information or are calculated based on the results of an expert survey.

Since the data brought into a matrix describe different properties of objects and have different units of measurement, the required computational procedures become much more complicated. So, the initial data matrix should be reduced to a standardized form according to the formula

$$Z_{ik} = \frac{X_{ik} - X_k}{S_k}, \tag{2}$$

where Z_{ik} – the standardized value of the k-th indicator for the i-th object;

X_{ik} – the value of the k-th indicator for the i-th object;

X_k – the arithmetic value of the k-th indicator;

S_k – the standard deviation of the k-th indicator.

The arithmetic mean of the k-th indicator is calculated by the formula

$$X_k = \frac{1}{\omega}\sum X_{ik}\left(i=1, \omega\right), \tag{3}$$

where ω – number of objects under consideration.

The standard deviation of the k-th indicator is determined by the formula

$$S_k = \left[\frac{1}{\omega}\sum\left(X_{ik} - X_k\right)^2\right]^{\frac{1}{2}}. \tag{4}$$

To calculate the elements of the distance matrix, a metric is most often used – the absolute average difference in the values of indicators:

$$C_{rs} = \frac{1}{\omega}\sum\left|Z_{rl} - Z_{sl}\right|,\ \ l=1, \omega;\ \ r, s=1, n. \tag{5}$$

By calculating the distance between all units of this population, let's obtain the required matrix. The elements of this matrix form the basis for a multidimensional comparative analysis of the processes and phenomena under consideration and have the following properties:

$$C_{rr} = 0;\ \ C_{rs} = C_{sr};\ \ C_{rs} \le C_{rv} + C_{vr}. \tag{6}$$

Now it is possible to carry out a number of procedures that allow to order the set of investigated and make various comparisons on multidimensional objects.

Taxonomy procedures are responsible for building a priority set of indicators based on providing them with importance factors (building a hierarchy). These coefficients indicate the position and role of each indicator in the studies performed, contributes to a targeted search and a reasoned choice of control action on the complex system under consideration.

To determine the coefficients of importance of indicators, one can use an approach based on calculating the so-called critical distance, for example, the greatest distance between indicators that are located close to each other, and, therefore, indicate strong relationships between indicators [14]:

$$C_k = \max_i \min_j \left(\alpha_i, \alpha_{ij}\right). \tag{7}$$

After that, for each indicator of the diagnostic set, all distances Q_i are found that do not exceed the critical C_k:

$$Q_i = \left\{\begin{matrix}(i,\ j)\left|\ \rho\ \left(\alpha_i, \alpha_{ij}\right) \le C_k;\right. \\ j=1,\ 2, ..., n;\ 0<i<n\end{matrix}\right\} \tag{8}$$

and sum them up

$$\overline{\omega_i} = \sum \rho\left(a_i, a_{ij}\right);\ (i, j) \in Q_i, \tag{9}$$

where $\rho(\alpha_i, \alpha_{ij})$ – the distance between adjacent indices α_i and α_{ij} of the diagnostic set.

Next, an indicator is selected for which the sum of the distances is the most

$$\omega_m = \max \omega_i, \tag{10}$$

and calculate the coefficients of the hierarchy of all indicators

$$\lambda_j = \frac{\omega_i}{\omega_m}. \tag{11}$$

The value of the hierarchy coefficient for the indicator is the greater, the greater the sum of the distances of the indicator from its neighbors.

Carrying out the above calculations makes it possible to compare and evaluate multidimensional objects based on a complex generalized indicator. For this, the indicators are differentiated taking into account the nature of their influence on the final result. Indicators, an increase in which causes an increase in the generalized indicator, are called

stimulants, and indicators, the growth of which causes a decrease in the generalized indicator, are called destimulants.

After that, a reference object is built and constitutes a point P_0 in a multidimensional space with coordinates:

$$Z_{01}, Z_{02}, ..., Z_{0F},$$

$$Z_{0F} = \max Z_{RF}, \text{ at } F \in S,$$

$$Z_{0F} = \min Z_{RF} \text{ at } F \in D \ (F = 1, 2, ..., n), \quad (12)$$

where Z_{OF} – the standardized value of the F-th indicator of the reference object;

Z_{RF} – the standardized value of the F-th indicator for the R-th object;

S, D – sets of stimulants and destimulants, respectively.

Then the distance between point P_0 and points-objects in the selected system of coordinates will be determined using reflection

$$C_{i0} = \left[\sum_f \left(Z_{if} - Z_{0f}\right)^2\right]^{\frac{1}{2}}, \quad i = 1, 2, ..., \omega, \quad (13)$$

These distances are the basis for calculating the relative generalized indicator of the object (solution options, level of development, degree of danger, etc.)

$$d_i = \frac{C_{io}}{\overline{C}_0}, \quad (14)$$

where $\overline{C}_0 = C_0 + 2S_0$; $S_0 = \left[\frac{1}{\omega}\sum_{i=1}^{\omega}\left(C_{i0} - \overline{C}_0\right)^2\right]^{\frac{1}{2}}$.

In practice, it is more convenient to use a modified generalized indicator $d_i = 1 - \frac{C_{i0}}{\overline{c}_0}$, with an increase in which the efficiency of the solution option increases.

4. 4. Building a tree of possible trajectories of the state's military security level for various solutions

Using the proposed approach to determine the target function in the military security system, it is possible to construct a tree of possible trajectories of the state's military security level for various decision options (Fig. 2).

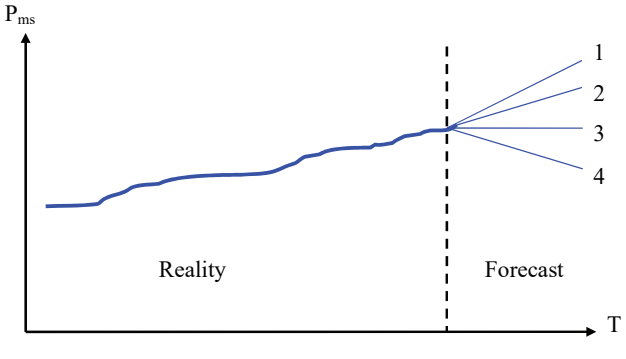

Fig. 2. The tree of possible trajectories of the level of military security of the state for various solutions

This tree of possible changes in the level of military security is advisable to apply in the course of developing forecasts of decisions in the field of military security, as well as, in particular, state programs during a defense review, planning the development of defense forces and the security and defense sector as a whole.

5. Discussion of the results of introducing the target function into the decision-making mechanism of the military security system

The main results research are the developed mechanism and technology for determining the target function as a comprehensive criterion for assessing the degree of realization of national interests in the field of military security - determining the level of military security.

The proposed approach to defining the target function in the military security system allows, based on the calculation of the taxonomic distance of the options considered from the reference object, to determine a rational decision. This process can be used to assess both the current state of conservation and the predicted state (Fig. 1).

It is noted that the proposed approach makes it possible to assess the level of military security both at the decision-making stage and after the implementation of the decision (a set of coordinated actions, measures, (Fig. 1).

The implementation of the proposed approach will allow at the decision-making stage to approve the option in which the level of military security becomes greater than the current one. If the level of military security under which variant of the decision is reduced, then such a decision is not approved and either policy, or strategy, or a set of coordinated actions change. Determination of the permissible (potential) level of military security P_{AMS} is carried out in conditions when the value of indicators is assessed based on the most favorable situations, the potential of the state, the level of danger of existing threats.

In the case of a defense review and the development of a state program for the development of defense forces, a tree of trajectories of changes in the level of military security is built and those trajectories are selected that are of the highest priority at the projected costs.

Taking into account certain coefficients of the importance of indicators, it becomes possible to identify certain positive accents in the state program for the development of the security and defense sector, the defense forces, the armed forces in particular, and the like. This will optimize the state program for reforming and developing the security and defense sector.

When comparative analysis of multidimensional objects using taxonomy methods, there are no restrictions on the number of options considered, and the number of indicators used. Correlation of indicators is allowed.

The proposed approach to decision-making in the planning of the use of defense forces is the basis for further research into the problems of increasing the efficiency of the functioning of the system for ensuring not only military security, but also other components of national security.

6. Conclusions

1. The paper proposes a decision-making mechanism in the state military security system. The essence of the decision-making mechanism is that an element with the function of calculating and comparing the level of military

security is added to the military security system. So, the system acquires an target function and feedback. This mechanism allows the military security system to acquire all the systemic properties of complex systems. On the practical side, the existence of such a mechanism will make it possible to determine the priority variants of military-political decisions in time close to real, and not wait for the results according to official statistics or real consequences that will take place. The introduction of a criterion into the decision-making mechanism in the system of ensuring the military security of the state will make it possible to objectively substantiate the decisions made and evaluate those decisions that have already been implemented.

2. The military security of a state depends on the degree of realization of national interests in the military sphere, and is determined by the values of the indicators given above. The proposed system of indicators , which fully characterizes the main spheres of military security – military-political, military-economic, military-technological, military-ecological, military, military-social, etc. The list of indicators is not final; it may change depending on the military-political conditions of the region, on the nature of the predicted military conflict, on the economic state of the state, and the like.

3. On the basis of a certain system of indicators, a method is proposed for calculating an integral indicator – the target function, which is a measure of the quality of decisions made in the military security system. The capabilities of the methodology allow not only to calculate the integral indicator for multidimensional objects, but also to determine the coefficients of the importance of indicators, calculate their hierarchy and justify the priorities of the implementation strategy. In addition to the above, the proposed methodology makes it possible to forecast both the average and the long term.

4. A feature of the above approach is that it becomes possible to use the proposed target function in the decision-making mechanism in the system of ensuring the military security of the state. This makes it possible to assess the level of a state's military security for various decision options, build a tree of its possible predictive trajectories and make informed decisions in almost real time, taking into account the coefficients of the importance of indicators. Determination of the target function – the level of military security and its application to assess the effectiveness of decisions in the field of military security can be carried out both in peacetime and in a threatened period. In a threatened period, the technique can be applied only at the stage of planning the use of defense forces. In the future, it will be useful to adapt the methodology for evaluating decisions in the management of defense forces during their application.

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