

**Qasim Abbood Mahdi,
Andrii Shyshatskyi,
Halyna Andriishena,
Larisa Degtyareva,
Nadiia Protas,
Yuliia Vakulenko,
Elena Odarushchenko,
Oksana Havryliuk,
Anna Lyashenko,
Bohdan Kovalchuk**

DEVELOPMENT OF A METHODOLOGICAL APPROACH TO THE RESEARCH OF SPECIAL PURPOSE COMMUNICATION SYSTEMS

As a result of Russian aggression against Ukraine, some fundamental theses regarding the nature of hybrid military operations will require clarification and even revision. First of all, this refers to the widespread perception of the asymmetric nature of hybrid threats as those used by a weaker adversary against a party with significantly greater military, technological and human potential, mainly by non-state actors against national states. This, in turn, requires the use of modern and proven mathematical apparatus, which is capable of processing a large array of various types of data in a short period of time with a given reliability of making management decisions. The object of research is the system of strategic management of national security. The subject of the research is the synthesis methodology of the intellectual system of strategic management of national security. The research developed a methodology for the synthesis of an intelligent national security management system. The novelty of the research: taking into account efficiency while choosing one or another method while researching the state of the national security system; calculation of reliability while choosing one or another method in researching the state of the national security system. Also, an element of novelty is taking into account the efficiency of the decisions made regarding the research of the state of the national security system while using one or another research method; adaptation to new challenges and threats to national security. The next element of novelty is the validity of management decisions in the management of the national security system; taking into account different data sources, which are different in origin and measurement units; analysis of large data sets.

It is expedient to implement the specified methodology in algorithmic and program software while studying the state of the national security system.

Keywords: national security system, hybrid threats, intelligent management methods, management decision making.

Received date: 12.01.2023

Accepted date: 17.02.2023

Published date: 22.02.2023

© The Author(s) 2023

This is an open access article
under the Creative Commons CC BY license

How to cite

Mahdi, Q. A., Shyshatskyi, A., Andriishena, H., Degtyareva, L., Protas, N., Vakulenko, Y., Odarushchenko, E., Havryliuk, O., Lyashenko, A., Kovalchuk, B. (2023). Development of a methodological approach to the research of special purpose communication systems. *Technology Audit and Production Reserves*, 1 (2) (69), 15–19. doi: <https://doi.org/10.15587/2706-5448.2023.274258>

1. Introduction

Hybrid war is a consequence of changes in the forms and methods of armed aggression due to changes in the principles of the geopolitical system, the development of scientific opinion on the conduct of armed struggle.

Due to a number of historical and geographical features, Ukraine has become the object of Russian hybrid aggression. The theory and practice of hybrid wars was first explained in the times of ancient China and actively began to develop since 2014 during the beginning of the Russian armed aggression of the Russian Federation on the territory of Ukraine [1, 2]. Thus, the works [3–5] consider changes in the forms and methods of hybrid aggression, the

role of information systems in them in terms of increasing the number of factors that must be paid attention to while countering them. However, over time, hybrid changes indicate changes and require revision of the mechanisms of counteraction to them.

In such conditions, a change in the strategic management of the national security system is needed. This, in turn, requires the use of modern and proven mathematical apparatus capable of processing a large array of various types of data in a short period of time with a given reliability of making management decisions [6–8].

The works [9, 10] carried out the analysis of approaches to processing various types of data in decision-making support systems, the use of artificial intelligence methods

to solve management issues and their implementation in management systems.

The existing strategic management approaches are narrowly focused and aimed at researching individual components of the national security subsystem and do not allow [6–10]:

- comprehensively and in a short time to identify and assess challenges and threats to national security;
- to assess the level of national security in real time;
- to process various types of data with different units of measurement, different in origin and sources of information extraction;
- to identify new and unusual challenges and threats to national security, and assess the degree of their destructive impact;
- to justify a set of management decisions necessary to neutralize challenges and threats to national security.

Taking into account the above, *the aim of the research* is to develop a methodology of synthesis of an intelligent national security management system. *The object of the research* is the system of strategic management of national security. *The subject of the research* is the methodology of synthesis of the intellectual system of strategic management of national security.

2. Materials and Methods

In the course of the research, let's use:

- classical methods of analysis – to solve the problem of analyzing the conditions and factors affecting the systems of strategic management of national security;
- methods of resource optimization – for making management decisions on the management of the system of strategic management of national security;
- theory of artificial intelligence – for processing various types of data in the course of identification and assessment of challenges and threats to national security.

3. Results and Discussion

3.1. Development of a methodology for the synthesis of an intellectual system of strategic management of national security. Achieving the required level of national security necessarily precedes the creation of the most effective system, because they are «limitations» for the further correct solution of the problem of its optimal parametric synthesis. The assessment of the level of national security is simply its statement. To conclude on the possibility of counteracting hybrid threats and challenges of today, it is necessary, firstly, to compare the existing state with the required one, which must be determined in advance, and, secondly, the available capabilities of the national security system will not exactly correspond to the required ones, which leads to a decrease in the level of national security. It is clear that this does not mean the maximum effectiveness of the functioning of the national security system at all.

The process of «application» of a complex system (one of its main features) is the most effective implementation of its system «potential ability» to achieve the system aim. The chosen option of applying the level of the national security system is also a limitation for the optimization

task of the optimal parametric synthesis of the most effective national security system.

The most effective use of the national security system for its purpose is connected, as it has been proven, with the appropriate use of the «internal» resource of the system.

On the other hand, the creation and improvement of complex «systems» (especially the «big» system of national security) are associated with the use of huge heterogeneous resources (financial, labor, material, special and general-purpose resources, information resources, etc.). The maximum expediency (efficiency) of the use of «external» resources for the national security system can also be achieved only by the optimal distribution of resource costs for creation and improvement activities.

Activities in the field of national security on a scientific basis, when the methodological basis is a «systemic» approach, objectively determine the theoretical foundations of public administration, operations research and cybernetics as a mandatory specialty of a manager and scientist. In general, the foundations of the theory of optimal solutions are a prerequisite for the necessary modern level of expertise of both scientists and persons occupying the leadership positions in public administration. Finally, such a requirement should be ensured by appropriate training of managerial and scientific personnel in the state and become a reality.

The purpose of system analysis is a comprehensive research of the national security system, namely:

- finding out the object system features (determining the content of their «frames»);
- identification and evaluation of object properties;
- determination of the object's characteristics to assess its actual capabilities.

The general concept of the system analysis of the national security system is given in Fig. 1.

System analysis makes it possible to determine the laws of functioning of «complex system» objects and the regularities through which they are manifested in general system characteristics. This makes it possible to formalize the problems of synthesis of «optimal» systems.

The aim of system synthesis is to create the «necessary» object (in our case, the national security system), namely (Fig. 2):

- determination of the required content of system features;
- provision and evaluation of the required properties;
- ensuring the values of the object characteristics to achieve its required capabilities.

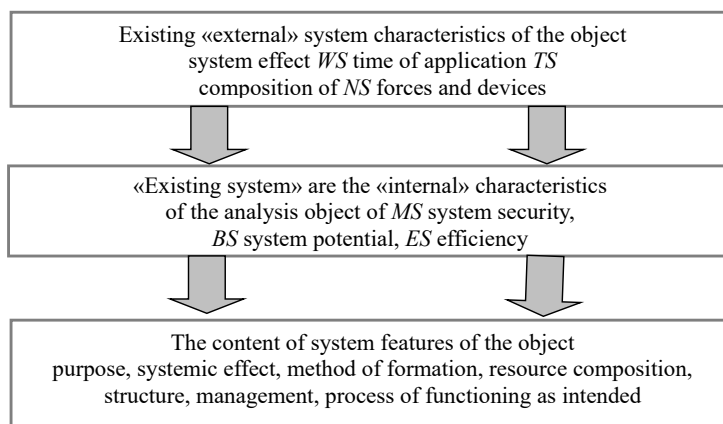


Fig. 1. General concept of system analysis of national security system

System synthesis makes it possible to formalize and correctly solve the tasks of building «optimal» national security systems with the necessary system-wide characteristics (Fig. 2).

The operational research method includes the following stages (Fig. 3):

- definition of the aim and substantive statement of the task of researching the national security system;
- determination of the characteristics of the research object (dependencies of the «effect» and «costs» on the system efficiency parameters);
- determination of the target function and functions of limitations, formal formulation of the research problem (development of a mathematical model of the national security system);
- choosing a method and solving the problem of optimizing system parameters that maximize the effectiveness of the research object (in this case, the national security system);
- adjustment of the model of the national security system based on the results of the implementation of the decision.

As stated in the previous part of the research, given the constant emergence of new types and types of challenges and threats to national security, it is necessary to detect and identify them in real time. Taking into account the above and the fact that there is a need to work with large arrays of various types of data, it is most appropriate to use the methods of the theory of artificial intelligence. This will allow:

- to describe the interrelationships between challenges and threats to the national security of the state;
- to update the database of challenges and threats to national security through training procedures;
- to detect, identify and assess the degree of challenges and threats to national security and the magnitude of their destructive impact in real time;
- to solve the problem of getting into global and local optima, etc.

The functioning of the intelligent national security management system can be described as constant decision making based on the analysis of current situations to achieve a certain aim (taking into account Fig. 1–3).

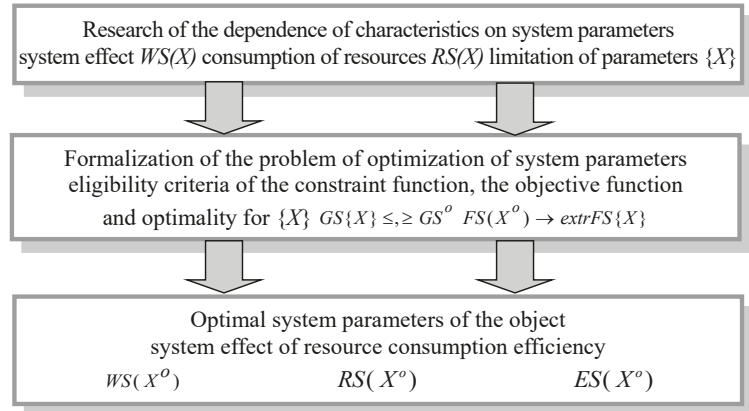


Fig. 3. The general concept of «operational research» national security system

The following stages of functioning of intelligent systems for managing the national security of the state are proposed:

1. Comprehensive analysis of external and internal challenges (threats) to national security. The result of the comprehensive analysis is the creation of a descriptive model (a set of models, a comprehensive model) of the state's national security level.
2. Comparison of the received comprehensive description of challenges and threats to national security with those available in the database of challenges and threats and replenishment of this description.
3. Justification of possible countermeasures against challenges and threats to the state's national security.
4. Implementation of the algorithm for countering challenges and threats to national security for the response of the intelligent national security management system to challenges and threats to national security.
5. Implementation of the response of the intelligent national security management system.

These actions are conditional and conceptually describe the main stages of functioning of intelligent systems to counter hybrid challenges and threats to the state's national security.

3.2. Results of the analysis and discussion of the results. In the course of the research, the authors developed a methodology for the synthesis of an intelligent national security management system.

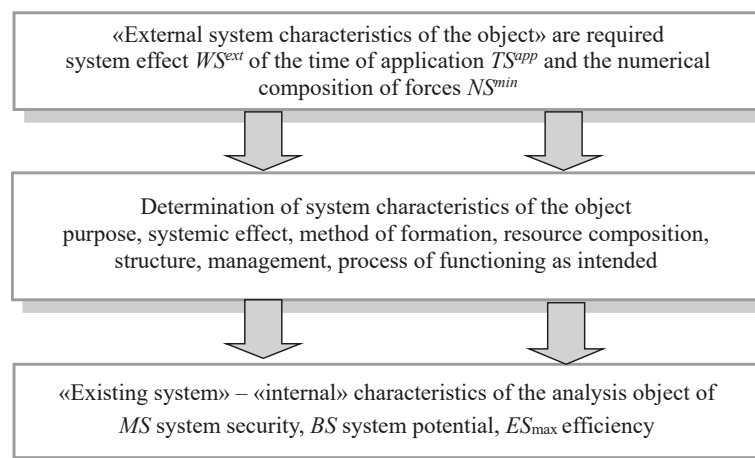


Fig. 2. General concept of system synthesis of national security system

The proposed methodology allows:

- to justify the methods of researching the state of the national security system;
- to determine the necessary error in assessing the state of the national security system of the destination while using one or another research method;
- to justify the effectiveness of the decisions made regarding the national security system while using one or another research method;
- to define and identify challenges and threats to national security;
- to justify the necessary management decisions in the management of the national security system.

The advantages of the research include:

- consideration of efficiency while choosing this or that method at research of the state of the national security system;
- calculate the reliability while choosing one or another method at research of the state of the national security system;
- consideration of the efficiency of the decisions made regarding the research of the state of the national security system while using one or another research method;
- adaptation to new challenges and threats to national security;
- reasonableness of management decisions in the management of the national security system;
- taking into account different raw data that are different in origin and measurement units;
- analyzing large data sets.

The shortcomings of the research include:

- the need for adequate software to implement possible research methods;
- availability of time to carry out calculations of the state of the national security system.

It is advisable to implement the specified methodology in algorithmic and program software during research of the state of the national security system.

Further improvement of the mentioned approach for an objective and complete approach should be considered as the direction of further research of the state of the national security system.

4. Conclusions

1. Development was carried out in the research of the methodology of the synthesis of the intellectual system of national security management.

2. The novelties of the proposed methodology are:

- the consideration of efficiency while choosing this or that method at research of the state of the national security system;
- reliability calculation while choosing one or another method at research of the state of the national security system;
- taking into account the efficiency of the decisions made regarding the research of the state of the national security system while using one or another research method;
- the adaptation to new challenges and threats to national security;
- reasonableness of management decisions in the management of the national security system;

- taking into account different data sources, which are different in origin and measurement units;
 - analysis of large data sets.
3. It is advisable to implement the specified methodology in algorithmic and program software during research of the state of the national security system.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this article.

Financing

Presentation of research in the form of publication through financial support in the form of a grant from SUES (Support to Ukrainian Editorial Staff).

Data availability

The manuscript has no associated data.

References

1. Shishatckii, A. V., Bashkirov, O. M., Kostina, O. M. (2015). Rozvitok integrovanikh sistem zv'iazku ta peredachi danikh dlia potreb Zbroinikh Sil. *Ozbroennia ta viiskova tekhnika*, 1 (5), 35–40.
2. Timchuk, S. (2017). Methods of Complex Data Processing from Technical Means of Monitoring. *Path of Science*, 3 (3), 4.1–4.9. doi: <http://doi.org/10.22178/pos.20-4>
3. Sokolov, K. O., Hudyma, O. P., Tkachenko, V. A., Shyiatyi, O. B. (2015). Main directions of creation of IT infrastructure of the Ministry of Defense of Ukraine. *Zbirnyk naukovykh prats Tsentru voienno-stratehichnykh doslidzhen*, 3 (6), 26–30.
4. Shevchenko, D. G. (2020). The set of indicators of the cyber security system in information and telecommunication networks of the armed forces of Ukraine. *Suchasni informacini tekhnologii u sferi bezpeki ta oboroni*, 38 (2), 57–62. doi: <https://doi.org/10.33099/2311-7249/2020-38-2-57-62>
5. Makarenko, S. I. (2017). Perspektivy i problemnye voprosy razvitiia setei sviazi spetsialnogo naznacheniiia. *Sistemy upravleniia, sviazi i bezopasnosti*, 2, 18–68. Available at: <http://secs.intelgr.com/archive/2017-02/02-Makarenko.pdf>
6. Zuiev, P., Zhyvotovskiy, R., Zvieriev, O., Hatsenko, S., Kuprii, V., Nakonechnyi, O. (2020). Development of complex methodology of processing heterogeneous data in intelligent decision support systems. *Eastern-European Journal of Enterprise Technologies*, 4 (9 (106)), 14–23. doi: <http://doi.org/10.15587/1729-4061.2020.208554>
7. Brownlee, J. (2011). *Clever algorithms: nature-inspired programming recipes*. LuLu, 441.
8. Gorokhovatsky, V., Stiahlyk, N., Tsarevska, V. (2021). Combination method of accelerated metric data search in image classification problems. *Advanced Information Systems*, 5 (3), 5–12. doi: <http://doi.org/10.20998/2522-9052.2021.3.01>
9. Meleshko, Y., Drieiev, O., Drieieva, H. (2020). Method of identification bot profiles based on neural networks in recommendation systems. *Advanced Information Systems*, 4 (2), 24–28. doi: <https://doi.org/10.20998/2522-9052.2020.2.05>
10. Rybak, V. A., Shokr, A. (2016). Analysis and comparison of existing decision support technology. *System analysis and applied information science*, 3, 12–18.

Qasim Abbood Mahdi, PhD, Head of Department of Computer Technologies Engineering, Al Taff University College, Karbala, Iraq, ORCID: <https://orcid.org/0000-0001-6612-3511>

✉ **Andrii Shyshatskyi**, PhD, Senior Researcher, Head of Department of Robotic Systems Research, Research Center for Trophy and Perspective Weapons and Military Equipment, Kyiv, Ukraine, e-mail: ierikon13@gmail.com, ORCID: <https://orcid.org/0000-0001-6731-6390>

Halyna Andriushena, Educational and Scientific Institute of Public Administration and Civil Service, Taras Shevchenko Kyiv National University, Kyiv, Ukraine, ORCID: <https://orcid.org/0000-0002-8863-7027>

Larisa Degtyareva, PhD, Associate Professor, Department of Information Systems and Technologies, Poltava State Agrarian University, Poltava, Ukraine, ORCID: <https://orcid.org/0000-0001-5927-9550>

Nadiia Protas, PhD, Associate Professor, Department of Information Systems and Technologies, Poltava State Agrarian University, Poltava, Ukraine, ORCID: <https://orcid.org/0000-0003-0943-0587>

Yuliia Vakulenko, PhD, Associate Professor, Department of Information Systems and Technologies, Poltava State Agrarian University, Poltava, Ukraine, ORCID: <https://orcid.org/0000-0002-6315-0116>

Elena Odarushchenko, PhD, Associate Professor, Department of Information Systems and Technologies, Poltava State Agrarian University, Poltava, Ukraine, ORCID: <https://orcid.org/0000-0002-2293-2576>

Oksana Havryliuk, Researcher, Scientific Center, Military Institute of Telecommunications and Information Technologies named after Heroes of Kruty, Kyiv, Ukraine, ORCID: <https://orcid.org/0000-0001-8694-7251>

Anna Lyashenko, Researcher, Scientific Center, Military Institute of Telecommunications and Information Technologies named after Heroes of Kruty, Kyiv, Ukraine, ORCID: <https://orcid.org/0000-0002-5318-8663>

Bohdan Kovalchuk, Junior Research Fellow, Research Department, Military Institute of Telecommunications and Informatization named after the Heroes of Kruty, Kyiv, Ukraine, ORCID: <https://orcid.org/0000-0001-5219-7624>

✉ Corresponding author