DEVELOPMENT OF AN APPROACH TO THE CREATION OF AN INTELLECTUAL SYSTEM OF NATIONAL SECURITY MANAGEMENT

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ABSTRACT

The object of the research is intelligent systems for collecting, processing and analyzing information about the state of national security.

Investigated problem: The problem that is solved in the research is the problem of building intelligent systems for collecting, processing and analyzing information about the state of national security with limitations on the available computing resources, reliability and given speed of processing of various types of data circulating in it. The main scientific results obtained during the study by the authors are: proposed approach to the development of intelligent systems for the collection, processing and analysis of information on the state of the state's national security. The proposed approach takes into account the security of the system, available forces and means, purpose, system effect, method of formation, resource composition, structure, management, the process of functioning according to the purpose, resource consumption and the specified efficiency criterion. This will allow to justify the requirements for software and hardware of intelligent systems for collecting, processing and analyzing information about the state of the state's national security.

Proposed architecture of intelligent systems for collecting, processing and analyzing information about the state of national security of the state. Its approximate composition, functional purpose and structure of the database management system are substantiated.

The area of practical use of the research results: It is advisable to use the proposed scientific results when conducting research and development works on the creation of intelligent systems for collecting, processing and analyzing information about the state of national security of the state, and developing requirements for hardware and software of this type of systems.

Field of application: software, information systems, decision support systems.through gas (air) flow.

1. Introduction

1. 1. The object of research

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 and some elements of it.

1. 2. Problem description

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.

1. 3. Suggested solution to the problem
The existing strategic management approaches are narrowly focused and aimed at researching individual components of the national security subsystem and do not allow [6–12]:

– 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 research is to develop a methodology of synthesis of an intelligent national security management system and the architecture of it.

2. Research 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;

– the 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. Research 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 determines 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.

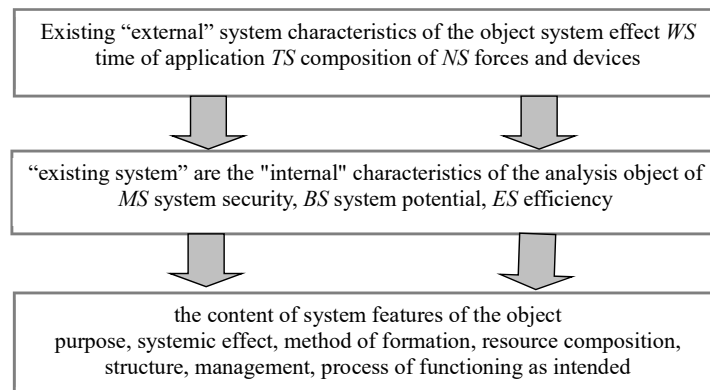The general concept of the system analysis of the national security system is given in **Fig. 1.**

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

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.

System synthesis makes it possible to formalize and correctly solve the tasks of building "optimal" national security systems with the necessary system-wide characteristics:
– determination 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.

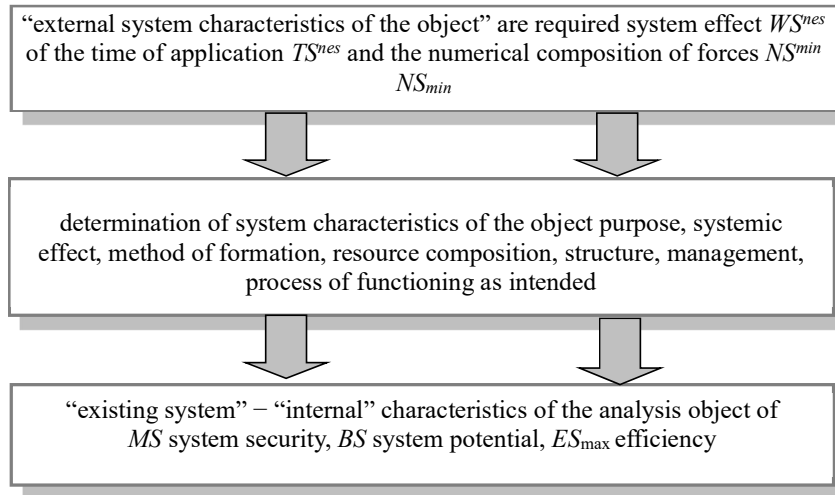The operational research method includes the following stages (**Fig. 3**):

"external system characteristics of the object" are required system effect WS^{nes} of the time of application TS^{nes} and the numerical composition of forces NS^{min} NS_{min}

determination of system characteristics of the object purpose, systemic effect, method of formation, resource composition, structure, management, process of functioning as intended

"existing system" − "internal" characteristics of the analysis object of MS system security, BS system potential, $ES_{\max}$ efficiency

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

research of the dependence of characteristics on system parameters system effect $WS(X)$ consumption of resources $RS(X)$ limitation of parameters $\{X\}$

formalization of the problem of optimization of system parameters eligibility criteria of the constraint function, the objective function

optimal system parameters of the object system effect of resource consumption efficiency
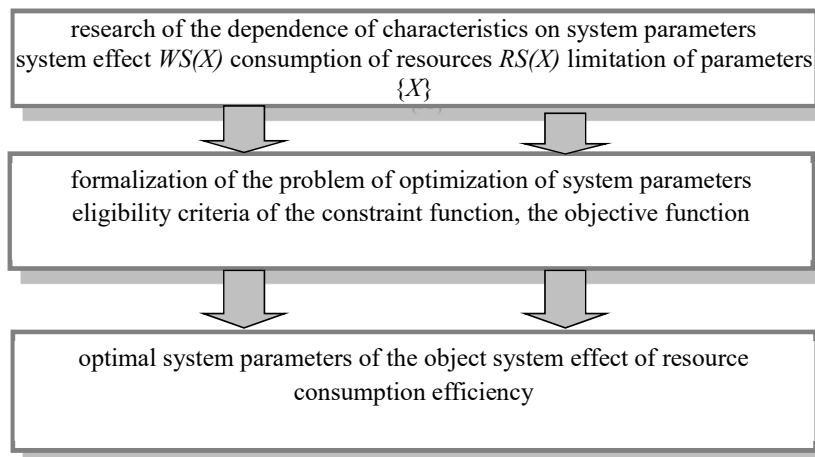
Fig. 3. The general concept of "operational research" national security system

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**).

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

Based on the developed approach, the basic architecture of the intelligent system for national security needs is presented in **Fig. 4**.

It is based on MySQL database management system, server subsystem and client subsystem.

Physically, this suite of applications can be hosted on a server under the management of any server operating system, such as Windows 2016 Server, Ubuntu 18.04 Server, etc.
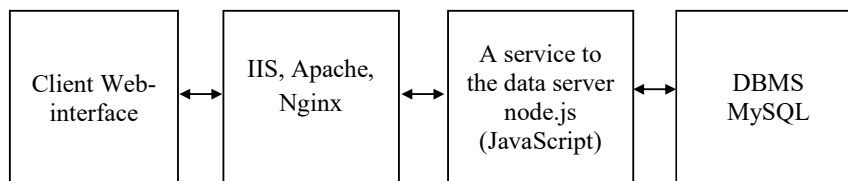
Client Web-interface ↔ IIS, Apache, Nginx ↔ A service to the data server node.js (JavaScript) ↔ DBMS MySQL

Fig. 4. Functional scheme of the complex of programs of intellectual system

The basis of the system of storage and accumulation of data in the "Data lake" in physical form is the MySQL database. The structure of the MySQL database table of civil control over the security and defense sector of Ukraine consists of the following tables:

– table **table1** contains information obtained from open sources of information. In addition, the table includes fields to identify the operator that has entered data into the "Data Lake" and possible conclusions that are drawn by the data user;

– the s**ource1** table contains information on the number and type of information on resources that are involved in the security and defense sectors. This information has a personal stamp. Therefore, the mentioned system should have access to protected information systems, in which information with the secrecy mark is circulated "secretly" and above;

– the **pidrozd** table contains fields that allow revealing the belonging of a subdivision to the group, as well as to specify its geographical coordinates if available. This information has a secret stamp. Therefore, the mentioned system should have access to protected information systems, in which information with the secrecy mark is circulated "secretly" and above;

– the **user** and **owner** tables are created to separate users and grant them access to the system and to monitor a specific group of messages.

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:

– 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;

– 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.

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Data availability

The manuscript has no associated data.

References

[1] Kuchuk, N., Mohammed, A. S., Shyshatskyi, A., Nalapko, O. (2019). The method of improving the efficiency of routes selection in networks of connection with the possibility of self-organization. International Journal of Advanced Trends in Computer Science and Engineering, 8 (1.2), 1–6.

[2] Sova, O., Turinskyi, O., Shyshatskyi, A., Dudnyk, V., Zhyvotovskyi, R., Prokopenko, Y. et al. (2020). Development of an algorithm to train artificial neural networks for intelligent decision support systems. Eastern-European Journal of Enterprise Technologies, 1 (9 (103)), 46–55. doi: https://doi.org/10.15587/1729-4061.2020.192711

[3] Makarenko, S. I., Mikhailov, R. L. (2013). Otcenka ustoichivosti seti sviazi v usloviiakh vozdeistviia na nee destabiliziruiushchikh faktorov. Radioengineering and Telecommunication Systems, 4, 69–79.

[4] Bodyanskyy, E. V., Strukov, V. M., Uzlov, D. Yu. (2017). Generalizedmetrics in the problem of analysis of multidimensional data with different scales. Zbirnyk naukovykh prats Kharkivskoho natsionalnoho universytetu Povitrianykh Syl, 3 (52), 98–101

[5] Semenov, V. V., Lebedev, I. S. (2019). Processing of signal information in problems of monitoring information security of unmanned autonomous objects. Scientific and Technical Journal of Information Technologies, Mechanics and Optics, 19 (3), 492–498. doi: https://doi.org/10.17586/2226-1494-2019-19-3-492-498

[6] Zhou, S., Yin, Z., Wu, Z., Chen, Y., Zhao, N., Yang, Z. (2019). A robust modulation classification method using convolutional neural networks. EURASIP Journal on Advances in Signal Processing, 2019 (1). doi: https://doi.org/10.1186/s13634-019-0616-6

[7] Shaheen, E. M., Samir, M. (2013). Jamming Impact on the Performance of MIMO Space Time Block Coding Systems over Multi-path Fading Channel. REV Journal on Electronics and Communications, 3 (1-2), 68–72. doi: https://doi.org/10.21553/rev-jec.56

[8] Malik, S., Kumar, S. (2017). Optimized Phase Noise Compensation Technique using Neural Network. Indian Journal of Science and Technology, 10 (5), 1–6. doi: https://doi.org/10.17485/ijst/2017/v10i5/104348

[9] Rotshteyn, A. P (1999). Intellektual'nyye tekhnologii identifikatsii: nechotkiye mnozhestva, geneticheskiye algoritmy, neyronnyye seti. Vinnitsa: "UNIVERSUM", 320.

[10] Mazhara, O. A. (2015). Treat algorithm implementation by the basic matchalgorithm based on CLIPS programming environmen. Elektronnoye modelirovaniye, 37 (5), 61–75.

[11] Bolotova, S. Yu., Makhortov, S. D. (2011). Algoritmy relevantnogo obratnogo vyvoda na osnove resheniya produktsionno-logicheskikh uravneniy. Iskusstvennyy intellekt prinyatiye resheniyi, 2, 40–50.

[12] Zhyvotovskyi, R. M., Shyshatskyi, A. V., Petruk, S. N. (2017). Structural-semantic model of communication channel. Problems of Infocommunications. Science and Technology. Kharkiv, 524–529. doi: https://doi.org/10.1109/infocommst.2017.8246454