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## INFORMATION AND ANALYTICAL SUPPORT FOR MAKING WELL-INFORMED ADMINISTRATIVE DECISIONS IN CIVIL PROTECTION SYSTEM

**Purpose.** To substantiate the basic requirements for information and to develop a quality evaluation method of the civil protection information and analytical support system operation in public administration.

**Methodology.** During the research, a set of general and special methods were used: regular observation and comparative analysis, content analysis, logical generalization, quantitative and qualitative comparison, scientific abstraction and systematization. A quality evaluation method of the civil protection information and analytical support system operation was applied, which led to outlining the quality of information as sufficient, corresponding with situation changes, and significant information for appropriate decision-making by the head of authority under certain conditions.

**Findings.** The basic information requirements are substantiated and its quality is defined as a set of characteristics (adequacy, completeness, responsiveness and utility) that outlines the degree of its suitability for achieving the goals of the information and analytical support system in civil protection. The quality evaluation method of the information and analytical support system operation in civil protection during emergencies was elaborated; it allows evaluating quantitatively the correspondence of the quality of system operation with the requirements stipulating usage of the integrated indicator – the extent of information and analytical support for the authority concerning its activity arrangement in emergencies. The obtained results of quality evaluation of the civil protection information and analytical support system operation were proposed to determine the rational method of its operation during the decision-making process by the head of authority under certain conditions.

**Originality.** The evaluation criterion was defined: achieving the condition when the extent of implementing the information and analytical support is higher or equal to the required one and provides for further evaluation of the operation methods of the system.

**Practical value.** It is proved that attaining the criterion of information and analytical support system operation quality in civil protection is a connecting link to the methodological approach. Therefore, there is a possibility to determine a rational method of the system operation using the hierarchical model of alternative method comparison taking into consideration analytic hierarchy process (AHP), which ensures the head of authority to perform the assigned tasks qualitatively, completely and timely.

**Keywords:** *emergencies, information and analytical support, civil protection, quality of information, system operation, security*

**Introduction.** In recent years, in Ukraine a number of victims as a result of emergencies has shown a need to improve the efficiency of the public authorities' operation and other forces' involvement in emergency response. This is closely related to the insufficient scientific and methodological approach to the quality evaluation of the civil protection system operation in general, and its constituent part that is the system of information and analytical support for civil protection, in particular. An extremely important scientific task in public administration is to develop a method for evaluating the performance of the civil protection information and analytical support system (hereinafter – CPIASS). This objective requires a thorough analysis of the civil protection system and scientifically based evaluation of the civil protection information and analytical support system.

**Literature review.** The issues of complex system evaluation in various areas of the society have received sufficient attention from both foreign and domestic researchers.

Public administration researcher Barylo O. argues that public authorities and officials have to operate in a context of fragmented, unclear, uncoordinated information and high dynamics in a situation of emergency. However, in the author's view, it is necessary to try to obtain as much reliable primary information as possible even in such difficult situations to make more accurate and adequate decisions and actions. At the same time, the researcher claims that all management information from whatever source is subject to the requirements of relevance, credibility, sufficiency and accessibility [1].

The information and analytical system for sociocultural organizations is described by Diehtiar A. who believes that information management as a process should meet the following basic requirements: adequacy, usefulness, quality, value of information [2].

The issues of improving the quality of information and analytical support and the efficiency of managerial decisions were considered by Stepanov V., who proved that for public administration any information should meet the criteria of adequacy, completeness, quality, relevance, timeliness. The au-

thor also notes that the quality, credibility and timeliness of information determine the decisions taken at various levels of government [3].

Tytarenko O. and Saukh Yu. characterize the information and analytical system of public administration as a set of inter-related and properly formed coordination, institutional and legal, information, consistent, program and technological components guaranteeing the right quality of the accepted managerial decisions through the practical use of information resources and information technology. The authors note that in public administration, in order to take certain decisions, information is first analyzed in terms of adequacy, completeness and relevance [4].

The urgent need for establishing modern information and analytical, program and technical systems to support administrative decisions was justified by Diehtiar A., who claims these systems provide an opportunity for state and local authorities to analyze and evaluate the situation in all areas of society in a comprehensive and timely manner. The author is of the opinion that this requires the establishment of the unified information and telecommunication system for the collection, processing and transmission of data that is necessary for strategic decision-making. In addition, Diehtiar A. defined the basic information requirements used by public administrative bodies, namely: probability, completeness, timeliness, scope and subject of information. It is such requirements that, in the author's view, are of great significance for improving the efficiency of public administration information support [5].

Semenenko K. stressed the need to improve administration in governmental bodies and specified the features of information such as quality, relevance, timeliness, accuracy as crucial qualities to disclose its nature. These features are considered by the author as the requirements for performance of public administration functions [6].

Zachosova N. and Horiachkivska I. addressed problematic information and analytical support issues on the implementation of the evaluation system of economic security of domestic enterprises and financial institutions. This system provides procedures for determining the level of information relevance, completeness, reliability and accuracy as the researchers believe that compliance with the requirements ensures that information is used for situation analysis and decision-making [7].

**Unsolved aspects of the problem.** An analysis of even a relatively small numbers of academic papers on the complex system evaluation in different areas of the society showed that the majority of papers was devoted to the evaluation of information and analytical systems for administrative decision-making. In these circumstances, the authors have substantiated the core information properties which are considered to be requirements for it and ensure the efficient operation of the information and analytical support system, in civil protection as well.

The diversity of the researchers' views on information requirements should be emphasized which are keys to evaluating the performance of the system of information and analytical support.

However, in our opinion, to address the issue of evaluating the quality of the system of civil protection information and analytical support it is necessary to apply a systemic approach and investigate it more widely in terms of multivariability of the operation of this system which is hierarchically an integral part of the management system in civil protection.

**The purpose** is to justify basic information requirements and develop a method of evaluating the performance of the civil protection information and analytical system in public administration.

**Methodology.** To achieve the purpose of the study, in the paper a system approach is applied which involves a comprehensive analysis of the civil protection information and analytical support system dynamics and contains data about the control object and processing methods. The application of system approach has made it possible to determine the actual

state of the system, to identify the factors affecting its operation and to find out the means to take the necessary management actions to achieve the purpose of managerial impact.

Mathematical modelling method was used to evaluate the performance of the system of information and analytical support in civil protection at the stage of decision-making by the head of the emergency administrative body to determine whether the system meets the requirements.

**Results.** At the same time, it should be noted that the material basis for the system of civil protection information and analytical support is a set of information, means, methods and technologies for searching, collecting, processing, generalization, analyzing and submitting it to the head. This contributes to the effectiveness of the management process, to the development and implementation of managerial decisions, in particular. Another important function of the system is to link information to the management system and the management process as a whole.

Information in a broad sense is a set of messages (data) received from the environment (information input) and transmitted in a reverse direction (information output) or remained within a particular system. The performance evaluation of any system, civil protection information and analytical system in particular, should be based on the group of principle characteristics of information which are classified as requirements to the system performance.

In this respect, the approach proposed by Barylo O. stating that the quality and operational performance of public authorities and their decision-making during emergency response depends crucially on the information completeness and usefulness is worth attention. Thus, obtaining the necessary information during information management should be addressed continuously by public authorities to make reasoned decisions, to develop plans, and to be timely and adequately responsive to changing environment [8].

Shevchenko R. emphasizes the attributes of information that are important in managerial decision-making, namely: quality, completeness, usefulness, probability, timeliness. According to the author, most of the attributes are objective and can be evaluated by temporal and quantitative characteristics, whereas the usefulness of information is ambiguous due to the apparent subjective component related to the effectiveness of decision-making about the security status of the facility monitored by the management decision-making system [9].

Karahodin O. considers information management system as an important element in the management process and claims that in the absence of it, managers are mainly forced to make managerial decisions in the uncertain and risky conditions and, in particular, due to the lack of information. Under such circumstances, the author highlights the key features of the information, in particular its quality, completeness, timeliness, and urgency. Furthermore, Karahodin O. argues that managerial decisions should be based on the sufficient, reliable, adequate, and accurate information. The author also points out that useful information has to meet the characteristics of completeness, adequacy, timeliness, provided that it is sufficient and is processed rapidly [10].

Demchyna L. reasonably states that the timeliness of analytical information depends on the nature of the decisions taken on its basis. The completeness and regularity of analytical information implies a systemic input of data and properly managed data storage. Preparation of analytical information for application makes it possible to use it more effectively for managerial decision-making and reduce stress in administration and management. Development of qualitative analytical information meets the criteria of reliability, timeliness, completeness and regularity as well as preparedness for its application [11].

The need to set up a system of information and analytical support in the executive branch was proved by Kolomiets Ye., who states that this system provides for the creation of techni-

cal conditions for the necessary information collection, storage, processing and delivery. In the author's view, the outlined issue can be addressed if the received, processed and transformed information is relevant, reliable and evaluated by a system of integrated indicators for the main purpose of the system operation [12].

According to Puhach A., for government leaders' decision-making public management information should be considered in terms of relevance, adequacy, credibility, and promptness. Under such conditions, the purpose of providing information to public authorities is based on the collected output data in order to obtain processed, synthesized information which should be grounds for managerial decisions [13].

The authors of the Encyclopedia of Public Administration claim that information in public administration (public management information) is viewed in terms of its actuality, reliability, timeliness, and adequacy for decision-making. The purpose of providing information to public authorities is to obtain processed, compiled information on the basis of collected data input which should form the grounds for administrative decisions [14].

Thus, it has been established that researchers' assertions about the properties of information that have a significant impact on the operation of the information and analytical support system have both common features and some differences.

A summary analysis of the important information properties that affect the operation of information and analytical support system and are identified by researchers as requirements for it is presented in Table.

Data analysis in Table shows that the authors have identified the most relevant attributes used by public administration bodies and view them as requirements that have significant impact on the operation of the administrative system of information and analytical support, in particular adequacy, completeness, timeliness, usefulness, and quality. The percentage of the total number of the researchers who have identified those properties (14 papers were analyzed) is almost 50 per cent.

It should be noted that the authors emphasize other requirements such as information relevance, reliability, timeliness and accuracy and consider sufficiency, value, accessibility and the like as less important.

Table

Quantitative indicators of the main information properties that support the achieving of objectives of the system

No.	Information properties	Number of research papers where this property is defined	Percentage of total number of research papers where information properties are defined
1	Adequacy	6	43
2	Completeness	8	57
3	Promptness	4	29
4	Usefulness	5	36
5	Quality	6	43
6	Relevance	9	64
7	Reliability	8	57
8	Timeliness	6	43
9	Accuracy	5	36
10	Sufficiency	2	14
11	Value of information	2	14
12	Accessibility	1	7

In our view, the general characteristic of the information is quality which is a set of properties (adequacy, completeness, efficiency, utility) reflecting the degree of information suitability for achieving the objectives by the system of information and analytical support. In the paper, definitions of information quality attributes are provided, namely:

- information adequacy is a feature which reproduces the degree of proportionality of the image which is formed by information to the present object, process, phenomenon. The degree of information adequacy determines precision in emergency decision-making;

- information completeness is a property which means that there is sufficient information to understand the nature of the emergency and to make the appropriate administrative decisions;

- information promptness is a property of data on time of collection and processing and corresponds to the movement of changes in the nature and scale of the emergency;

- information usefulness is an indicator of the information relevance to the outlined task relating to the organization of the work of the civil protection information and analytical support system.

Research paper analysis on the main characteristics of information (Table) made it possible to determine the significance of indicators of the core information properties that contribute to the achievement of the objective of the civil protection system of information and analytical support (Fig. 1).

An integrated approach to evaluating the performance of the civil protection information and analytical support system has made it possible to determine the quality of information as sufficient and appropriate to changing circumstances, as meaningful for rational decision-making by the head of the administrative body in specific conditions.

Based on the processed research, a method for evaluating the performance of the civil protection information and analytical support system in an emergency was developed and proposed for use which is based on the integrated approach to the study of complex systems and on the analysis of the main factors affecting them under the conditions specified.

For identification of the indicators of separate areas of the information and analytical support system, the analytical method was applied, which relies on the relationships described in [8] and used by the authors in the previous research works.

Quantitative measures of the quality evaluation of the information and analytical support system performance are calculated in accordance with the following limitations:

- defining the objective by the highest level of administrative body is provided on time;

- activities carried out prior to assignment have been completed in full and on time;

- the conditions of the emergency area are the same for all parts of the civil protection information and analytical support system.

In the method, the constant input data is:

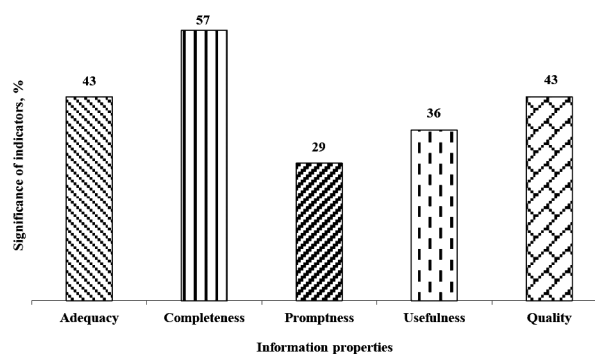


Fig. 1. Relevance of the indicators of key information properties

- circumstances in the emergency zone;
- civil protection forces;
- representatives from the civil protection administration and management system;
- list of activities to fulfil by the administrative bodies during an emergency;
- conditions in the emergency zone;
- time available to carry out the tasks by administrative bodies;
- training of government officials to complete assignments;
- promptness and timeliness as requirements to information and analytical support as a condition to achieve a proper balance between the time required and the time which is at the disposal of the head of administration.

The information that is evolving is as follows:

- the amount of information used by the administrative authorities in an emergency;
- level of equipment of the administrative authorities with the means of automation and communications;
- organizational structure of the administrative bodies;
- the number of information and calculation tasks to be solved by the administrative authorities.

The quality evaluation method of the civil protection information and analytical support system performance enables to determine whether the system performance meets the emergency requirements and to calculate the degree of information and analytical support provided to the administrative body under emergency conditions.

Logical framework of the quality evaluation method of the civil protection information and analytical support system operation in an emergency is shown in Fig. 2.

In cluster 1 of the diagram the input data is generated:

- conditions of the emergency area in which the civil protection information and analytical support system operates;
- administrative personnel;
- the content of the tasks of the administrative bodies in an emergency;
- time available to the administrative body;
- the number of information tasks (IT) and calculation tasks (CT) to be solved by the administrative body;
- composition, state and level of equipment of the civil protection administrative bodies (AB, control posts (CP), support systems (SS), automated control system (ACS)).

In cluster 2, the adequacy of the information [15] to the circumstances is assessed on the basis of the input data (cluster 1) ( $K_{ad}$ ).

In cluster 3, in accordance with the input data (cluster 1) the amount of useful information available to the civil protection authorities in an emergency is evaluated ( $\theta$ ).

Building on previous studies [8, 15],  $I$  is calculated.

In clusters 4–6 the efficiency of information processing by the administrative body is evaluated ( $T_a, T_c, T_{ab}$ ). In the event of failure to balance the time available with the critical time, recommendations are drawn up to improve administrative authority's operational efficiency (cluster 7).

In cluster 8 on the basis of the input data and results of the expert survey, subject to inequality in cluster 6, the necessary level of information and analytical support for the emergency administration and management is calculated.

In cluster 9, the information and analytical support rate for the emergency administration and management is determined subject to the balance of time required and time available to the administrative body [8] and taking into account the ratio of relative importance indicator (cluster 3a) [15].

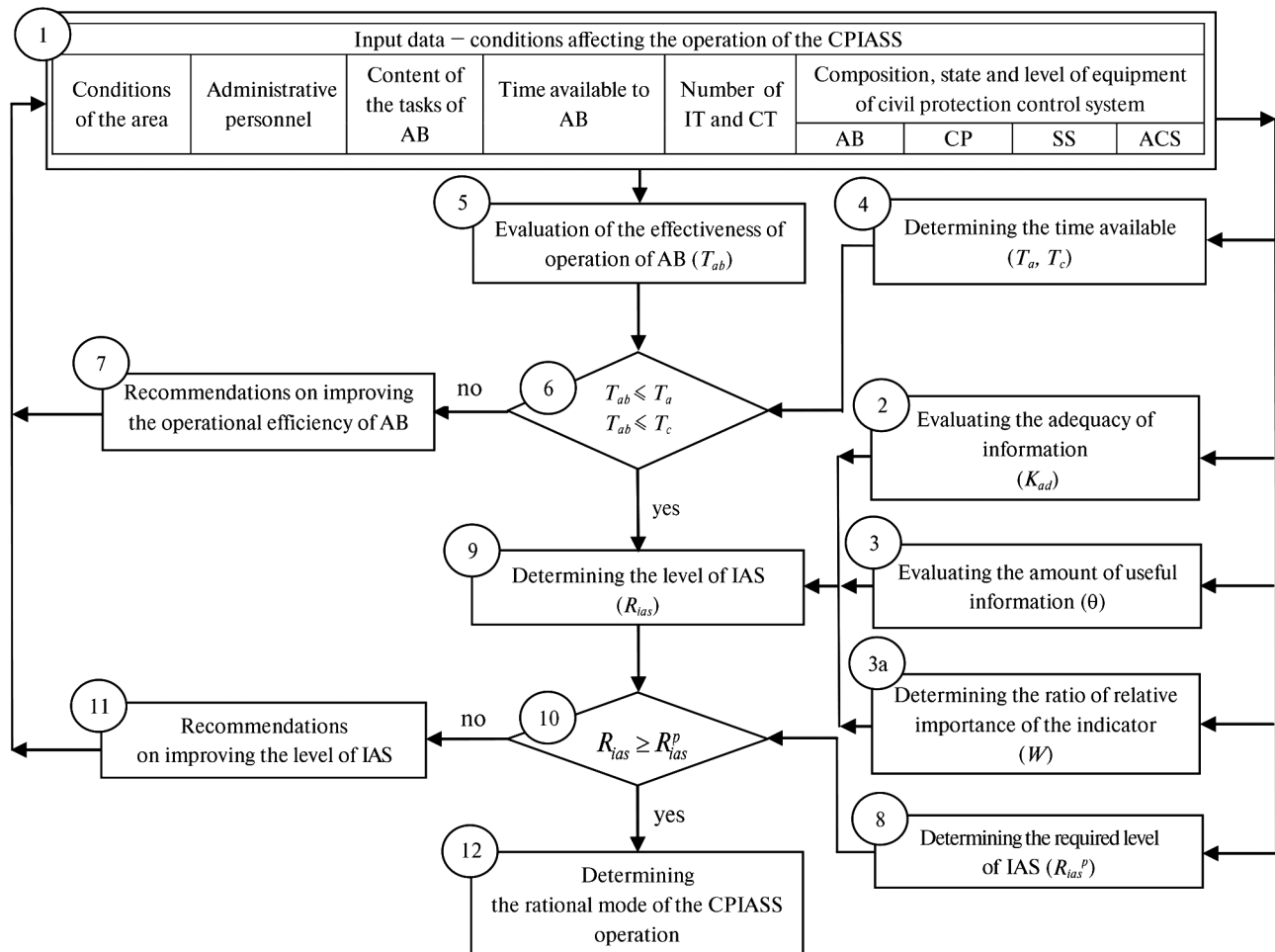


Fig. 2. Logical framework of the quality evaluation method of the civil protection information and analytical support system

At the same time, the extent of information and analytical support which is implemented has a boundary of  $0 < R_{ias} \leq 1$ .

In cluster 10, the quality performance criterion of the civil protection information and analytical support system is reviewed that is achieving inequality  $R_{ias} \geq R_{ias}^p$ . If inequality is not achieved, in order to improve the rate of the information and analytical support system, some reasons for the lack of correlation between the requirements and the quality of system performance are identified in cluster 11.

Based on certain reasons for inconsistencies, in the same cluster recommendations are developed to modify the input data used in emergency administration and management and for performance evaluation of the civil protection information and analytical support system (cluster 1) with the purpose of its improvement.

If the quality criterion of the civil protection information and analytical support system operation is met, the rational method of the system operation is determined by means of a hierarchical model for the comparison of alternative methods of the system operation based on the method of hierarchy analysis (MHA).

### Conclusions.

1. The quality of the operation of the civil protection information and analytical support system during emergency response should be evaluated by the indicators that measure compliance with the requirements to the system. It is possible to quantify the compliance of the system operation with the requirements to it if an integral indicator is used – the extent of information and analytical support for the administrative body. The criterion for compliance of the quality of operation of the civil protection information and analytical support system with the requirements to it is the necessary condition justified in the course of this study when the degree of actual information and analytical support is more or equal to the required.

2. During emergency response, the quality of the civil protection information and analytical support system is subject to the following requirements: adequacy of the information to the circumstances; information completeness and usefulness; efficiency of information processing by the administrative body.

The following are selected as partial indicators for evaluating the level of information and analytical support: the extent to which the adequacy of information has been achieved in the circumstances that have arisen; the extent to which the administrative body is able to make decisions based on the amount and usefulness of the information during emergency response; the operating time of the administrative body during the processing of the information in the course of actions.

These indicators make it possible to evaluate with accuracy not only the compliance of quality of the performance of the civil protection information and analytical support system with the requirements to it but the usefulness of recommendations designed to improve it.

3. The quality of operation of the civil protection information and analytical support system is evaluated by means of the proposed method, which is introduced in the logical framework containing certain clusters, forward and backward links.

The proposed method makes it possible:

- to determine whether the performance of the civil protection information and analytical support system meets the requirements to it during emergency response;
- to calculate the degree of information and analytical support for the administrative body;
- to determine the appropriateness of the recommendations aimed at improving the quality of performance of the civil protection information and analytical support system;
- to use the quality evaluation of the performance of the civil protection information and analytical support system to determine the rational method of its operation.

4. The achievement of the quality criterion of the performance of the civil protection information and analytical support system is a link in the methodological approach which makes it possible to determine the rational method of opera-

tion of the system by means of the hierarchical model for the comparison of alternative methods of the system operation based on the method of hierarchical analysis, which ensures that the head of the administrative body performs the assigned task in a high-quality, complete and timely manner.

5. The practical application of the proposed method provides for the quality evaluation of the civil protection information and analytical support system daily operation, as well as its work in the modes of high alert and emergency state.

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## Інформаційно-аналітичне забезпечення прийняття обґрунтованих управлінських рішень у системі цивільного захисту

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**Мета.** Обґрунтувати основні вимоги до інформації та розробити метод оцінювання якості функціонування системи інформаційно-аналітичного забезпечення цивільного захисту в державному управлінні.

**Методика.** У ході дослідження використана сукупність загальних і спеціальних методів пізнання: регулярного спостереження й порівняльного аналізу, контент-аналізу, логічного узагальнення, кількісного та якісного порівняння, наукового абстрагування та систематизації. Застосовано метод оцінювання якості функціонування системи інформаційно-аналітичного забезпечення цивільного захисту, що дозволив визначити якість інформації як достатню, відповідну зміні обставин, значущу інформацію для прийняття доцільного рішення керівником органу управління в певних умовах.

**Результати.** Обґрунтовані основні вимоги до інформації та визначена її якість як сукупність властивостей – адекватності, повноти, оперативності, корисності, що окреслює ступінь її придатності для досягнення цілей, які стоять перед системою інформаційно-аналітичного забезпечення цивільного захисту. Розроблено метод оцінювання якості функціонування системи інформаційно-аналітичного забезпечення цивільного захисту в надзвичайних ситуаціях, що дозволяє кількісно оцінити відповідність якості функціонування досліджуваної системи вимогам, які до неї пред'являються, за умови використання інтегрального показника – ступеня інформаційно-аналітичного забезпечення органу управ-

ління щодо організації дій в умовах надзвичайних ситуацій. Отримані результати оцінювання якості функціонування системи інформаційно-аналітичного забезпечення цивільного захисту запропоновані для визначення раціонального методу її функціонування під час ухвалення рішення керівником органу управління в конкретних обставинах.

**Наукова новизна.** Визначено критерій оцінювання – досягнення умови, коли ступінь інформаційно-аналітичного забезпечення, що реалізується, більший або дорівнює потрібному й забезпечує подальше оцінювання методів функціонування зазначеної системи.

**Практична значимість.** Доведено, що досягнення критерію якості функціонування системи інформаційно-аналітичного забезпечення цивільного захисту є з'єднувальною ланкою методологічного підходу. Виникає можливість визначення раціонального методу функціонування зазначеної системи за допомогою ієрархічної моделі порівняння альтернативних методів її функціонування на основі методу аналізу ієрархій (МАІ), що забезпечує керівнику органу управління здійснення якісного, повного та своєчасного виконання завдань за призначенням.

**Ключові слова:** *надзвичайні ситуації, інформаційно-аналітичне забезпечення, цивільний захист, якість інформації, функціонування системи, безпека*

*The manuscript was submitted 03.06.21.*