

## **SECURE ASPECTS OF DIGITALIZATION IN MANAGEMENT ACCOUNTING AND FINANCES OF THE SUBJECT OF THE NATIONAL ECONOMY IN THE CONTEXT OF GLOBALIZATION**

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### **Abstract**

In the context of globalization, the subjects of the national economy have faced increasing competition in global and national markets, the rapid introduction of the latest management standards, a significant complication of business processes and their rapid digitalization. In such conditions, enterprises are forced to look for and implement new digital solutions for managing business processes, in particular in the field of management accounting, which is a key element of the management decision-making system. Effective digitalization of the management accounting system allows providing reasonable and optimal solutions at all levels of management, but digitalization is a complex and multidimensional process that leads to difficulties, including those related to enterprise security. Therefore, the identification of possible threats and security measures associated with the digitalization of management accounting and finance, and their assessment are important elements of the digitalization of business processes of the national economy is the aim of this research?

The data for this research were gotten from Elmechanics Ltd Company which is a distributor of electronic components in Ukraine. To assess the risks

and measures to ensure cybersecurity associated with the digitalization of management accounting, the authors first tested the Saaty's [23], priority rating scale, based on the decomposition of a complex problem into: target, criteria, subcriteria, and alternatives. We believe that the choice of alternative measures to ensure the safety of management accounting depends on the experience and knowledge of the expert or the person making management decisions. In this case, the subjectivity of security risk assessment and management decisions can be traced. At the same time, the expediency of using the priority rating scale is explained by the possibility of choosing the best option for management measures while minimizing the subjectivity of the manager.

The research resulted in identifying the most likely threats and the set of cybersecurity measures for eliminating them. The highest priority of measures aimed at ensuring the availability of data indicates that the most likely cyber threats to the management accounting system that may face the company are those related to the violation of access, modification or destruction of data authorized employees. Therefore, the most important thing for the business entity

is to implement measures aimed at protecting the management accounting system from relevant natural and artificial threats by physically protecting media and other elements of the information infrastructure of the enterprise from damage, backing up data to prevent cyberattacks on the management accounting system and internal network, etc. It is important to note that according to the results of the analysis, measures aimed at protecting data from dissemination among unauthorized users are also extremely important from the point of view of ensuring the security of management accounting. Therefore, the company should also improve the quality of authentication and authorization, ensure an adequate level of personal responsibility for data leakage, and implement logging of employees' actions that are related to confidential data.

The introduction of the priority rating scale in the decision-making process to select the most priority measures to ensure the security of the management accounting system and enterprise finance will protect the system from the most likely cyber threats. The method tested by the authors contains step-by-step directions that should be implemented by managers to increase the competitiveness of the enterprise and ensure its information security.

**Key words:** *Digitalization, Management Accounting, Finance, Information Security, Management Decision, Cyber Threats.*

## 1. Introduction

In the modern world, the avalanche-like nature of information technology development leads to an increase in the pace of digitalization and the spread of technological innovations in all spheres of public life, including economic activity. Big data, mobile technologies, artificial intelligence, cloud technologies, virtual and augmented reality, social networks, digital payment systems and some other new technologies form a new digital environment in which business entities operate. To a large extent, the need for innovation is due to the growing level of competition among businesses in both national and international markets. Therefore, digitalization, which occurs in conditions of significant turbulence in the economic environment, is a factor in achieving sustainable economic development and increases the importance of information to a critical level.

Under such conditions, at the micro level, the implementation of information technology in the management decision-making process, which is implemented through the introduction of technological innovations in the collection, processing,

storage, access and analysis of management, financial and accounting information. The main functions of management accounting are information support for management decisions and development of forecasts, strategies, operational plans, cost accounting and analysis, evaluation and analysis of current activities. That is, in contrast to financial accounting, which focuses on generating reporting information for external users, management accounting provides the necessary information to internal users, especially managers of different levels of management. Digitalization of management accounting involves the transformation of the information environment of the enterprise through the comprehensive implementation and use of the latest information technologies that allow you to generate, store, analyze and transmit information both at the enterprise level and at the level of counterparties. This level of digitalization occurs when information technology penetrates into all business processes of the enterprise and changes the economic paradigm to one that implements the ideas and strategies of digitalization at all levels of the national economy. Effective digitalization of management accounting and finance allows you to speed up accounting processes and achieve maximum efficiency in the implementation of their functions thanks to timely and reliable information. However, despite the large number of advantages, the digitalization process, like all complex phenomena, can bring with it risks and dangers for business entities.

Many scientific works are devoted to the process of digitalization of various spheres of economic activity. Thus, Bhimani [1], analyzes the formation of the relationship between digitalization and management accounting. The author emphasizes that digitalization highlights the need to reform approaches to enterprise management and in particular to management accounting. In his work, Quattrone [2], explores the development of management accounting practices in the context of digitalization and emphasizes the impossibility of building an accounting system that generates perfect information and allows you to make completely rational decisions through innovation.

Alves [3], investigates the impact of information technology on accounting and management accounting. In its work, Alves pays special attention to the study of customer satisfaction, as well as the relationship between the organizational structure of the enterprise and the construction of technical infrastructure. The author emphasizes the important role of information technology in ensuring the effectiveness of accounting and management accounting. The study also indicates an increase in the satisfaction of information technology users with increased investment in information technology.

Kusuma and Shulthoni, [4], in their study highlight the general trends in the development of information technology in the modern world and their impact on management accounting. The authors emphasize the importance of the introduction of information technology in order to ensure a high level of competitiveness of enterprises in modern conditions. Boyd and Pitre, [5], also explore management and accounting, emphasizing the importance of implementing information technology in the context of fiscal management. Möller *et al.*, [6], in their work analyze the concept of digitalization and its impact on management accounting, noting that the changes caused by digitalization may have a negative impact on the effectiveness of management accounting.

Appelbaum *et al.*, [7], analyze the features of the use of business intelligence and propose a structure for the analysis of management accounting data, as well as discuss the problems of data integrity and quality.

The need to create an information system of management accounting is substantiated in their study by Rozhkova *et al.*, [8], drawing attention to the transformation of methods of automation of management accounting from the 50s of the twentieth century to the present. The authors identified two groups of management accounting automation technologies: local systems, which the authors recommend for use by small businesses, and integrated systems, which are recommended for use by medium and large businesses. In their work, Rozhkova *et al.*, [8], argue the feasibility of implementing integrated ERP systems. Spraakman, [9], also studied the functioning of ERP systems, namely, analyzed the functioning of systems in large Canadian enterprises and the features of the implementation of management accounting in the use of these systems. He concluded that the introduction of ERP systems leads to significant changes in the practice of management accounting, which requires staff of new knowledge and skills, namely to participate in the design of business processes and better knowledge of information technology and security.

Keulana [10], examines the implementation of digital technologies in management accounting, paying attention to the impact of various information systems on the effectiveness of management accounting. The author emphasizes the significant effect of both positive and negative nature of digitalization on the process of making managerial decisions using information generated by management accounting. Medved [11], noting the important role of management accounting in the sustainable development of the enterprise, analyzes the development of management accounting in the digital transformation and the

introduction of information technology, including big data technology, to improve the implementation of management accounting functions. According to Medved, the use of innovative technologies is appropriate in the advanced training of employees, because the implementation of innovations in management accounting requires appropriate knowledge and skills from staff. Problems of staff adaptation to modern conditions are also analyzed by Moll and Yigitbasioglu [12], researching the process of digitalization of accounting and emphasizing the features of the digital transformation of accounting. The authors note that the decision-making process is largely transformed by the introduction of blockchain technologies and big data, which are accompanied by cloud analytics technologies and artificial intelligence. This trend increases the need to study the impact of digitalization on the work of accountants. Bhimani and Willcocks [13], examine the positive and negative consequences of big data technology, highlighting the need for enterprises to clearly understand what the enterprise itself can gain from the implementation of technological innovations and highlighting the fact that digitalization needs to solve the problems associated with "information literacy".

The problems of primary accounting are investigated in their article by Haje *et al.*, [14], noting that it is the shortcomings of the organization of primary accounting that affect the implementation of integrated information systems. The authors see the solution to this problem in the introduction of innovative technologies and increasing the level of automation of all stages of accounting, which will also minimize the use of paper documents.

Aslanertik and Yardimci [15], reveal the impact of "Industry 4.0" on the development of accounting, emphasizing that the introduction of new technologies, namely cyber-physical systems (CPS) and the Internet of Things (IoT), and the overall transformation of the accounting system in accordance with modern requirements will improve business processes, which will increase the efficiency of accounting.

Today, more and more work is devoted to the study of cybersecurity and innovation, because the penetration of information technology in all spheres of public life creates a kind of dependence on technology and predictably raises many concerns about the negative effects that can be caused by this transient process [17-19].

The security of the information environment of the enterprise is also the subject of scientific research, because the enterprise is extremely vulnerable to various cyber threats, especially to the loss or damage

of information. Of scientific interest are various aspects of information security of the enterprise, in particular the assessment of information security risks. Thus He and An [16], and Khajouei *et al.*, [20], in their research analyze the problems of risk assessment of information security of enterprises, first of all the problem of finding the optimal set of indicators and propose the application of the priority rating scale for risk assessment. Information security is important for agricultural and ecological systems [21, 22].

However, the analysis of scientific research indicates that the problems of information security of management accounting in the context of digitalization remain insufficiently covered in scientific research, which actualizes the topic of this article.

The purpose of the article is to study the threats that arise in the process of digitalization of management accounting and finance, as well as the development of methods for assessing measures to ensure cybersecurity of management accounting in the enterprise.

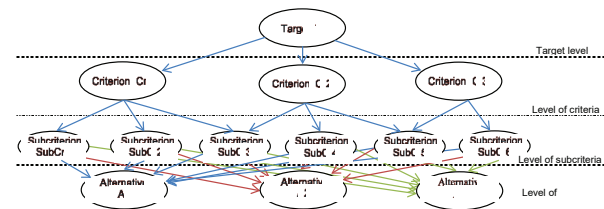
## 2. Materials and Methods

There are many different risk assessment methods and measures to ensure cybersecurity, but each has its advantages and disadvantages. For the analysis of alternative cybersecurity measures, the priority rating scale was chosen, which was proposed by Professor Saaty [23], to solve complex problems and involves the decomposition of a complex problem into a goal, criteria, subcriteria, and alternatives. The advantages of this method include: the method does not require to form a decision-making model according to general rules; the method allows to coordinate different expert opinions by defining priorities; the constructed model reflects the detailed perception of the interaction of factors influencing the priorities of alternatives; the calculation algorithm is not complicated and involves the accumulation of data using pairwise comparisons; the method is universal, because the scope is unlimited. The disadvantages of this method are the following: the method does not have built-in tools for interpreting ratings of alternatives, so the conclusions about the decisions depend entirely on the decision maker; The method does not have data validation tools, but the practice of using the method assumes that the method is used in cases where it is impossible to obtain objective data. Given the relationship between the advantages and disadvantages of the priority rating scale, the authors consider it appropriate to use this method to assess measures for cybersecurity and protection against cyber threats associated with the digitalization of management accounting.

The general algorithm of the priority rating scale includes the following stages:

- 1) Decomposition of the problem and construction of a hierarchical model.
- 2) Formation of a matrix of pairwise comparisons.
- 3) Calculation of the vector of priorities.
- 4) Determining the consistency ratio.
- 5) Calculation of general weights for each alternative.
- 6) Determining the best alternative.

At the first stage there is an analysis and decomposition of a complex problem into separate elements of the hierarchical structure, dividing them into groups according to the level of dominance. Analyzing a system or problem is a necessary part of building a hierarchy model. The result is a tree model of hierarchical structure. The components of the model in general are: the target level, the level of criteria, the level of subcriteria, the level of alternatives, as shown in Figure 1.



**Figure 1. Hierarchical structure of the MAI model**  
Source: author's development

At the target level, there is only one element - Target (T). At the level of criteria, there may be a group of elements Criterion (Cr) and several levels of subcriteria, at which, respectively, there may be groups of elements - Subcriterion (SubCr) and intermediate links between them. At the level of alternatives, there may be several elements - Alternative (A).

The second step is to create a comparison matrix by comparing a specific item from the top level with all the items associated with that item at the current level. Thus, for example, for the criterion Cr there are k elements (A<sub>1</sub>, A<sub>2</sub>, ... A<sub>k</sub>) with which it is associated at the level of alternatives. The formula of the matrix of pairwise comparisons is as follows (1):

$$M = \begin{bmatrix} 1 & \gamma_1 \cdot \gamma_2^{-1} & \dots & \gamma_1 \cdot \gamma_k^{-1} \\ \gamma_2 \cdot \gamma_1^{-1} & 1 & \dots & \gamma_2 \cdot \gamma_k^{-1} \\ \vdots & \vdots & \ddots & \vdots \\ \gamma_k \cdot \gamma_1^{-1} & \gamma_k \cdot \gamma_2^{-1} & \dots & 1 \end{bmatrix} = \begin{bmatrix} \alpha_{11} & \alpha_{12} & \dots & \alpha_{1k} \\ \alpha_{21} & \alpha_{22} & \dots & \alpha_{2k} \\ \vdots & \vdots & \ddots & \vdots \\ \alpha_{k1} & \alpha_{k2} & \dots & \alpha_{kk} \end{bmatrix} \quad (1)$$

The matrix *M* shows  $\alpha_{ij}$  – the ratio of the priorities of element *i* and element *j* of the criterion Cr and meets the following conditions:  $\alpha_{ij} = \frac{1}{\alpha_{ji}}$  ( $i, j \in \overline{1, k}$ ) and, provided  $i = j$ ,  $\alpha_{ij} = 1$ . The assessment of priority is

based on the scale of assessments of priorities Saaty, i.e. takes values from 1 to 9. The values of the assessments are given in Table 1.

According to the method, the higher the priority of an element, the more whole scores there will be in the corresponding row of the matrix, and the scores will be higher. Usually, the matrix of paired comparisons is filled in by an expert or a decision-maker, guided by his or her knowledge, experience, and beliefs.

The next step is to calculate the eigenvector of the priority matrix. To calculate the eigenvector of the matrix, it is necessary to calculate the weight vector  $V = (\bar{\gamma}_1, \bar{\gamma}_2, \dots, \bar{\gamma}_k)^T$ , for this purpose it is advisable to use the following formula (2):

$$\bar{\gamma}_i = \left( \prod_{j=1}^k \alpha_{ij} \right)^{1/k}, i \in \overline{1, k} \quad (2)$$

To obtain the required normalized eigenvector  $V_n = (\gamma_1, \gamma_2, \dots, \gamma_k)^T$ , it is appropriate to use the following formula (3):

$$\gamma_i = \bar{\gamma}_i \cdot \left( \sum_{j=1}^k \bar{\gamma}_j \right)^{-1}, i \in \overline{1, k} \quad (3)$$

The stage of determining the consistency ratio is critical, because the effectiveness of the method depends on the level of consistency of local priorities. It is to assess the level of consistency that the  $RC$  consistency ratio is calculated by the formula (4):

$$RC = \frac{IC}{CC} \quad (4)$$

Where:  $IC$  - consistency index, which is a measure of consistency of the matrix and is calculated by the formula (5);  $CC$  - random agreement index, which is determined for a square  $k$ -dimensional positive inversely symmetric matrix.

**Table 1. Saaty priority rating scale**

	Intensity of importance					
	1	3	5	7	9	2, 4, 6, 8
Definition	Equal importance	Moderate importance	Strong importance	Very strong importance	Extreme importance	In appropriate intermediate cases

Source: Saaty, [23].

**Table 2. Value of the index of random consistency**

$k$	2	3	4	5	6	7	8	9	10
$CC$	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

Source: Saaty, [23].

The values of which are determined by the generator of random numbers distributed according to the uniform law and are shown in Table 2.

Consistency index -  $IC$  is calculated by following formula:

$$IC = (\lambda_{max} - k) \cdot (k - 1)^{-1} \quad (5)$$

Where:  $k$  - order of the priority matrix;  $\lambda_{max}$  - the maximum eigenvalue of the priority matrix.

To calculate the maximum eigenvalue of the matrix, it is advisable to use the formula (6):

$$\lambda_{max} = k^{-1} \cdot \sum_{i=1}^k \gamma_i^{-1} \cdot (M\gamma)_i \quad (6)$$

Where:  $(M\gamma)_i$  -  $i$ -th element of the vector  $P$ ;  $M\gamma$  - vector  $P$ , which is the product of the matrix  $M$ , and the vector  $\gamma$  by the formula (7):

$$P = M\gamma = \begin{bmatrix} \alpha_{11} & \alpha_{12} & \dots & \alpha_{1k} \\ \alpha_{21} & \alpha_{22} & \dots & \alpha_{2k} \\ \vdots & \vdots & \vdots & \vdots \\ \alpha_{k1} & \alpha_{k2} & \dots & \alpha_{kk} \end{bmatrix} \cdot \begin{bmatrix} \gamma_1 \\ \gamma_2 \\ \vdots \\ \gamma_k \end{bmatrix} = \begin{bmatrix} \rho_1 \\ \rho_2 \\ \vdots \\ \rho_k \end{bmatrix} \quad (7)$$

Under ideal conditions, the consistency index is 0, but for real conditions, the smaller the  $IC$  value, the better. But to check the level of consistency,  $RC$  is analyzed. Thus, if the value of  $RC \leq 0.1$ , it is considered that the level of consistency is satisfactory, the estimates of the priority matrix are consistent, and the eigenvector  $V_n$  will be a weight vector, each element of which reflects the share of the corresponding alternative for the criterion Cr. f the value of  $RC > 0.1$ , then the level of consistency is unsatisfactory, so the matrix must be changed to achieve a satisfactory level of consistency.

At the stage of calculating the general weights for each alternative, it is necessary to determine the weight vector for all elements at the level of alternatives.

The local weights of the elements at different levels are aggregated to obtain general weights for the alternatives. Each element of the vector reflects the share of the corresponding alternative in the achieved goal.

Aggregation occurs according to the formula (8):

$$G = \begin{bmatrix} \gamma_{11} & \gamma_{12} & \dots & \gamma_{1r} \\ \gamma_{21} & \gamma_{22} & \dots & \gamma_{2r} \\ \vdots & \vdots & \ddots & \vdots \\ \gamma_{m1} & \gamma_{m2} & \dots & \gamma_{mr} \end{bmatrix} = (D_1, D_2, \dots, D_r) \quad (8)$$

Where:  $G$  - combined weight vector taking into account all elements of the level of alternatives to the level of criteria;  $m$  - number of elements at the level of alternatives;  $r$  - the number of elements at the level of criteria;  $D$  - a weight vector that represents the fractions of all elements of the alternative level for the corresponding criterion.

The weight vector  $B = b_1, b_2, \dots, b_r$  of all elements at the level of criteria to the target level is determined next. The vector of general weights  $F$ , which reflects the weight values of all elements at the level of alternatives and is calculated as the product of vector  $G$  and vector  $B$  by formula (8):

$$F = G \cdot B = \begin{bmatrix} \gamma_{11} & \gamma_{12} & \dots & \gamma_{1r} \\ \gamma_{21} & \gamma_{22} & \dots & \gamma_{2r} \\ \vdots & \vdots & \ddots & \vdots \\ \gamma_{m1} & \gamma_{m2} & \dots & \gamma_{mr} \end{bmatrix} \cdot \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_r \end{bmatrix} = \begin{bmatrix} f_1 \\ f_2 \\ \vdots \\ f_m \end{bmatrix} \quad (9)$$

At the last stage, it is necessary to rank the alternatives, i.e. alternative measures of cybersecurity management accounting in accordance with the values of  $f_i$ . The alternative, which has the highest value of  $f$ , is the highest priority.

### 3. Results and Discussion

In the context of transit to the information economy, information becomes a critical resource for any business entity. One of the reasons for the extremely high importance of information is due to the fact that it reduces the level of uncertainty in the management decision-making process. Therefore, the information used in the decision-making process must be: reliable, timely, reliable, complete and accurate. A significant role in the formation of information used for management decisions is played by management accounting. It is management accounting that allows you to identify, measure, accumulate, analyze and transmit information that provides forecasting, planning, evaluation and control, which are carried out by managers at different levels of management. The implementation of these functions in the enterprise depends on the management accounting system, which is a combination of two elements - the financial and management subsystem of the accounting

system of the enterprise. The system of management accounting is individual for each enterprise, because it is formed on the basis of organizational principles and methods of economic activity, which are a trade secret. The complexity of the structure of the business entity affects the amount of information that the entity accumulates and the complexity of the management accounting system.

Digitalization of management accounting involves the transformation of the information environment of the enterprise through the introduction of digital innovations. Increasing competition in local and global markets, the introduction of information technology in production processes, the implementation of modern management principles, the critical role of information in making effective management decisions are the main factors in the digitalization of management accounting. As a result of successful digitalization, the company can get the following benefits:

- Ensuring reliable, complete, accurate and timely information flows.
- Ensuring prompt access to information flows.
- Reduction of terms of preparation and receipt of analytical materials concerning a condition of the enterprise.
- Increasing the productivity of accountants, analysts and managers.
- Increasing the efficiency of management decisions, in particular planning and forecasting, which leads to an increase in the level of efficiency of the business entity as a whole.
- However, there are a number of problems associated with digitalization, namely:
  - High cost of implementing technological innovations.
  - Lack of specialists who are able to successfully implement and apply information technology in business processes of the enterprise.
  - Lack of the necessary degree of digitalization at various levels of economic activity.
  - Infinity of the digitalization process, because in the modern world the development and improvement of innovative technologies is unlimited.
  - Cyber threats that arise as a result of the implementation of technological innovations in business processes and management accounting system of the enterprise.
  - The problem of protection of information assets of the enterprise becomes more acute, because the implementation of cyber threats can lead to financial losses, undermine the competitiveness of the enterprise, and destroy the business model or reputation of the business entity. It is worth noting that cybersecurity is a problem for both small and medium enterprises and large enterprises. Although large enterprises have much more resources to successfully digitalize management accounting, including the creation of a system of cybersecurity measures, the

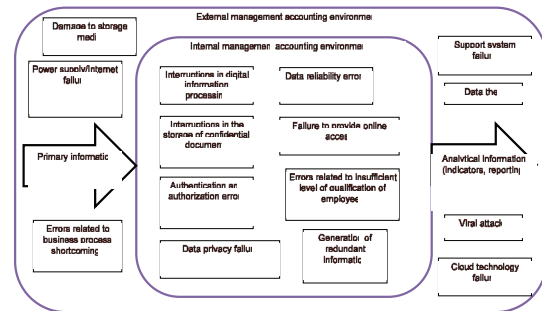
management of large national enterprises generally does not consider cybersecurity of the accounting system a strategic priority.

1) The algorithm for cybersecurity of the accounting system includes the following steps:

- 1) Identification of threats and identification of cybersecurity risks.
- 2) Development of a system of measures to combat cybersecurity threats.
- 3) Control and evaluation of the effectiveness of cybersecurity measures.
- 4) Correction of measures in accordance with the obtained evaluation results.
- 5) Ensuring the digitalization of business processes in the enterprise, the business entity may face a variety of cyber threats of both external and internal origin, namely: theft of critical data, damage to information infrastructure, damage to data due to disruptions of digital data processing, breach of data confidentiality due to disruption storage of electronic documents and many others (Figure 2).

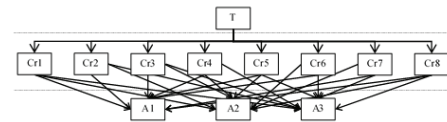
Precisely because information is a critical resource for almost any business entity, it is important to timely identify possible threats associated with the digitalization of business processes, and the implementation of a set of adequate measures to ensure cybersecurity management system. In the process of making decisions on the choice of a set of measures, it is advisable to assess alternative options for cybersecurity measures and choose the one that has the highest priority level.

In order to assess the priority of cybersecurity measures of the management accounting system in the process of research, a survey of enterprise N was conducted and the priority rating scale was applied.



**Figure 2. The structure of cyber threats associated with the digitalization of management accounting**  
Source: author's development

A three-layer model of hierarchies was chosen for this enterprise, which consists of 8 criteria and 3 alternative sets of cybersecurity measures of the management accounting system, as shown in Figure 3.



**Figure 3. Three-layer model of hierarchies**  
Source: author's development

In the model at the target level, there is only one element T, which is the target - to assess measures to ensure cybersecurity of the management accounting system. At the level of criteria, there are 8 criteria that reflect the cyber threats that an enterprise may face during the digitalization of accounting. At the level of alternatives, there are 3 alternative measures aimed at eliminating cyber threats and ensuring the sustainable operation of the management accounting system. The content and designation of structural elements of the hierarchical model are given in Table 3.

**Table 3. Contents of structural elements of the hierarchical model**

Model element designation	The content of the element
T	Assessment of cybersecurity measures for management accounting
Cr1	Failure of the management accounting system due to damage to media, remote data warehouses or other elements of the information infrastructure of the enterprise
Cr2	Data availability issues due to power failure, Internet or cloud technologies
Cr3	Violation of data confidentiality due to authentication and authorization errors
Cr4	Violation of data confidentiality due to interruptions in the storage of electronic documents
Cr5	Violation of the efficiency of access to the necessary data due to failure of the technical support systems of the automated accounting system
Cr6	Errors in the operation of the management accounting system due to errors in digital data processing
Cr7	Problems of data reliability due to insufficient level of qualification of employees
Cr8	Failure of the management accounting system as a result of a virus attack or an attack on the internal network of the business entity
A1	Measures aimed at ensuring data confidentiality
A2	Measures aimed at ensuring the reliability of data
A3	Measures aimed at ensuring the availability of data

Source: author's development

Data for the formation of comparative matrices were obtained from an expert who knows the features of the management accounting system of the enterprise and makes decisions on information security of the enterprise.

For the target level - the level of criteria relationship, the following comparative matrix  $M_1$  was constructed (10):

$$M_1 = \begin{bmatrix} 1 & 3 & 1 & 3 & 5 & 6 & 6 & 7 \\ 0.33 & 1 & 2 & 4 & 5 & 6 & 7 & 8 \\ 1 & 0.50 & 1 & 2 & 5 & 6 & 6 & 7 \\ 0.33 & 0.25 & 0.50 & 1 & 5 & 5 & 6 & 8 \\ 0.20 & 0.20 & 0.20 & 0.20 & 1 & 2 & 4 & 6 \\ 0.17 & 0.17 & 0.17 & 0.20 & 0.50 & 1 & 4 & 4 \\ 0.17 & 0.14 & 0.17 & 0.17 & 0.25 & 0.25 & 1 & 2 \\ 0.14 & 0.13 & 0.14 & 0.125 & 0.17 & 0.25 & 0.17 & 1 \end{bmatrix} \quad (10)$$

For the matrix  $M_1$ , the dimension  $k$  is 8. On the basis of estimates given in the matrix  $M_1$ , eigenvector  $V_1 = (\bar{y}_1, \bar{y}_2, \dots, \bar{y}_k)^T = (3.21, 2.86, 2.44, 1.63, 0.73, 0.54, 0.31, 0.23)^T$  is calculated, the next step is to calculate the normalized value of the vector  $V_1$ :  $V_{1n} = (y_1, y_2, \dots, y_k)^T = (0.27, 0.24, 0.20, 0.14, 0.06, 0.05, 0.03, 0.02)^T$

The maximum eigenvalue of the matrix  $M_1$  is equal to  $\lambda_{max1} = 8.941$ , and the consistency index is equal to  $IC = (8.941 - 8) \cdot (8 - 1)^{-1} = 0.134$ , according to the values proposed by Professor Saaty for  $k = 8$  index of random consistency  $CC = 1.4$ , then  $RC$  is equal to 0.096, which is less than the normative value of 0.1, i.e. the matrix has been tested for consistency. Therefore,  $V_{1n}$  is considered a weight vector.

For relations the level of criteria is the level of alternatives, for criterion Cr1, a matrix of pairwise comparisons of  $M_{Cr1}$  priorities was constructed (11):

$$M_{Cr1} = \begin{bmatrix} 1 & 0.20 & 0.25 \\ 5 & 1 & 2 \\ 4 & 0.50 & 1 \end{bmatrix} \quad (11)$$

For the matrix  $M_{Cr1}$  the dimension  $k$  is 3. Based on the estimates given in the matrix  $M_{Cr1}$ , the eigenvector  $V_{Cr1} = (0.368, 2.154, 1.26)^T$ , is calculated, and the next step is to calculate the normalized value of the vector  $V_{Cr1}$ :  $V_{Cr1n} = (0.097, 0.57, 0.333)^T$ .

The maximum eigenvalue of the matrix  $M_{Cr1}$  is equal to  $\lambda_{maxCr1} = 3.02$ , and the consistency index is equal to  $IC_{Cr1} = (3.02 - 3) \cdot (3 - 1)^{-1} = 0.01$ , according to the values proposed by Professor Saaty for  $k = 3$  index of random consistency  $CC = 0.52$ , then  $RC_{Cr1}$  is equal to 0.02, which is much less than the normative value of 0.1, i.e. the matrix is tested for the level of consistency. Therefore,  $V_{Cr1n}$  is considered a weight vector.

For criterion Cr2, A matrix of pairwise comparisons of

$M_{Cr2}$  priorities was constructed (12):

$$M_{Cr2} = \begin{bmatrix} 1 & 4 & 0.25 \\ 0.25 & 1 & 0.14 \\ 4 & 7 & 1 \end{bmatrix} \quad (12)$$

For the matrix  $M_{Cr2}$ , the dimension  $k$  is 3. Based on the estimates given in the  $M_{Cr2}$  matrix, the eigenvector  $V_{Cr2} = (1, 0.329, 3.037)^T$  is calculated, the next step is to calculate the normalized value of the vector  $V_{Cr2}$ :  $V_{Cr2n} = (0.229, 0.075, 0.696)^T$ .

The maximum eigenvalue of the matrix  $M_{Cr2}$  is equal to  $\lambda_{maxCr2} = 3.08$ , and the consistency index is equal to  $IC_{Cr2} = (3.08 - 3) \cdot (3 - 1)^{-1} = 0.04$ , according to the values proposed by Professor Saaty for  $k = 3$  index of random consistency  $CC = 0.52$ , then  $RC_{Cr2}$  is equal to 0.07, which is less than the normative value of 0.1, i.e. the matrix is tested for the level of consistency. Therefore,  $V_{Cr2n}$  is considered a weight vector.

A matrix of pairwise comparisons of priorities  $M_{Cr3}$  was constructed for criterion Cr3 (13):

$$M_{Cr3} = \begin{bmatrix} 1 & 7 & 2 \\ 0.14 & 1 & 0.14 \\ 0.50 & 7 & 1 \end{bmatrix} \quad (13)$$

For the matrix  $M_{Cr3}$  the dimension  $k$  is 3. Based on the estimates given in the matrix  $M_{Cr3}$  the eigenvector  $V_{Cr3} = (2.41, 0.273, 1.518)^T$  is calculated, and the next step is to calculate the normalized value of the vector  $V_{Cr3}$ :  $V_{Cr3n} = (0.574, 0.065, 0.361)^T$ .

The maximum eigenvalue of the matrix  $M_{Cr3}$  is equal to  $\lambda_{maxCr3} = 3.05$ , and the consistency index is equal to  $IC_{Cr3} = (3.05 - 3) \cdot (3 - 1)^{-1} = 0.03$ , according to the values proposed by Professor Saaty for  $k = 3$  index of random consistency  $CC = 0.52$ , then  $RC_{Cr3}$  is equal to 0.05, which is much less than the normative value of 0.1, i.e. the matrix is tested for the level of consistency. Therefore,  $V_{Cr3n}$  is considered a weight vector.

For the criterion Cr4, a matrix of pairwise comparisons of  $M_{Cr4}$  priorities was constructed (14):

$$M_{Cr4} = \begin{bmatrix} 1 & 8 & 3 \\ 0.13 & 1 & 0.20 \\ 0.33 & 5 & 1 \end{bmatrix} \quad (14)$$

For the matrix  $M_{Cr4}$  the dimension  $k$  is 3. On the basis of estimates given in the matrix  $M_{Cr4}$  eigenvector  $V_{Cr4} = (2.884, 0.292, 1.186)^T$  is calculated, the next step is to calculate the normalized value of the vector  $V_{Cr4}$ :  $V_{Cr4n} = (0.661, 0.067, 0.272)^T$ .

The maximum eigenvalue of the matrix  $M_{Cr4}$  is equal to  $\lambda_{maxCr4} = 3.04$ , and the consistency index is equal to  $IC_{Cr4} = (3.04 - 3) \cdot (3 - 1)^{-1} = 0.02$ , according to

the values proposed by Professor Saaty for  $k = 3$  index of random consistency  $CC = 0.52$ , then  $RC_{Cr4}$  is equal to 0.04, which is much less than the normative value of 0.1, i.e. the matrix is tested for the level of consistency. Therefore,  $V_{Cr4n}$  is considered a weight vector.

For the criterion Cr5, a matrix of pairwise comparisons of  $M_{Cr5}$  priorities was constructed (15):

$$M_{Cr5} = \begin{bmatrix} 1 & 2 & 1 \\ 0.50 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} \quad (15)$$

For the matrix  $M_{Cr5}$ , the dimension  $k$  is 3. On the basis of estimates given in the matrix  $M_{Cr5}$  eigenvector  $V_{Cr5} = (1.26, 0.794, 1)^T$  is calculated, the next step is to calculate the normalized value of the vector  $V_{Cr5}$ :  $V_{Cr5n} = (0.413, 0.26, 0.327)^T$ .

The maximum eigenvalue of the matrix  $M_{Cr5}$  is equal to  $\lambda_{maxCr5} = 3.05$ , and the consistency index is equal to  $IC_{Cr5} = (3.05 - 3) \cdot (3 - 1)^{-1} = 0.025$ , according to the values proposed by Professor Saaty for  $k = 3$  index of random consistency  $CC = 0.52$ , then  $RC_{Cr5}$  is equal to 0.05, which is much less than the normative value of 0.1, i.e. the matrix is tested for the level of consistency. Therefore,  $V_{Cr5n}$  is considered a weight vector.

For the criterion Cr6, a matrix of pairwise comparisons of  $M_{Cr6}$  priorities was constructed (16):

$$M_{Cr6} = \begin{bmatrix} 1 & 0.33 & 6 \\ 3 & 1 & 8 \\ 0.17 & 0.13 & 1 \end{bmatrix} \quad (16)$$

For the matrix  $M_{Cr6}$ , the dimension  $k$  is 3. On the basis of estimates given in the matrix  $M_{Cr6}$  eigenvector  $V_{Cr6} = (1.26, 2.884, 0.275)^T$  is calculated, the next step is to calculate the normalized value of the vector  $V_{Cr6}$ :  $V_{Cr6n} = (0.285, 0.653, 0.062)^T$ .

The maximum eigenvalue of the matrix  $M_{Cr6}$  is equal to  $\lambda_{maxCr6} = 3.07$ , and the consistency index is equal to  $IC_{Cr6} = (3.07 - 3) \cdot (3 - 1)^{-1} = 0.04$ , according to the values proposed by Professor Saaty for  $k = 3$  index of random consistency  $CC = 0.52$ , then  $RC_{Cr6}$  is equal to 0.07, which is much less than the normative value of 0.1, i.e. the matrix is tested for the level of consistency. Therefore,  $V_{Cr6n}$  is considered a weight vector.

For the criterion Cr7, a matrix of pairwise comparisons of  $M_{Cr7}$  priorities was constructed (17):

$$M_{Cr7} = \begin{bmatrix} 1 & 0.33 & 4 \\ 3 & 1 & 6 \\ 0.25 & 0.17 & 1 \end{bmatrix} \quad (17)$$

For the matrix  $M_{Cr7}$ , the dimension  $k$  is 3. On the basis

of estimates given in the matrix  $M_{Cr7}$  eigenvector  $V_{Cr7} = (1.101, 2.261, 0.347)^T$  is calculated, the next step is to calculate the normalized value of the vector  $V_{Cr7}$ :  $V_{Cr7n} = (0.271, 0.644, 0.085)^T$ .

The maximum eigenvalue of the matrix  $M_{Cr7}$  is equal to  $\lambda_{maxCr7} = 3.05$ , and the consistency index is equal to  $IC_{Cr7} = (3.05 - 3) \cdot (3 - 1)^{-1} = 0.025$ , according to the values proposed by Professor Saaty for  $k = 3$  index of random consistency  $CC = 0.52$ , then  $RC_{Cr7}$  is equal to 0.05, which is much less than the normative value of 0.1, i.e. the matrix is tested for the level of consistency. Therefore,  $V_{Cr7n}$  is considered a weight vector.

For the criterion Cr8, a matrix of pairwise comparisons of  $M_{Cr8}$  priorities was constructed (18):

$$M_{Cr8} = \begin{bmatrix} 1 & 2 & 5 \\ 0.50 & 1 & 5 \\ 0.20 & 0.20 & 1 \end{bmatrix} \quad (18)$$

For the matrix  $M_{Cr8}$ , the dimension  $k$  is 3. On the basis of estimates given in the matrix  $M_{Cr8}$  eigenvector  $V_{Cr8} = (2.154, 1.357, 0.342)^T$  is calculated, the next step is to calculate the normalized value of the vector  $V_{Cr8}$ :  $V_{Cr8n} = (0.559, 0.352, 0.089)^T$ .

The maximum eigenvalue of the matrix  $M_{Cr8}$  is equal to  $\lambda_{maxCr8} = 3.05$ , and the consistency index is equal to  $IC_{Cr8} = (3.05 - 3) \cdot (3 - 1)^{-1} = 0.025$ , according to the values proposed by Professor Saaty for  $k = 3$  index of random consistency  $CC = 0.52$ , then  $RC_{Cr8}$  is equal to 0.05, which is much less than the normative value of 0.1, i.e. the matrix is tested for the level of consistency. Therefore,  $V_{Cr8n}$  is considered a weight vector.

The next step is to calculate the combined weight vector taking into account all the elements of the level of alternatives to the level of criteria (19):

$$G = \begin{bmatrix} 0.097 & 0.229 & 0.574 & 0.661 & 0.413 & 0.285 & 0.271 & 0.559 \\ 0.570 & 0.075 & 0.065 & 0.067 & 0.260 & 0.653 & 0.644 & 0.352 \\ 0.333 & 0.696 & 0.361 & 0.272 & 0.327 & 0.062 & 0.085 & 0.089 \end{bmatrix} \quad (19)$$

Weight vector  $B = V_{in} = (0.27, 0.24, 0.20, 0.14, 0.06, 0.05, 0.03, 0.02)$ . Then the next step is to calculate the vector of general scales F (20):

$$F = \begin{bmatrix} 0.097 & 0.229 & 0.574 & 0.661 & 0.413 & 0.285 & 0.271 & 0.559 \\ 0.570 & 0.075 & 0.065 & 0.067 & 0.260 & 0.653 & 0.644 & 0.352 \\ 0.333 & 0.696 & 0.361 & 0.272 & 0.327 & 0.062 & 0.085 & 0.089 \end{bmatrix} \cdot \begin{bmatrix} 0.27 \\ 0.24 \\ 0.20 \\ 0.14 \\ 0.06 \\ 0.05 \\ 0.03 \\ 0.02 \end{bmatrix} = (0.34, 0.26, 0.39) \quad (20)$$

The obtained vector F allows choosing the most priority set of measures to ensure cybersecurity of the management accounting system. Thus, the highest value of the scales has an alternative A3, which is equal to 0.39, i.e. measures to ensure data availability are the highest priority, alternative A1 has a lower

priority, which is 0.34, so according to the expert, these measures are also quite important for cybersecurity and have been aimed at ensuring the confidentiality of information. The least priority measures are those aimed at ensuring the reliability of data, but this may indicate that the level of confidence in the management accounting system is generally quite high.

#### 4. Conclusions

- The rapid development of information technologies and their penetration into all spheres of public life leads to the rapid introduction of technological innovations in economic activity. Digitalization involves the process of implementing digital technologies in the operation of the enterprise, which leads to the transformation of the business model, business processes, management methods in the enterprise, and becomes an important factor in achieving a high level of competitiveness and sustainable development of the business entity. The results of digitalization are large amounts of data that can be used in enterprise management, in particular in the process of making management decisions. In this context, special attention is drawn to the digitalization of management accounting and finance of the business entity, which involves the transformation of the information environment of the enterprise through the comprehensive implementation and use of innovative technologies. In the case of successful digitalization of accounting, the company receives benefits in the form of: accelerating accounting processes, reducing the impact of "human" factors on the formation and reliability of data, accelerating management decisions using reliable information, improving the efficiency of management decisions. However, like all complex phenomena, digitalization can lead to both positive and negative consequences.

- One of the negative consequences of digitalization is the growing vulnerability of the business entity to various threats that are associated with the loss or damage of both information and the information environment of the enterprise as a whole. Given that information is a critical resource for the business entity, information security is becoming an extremely important aspect of the operation of the enterprise. Examples of such cyber threats are data theft, damage to the information infrastructure, breach of confidentiality or reliability of data, etc.

- In order to increase the level of information security in the context of digitalization of management accounting, it is necessary to create a system of cybersecurity that is able to detect cyber threats in a timely manner and protect the business entity from their negative impact. In the process of making decisions on the implementation of various measures of cybersecurity management accounting, it is important not only to identify possible threats, but

also to assess measures to protect against them. Therefore, in order to assess alternative cybersecurity measures, it is advisable to use the priority rating scale. This method makes it possible to analyze a variety of criteria and determine the most priority set of cybersecurity measures, which will increase the level of cybersecurity of the management accounting system of the enterprise. The advantages of this method are the versatility of application, the ability to coordinate different expert opinions, a simple calculation algorithm. However, the structure of the model hierarchies, criteria and possible alternatives to cybersecurity measures may be the subject of further research.

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