

FORMATION OF AN INNOVATIVE MODEL FOR THE DEVELOPMENT OF E-COMMERCE AS PART OF ENSURING BUSINESS ECONOMIC SECURITY

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Abstract. The purpose of the article is to formulate a methodological approach to building a model of e-commerce development in the context of ensuring the economic security of business. The object of the study is the business activity of socio-economic systems and their economic security. The scientific task is to model the stages and processes of e-commerce development in the framework of ensuring business economic security. The key problem is the lack of a clear methodological approach to modeling the development of e-commerce in the context of ensuring the economic security of business. A review of the literature showed that there is no single approach to solving this problem. The research methodology involves the use of functional modeling technology. This is achieved through a graphical modeling method. Based on the results of the study, the main model for the development of e-commerce in the framework of ensuring the economic security of business was presented. Each block has been modeled separately for better understanding. The scientific innovativeness of the presented research results consists in the presented methodological approach to determining the ways for the development of e-commerce in the framework of ensuring the economic security of a business.

Keywords: business, economic security, innovation, model, e-commerce, modelling.

JEL Classification: M21, M20, L53, L81.

Introduction

The digitalization of economic processes and increased competition in the new economic conditions encourage enterprises to adapt and search for new sales markets, and flexible adaptation to the ever-growing consumer requirements for their products and services. The organization of the e-commerce system within the framework of business security is becoming a constant trend in the business practice of engineering enterprises to use new Internet technologies and provide strategic advantages in promising markets. The organizational effectiveness of the use of e-commerce within the framework of business security is reflected in an increase in the profitability of the operating profit of the enterprise by at least 109% and can reach up to 168%; Entering new markets and increasing

the share of existing ones; Establishing close and constant communication with clients; improving their service and fast delivery of products; improvement of logistics processes. The introduction of an e-commerce system within the framework of business security can, through the use of electronic technologies, improve communications with all stakeholders of the enterprise – customers, suppliers, investors, financial institutions, employees, the public, and government regulators – through a service management approach. These advantages of introducing an e-commerce system are especially relevant to those areas of economic activity that are in a state of active development but have not revealed their economic potential and security.

Modern business realities require enterprises operating in the market to expand the distribution channels for their products precisely through the use of e-commerce tools.

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This trend is because, compared with the classical form of selling goods, e-commerce requires less financial investment at the initial stage, and is also a more convenient and faster way for consumers to order and receive goods.

E-commerce opens up new business opportunities, including expanding markets, increasing sales, and personalizing offerings to customers. Secondly, in the context of economic security, e-commerce requires a high level of data and transaction security, which ensures customer trust and business resilience in the face of cyber threats. The growing reliance on digital technology also highlights the need to develop strategies to protect against potential cyberattacks and maintain data privacy. At the same time, integration with other digital platforms such as social media and mobile applications creates additional security dimensions and management challenges. E-commerce also promotes innovation in business models, giving companies the flexibility to adapt to changing market conditions. Thus, research and development in the field of e-commerce become important not only for the growth and development of a business but also for ensuring its sustainability and security in the global digital economy.

The introduction of e-commerce can have a significant positive impact on the economic security of a company, as it opens up new ways to expand the business and stabilize it. The move to an online format allows companies to reach a wider market without being limited by geographical boundaries. This creates opportunities to increase sales and attract new customers, which leads to diversification of income and reduced dependence on local market fluctuations. In addition, e-commerce allows large amounts of consumer data to be collected and analyzed, giving companies the tools to more accurately forecast demand and manage inventory more effectively. This reduces the risks of overproduction and surplus goods, helping to optimize costs and increase business efficiency.

E-commerce also plays a key role in enhancing cybersecurity. As businesses are forced to protect their online platforms and transactions from potential cyber attacks, this leads to an increase in the company's overall security level. The use of modern encryption technologies and a secure payment system helps ensure reliability and customer trust.

Today, the European annual index of the development of Internet commerce in the world, only from year to year, is growing. By the way, the same trend is observed in the global e-commerce market. If back in 2018 the European e-commerce market grew by 35%, showing the second result in the world in terms of growth, then in 2022 the e-commerce market grew by 17% to 5 billion Euros (Figure 1).

The forced isolation of the population rapidly led to the total digitalization of many types of economic activity and individual business processes, which, in turn, significantly affected the level of money circulation.

At the same time, one should pay attention to another important indicator – the percentage of e-commerce penetration in the EU. As you can see from the graph above, this figure shows a steady increase every year. This means that every year the volume of the Ukrainian e-commerce market in the Internet direction takes an increasing share of the total retail sales, which is a positive trend.

The effective management of e-commerce enterprises in the engineering sector of the economy requires a reorganization of the very approach to ensuring economic security. Also, standards, technologies, or improved procedures have not yet been defined in building an e-commerce system for organizing the interaction of an enterprise with its stakeholders and a business model for making a profit, especially in the field of logistics management. This limits the use of all the benefits of the e-commerce enterprise engineering sector of the economy for undisclosed opportunities to enter global markets.

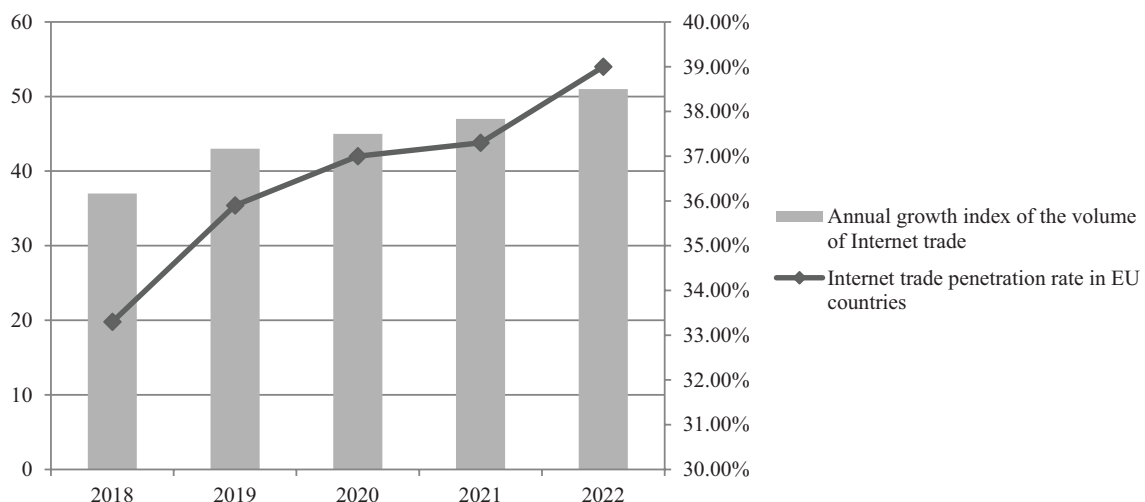


Figure 1. Dynamics of the e-commerce development index in the EU (source: developed by the author)

Thus, the main scientific and practical task of the work, together with the hypothesis put forward, is to determine such a methodological approach that will give the development of e-commerce to enterprises in the engineering sector of the economy, based on the implementation of an innovative model with the appropriate functional blocks.

The purpose of the article is to formulate a methodological approach to building a model of e-commerce development in the context of ensuring the economic security of business. The object of the study is the business activity of socio-economic systems and their economic security.

The structure of the article provides for a review of the literature and methodology, the presentation of the main results of the study and their discussion, the formation of conclusions, and prospects for further research.

1. Literature review

As Guseva (2010), Daniel et al. (2002) note, the launch of the digital economy, as a new direction of the general world economy, has led to the emergence of many new economic entities and concepts that should describe a new system of electronic relations between business entities. Subsequently, such relationships received many definitions, such as “electronic commerce”, “electronic business”, “electronic commerce”, “electronic commerce”, “economic security” and other definitions with the prefix “electronic”, “internet trading”, and “internet trading”. “Online business” and others.

Rushchysyn et al. (2021), Sylkin et al. (2019a) notes that electronic activity within the framework of business security is based on the same principles and principles as traditional commerce, that is, on a complex multi-structural trade and technological process. The imitation of e-commerce to the principles of traditional commerce suggests that e-commerce is also inextricably linked with economic security, which plays a decisive role in almost all of its stages on the way to the economic performance of an enterprise.

Barrera Verdugo (2019) and Al Azzam (2019) in the literature note that the current level of development of e-commerce and its importance for business security actualize a deep study of this concept using scientific approaches. The essence of e-commerce of enterprises is inextricably linked with technical and economic aspects, which requires, first of all, the study of the theoretical foundations of the conceptual and categorical apparatus of its problems.

Agreeing with the thesis in the literature (Alazzam et al., 2020b; Bazyluk et al., 2019) that electronic (Internet) commerce as a line of business is an activity that includes all trade and financial transactions performed via the global Internet and business processes associated with such transactions.

At the same time, Alazzam et al. (2020c) and Fetai et al. (2020) believe that e-commerce within the framework of economic security is a set of all transactions between an

enterprise and all counterparties carried out using information technology to automate business processes to optimize costs and increase the economic efficiency of a business.

Alazzam (2020a), Toska and Fetai (2023), and Awa et al. (2015) note in the literature that the range of e-commerce operations is wider than the totality of the stages of a direct sale and purchase agreement. The list of the main areas of e-commerce includes not only digital trade transactions, but also the preparation of electronic infrastructure, online market analysis, marketing activities in the electronic network, maintaining relationships with suppliers and consumers, and organizing electronic document management.

Saleh et al. (2020) and Alford and Page (2015) note that the functionality of commerce is more diverse than the same type of process of buying and selling goods. Thus, the main task of commerce can be more accurately revealed through the concept of “trade and technological process”; that is, the sequence of such actions that ensure the completion of the transaction for the sale of products. Specifically, the trade and technological process underlies the functional actions of e-commerce companies.

A study by Alazzam et al. (2023) focuses on the development of an information model for e-commerce platforms, with an emphasis on modern socio-economic systems in the context of global digitalization and legal compliance. An important aspect is also the study by Pang and Pang (2022), which analyzes the model and influencing factors of consumer satisfaction with e-commerce. Tridalestari et al. (2022) provide an analysis of e-commerce processes in the context of supply chain management, using data processing and process analysis techniques. Tytykalo et al. (2023) study the adaptive management of economic security of enterprises in the context of globalization challenges and sustainable development.

Teerasoponpong and Sopadang (2022) focus on a decision support system for adaptive procurement management and inventory management in small and medium enterprises. Marhasova et al. (2022) model the harmony of economic development of regions in the context of sustainable development, and Zybareva et al. (2022) assess the spatial challenges of the system of economic security of industrial enterprises.

With the roar of literature, we highlight the gaps in our study (Table 1).

Table 1. Gaps in the literature in the context of our study (source: developed by the author)

Main Gaps	Characteristics
Methodical approach	Lack of a new methodical approach to the development of electronic commerce
Modeling	Lack of a convenient and informative model for research
Directions for improvement	Directions are given in the text or tabular form without appropriate graphic language

In particular, due to the rapid development of modern information technologies and the simplification of the procedure for active and passive trade due to the reduction of physical contact with customers, consumers, and other stakeholders in the supply chain, the issues of the formation and functioning of the e-commerce system of enterprises, engineering and their application of innovative business models of relations, especially within the framework of economic security. The combination of these and other problematic issues determined the choice of the topic of work, goals, objectives, objectives, and directions for using the results of the study.

2. Methodology

When analyzing the operation of complex systems such as business activities and the development of e-commerce, large distributed complex companies in general, it is important to build both static models showing the work of the company, the execution of individual business processes of the company, and simulation of business processes, for the analysis of which the most important factor is the time costs, the speed of operations and other time calculations in the development of e-commerce. At the same time, researchers at the initial stages often face the problem of choosing a modeling methodology, and the relationship of different methodologies, and modeling tools. In this article, using the example of a specific company, the issues of modeling and analyzing some business processes using various notations will be considered, and an option for building an innovative model as part of the development of e-commerce and business security will be presented. It is also very important to develop and apply methods for modeling complex organizational systems using the latest software and tools, such as Integration DEFinition.

The IDEF method, used to model business processes and systems, has a number of significant advantages due to standardization and universality. This means that it applies to various industries and organizations. Its flexibility allows you to adapt the method to the specifics of a particular project or organization, which is key to the successful implementation of business processes.

Integration DEFinition in our study is a set of methodologies developed to support information systems integration and business process modeling. Integration DEFinition includes various approaches such as IDEF0 (functional modeling), IDEF1X (data modeling), and IDEF3 (process modeling). The advantages of functional modeling are structure, versatility, and flexibility, which allow you to adapt the methodology to different areas and tasks within our study. However, Integration DEFinition can be difficult to understand and requires special training to use effectively.

We can highlight the pros and cons of the chosen modeling method (Table 2).

Table 2. Pros and cons of the chosen methodology in our study (source: developed by the author)

+	-
Simplicity, as only 3–5 main description objects are used	Excessive formalization of notation, which is not only ineffective but also harmful due to the specifics of the notation
The possibility of the detailed detailing of processes, allows us to consider the process from different points of view, but in the task at hand, such a need does not arise	Lack of binding to subjects (positions, departments, etc.), which does not allow you to fully see the business process
Possibility of interaction with other notations of the modeling family	A complex scheme is quickly overloaded, which requires thinking through the processes and their detailing at the stage of preparation for the description

Using the methodology of functional modeling, the studied business process appears as a set of interrelated functions (functional blocks). The methodology applies the principle of decomposition of functions, that is, the division of any complex process into its constituent functions. This principle allows you to gradually and structurally represent the circuit model through the hierarchical structure of individual diagrams, which makes it less overloaded.

As part of our study, an innovative model was built for enterprises by the engineering sector of the economy to take into account their specifics.

As part of the study, the SWOT analysis method was used to identify the main weaknesses of engineering enterprises in the economic sector.

3. Results of research

E-commerce can significantly contribute to the economic security of a business through a range of strategies and innovative approaches. It allows businesses to expand their markets beyond traditional geographic limitations, thereby providing more stable and diverse sources of income. This is especially important in times of global economic uncertainty, where access to different markets can serve as a buffer against local economic fluctuations.

In addition, the use of advanced technologies within e-commerce allows businesses to effectively manage their inventory and optimize logistics, reducing costs and increasing responsiveness. Automating your ordering and delivery processes can significantly improve efficiency and reduce human errors, which in turn impacts overall business productivity and profitability. In addition, e-commerce provides the ability to collect and analyze large amounts of customer data, allowing companies to more accurately predict market trends, tailor their products and services to consumer needs, and develop effective marketing strategies. This information can be used to increase

customer loyalty, attract new customers and maintain stable sales levels.

However, the growth of digital transactions also increases the risks associated with cybersecurity. Therefore, it is important to implement advanced technologies and practices to protect data privacy, ensure secure transactions, and prevent fraud. This includes using strong encryption methods, establishing effective access control systems, and regularly updating software.

Taken together, e-commerce provides businesses with the means to expand markets, streamline internal processes, enhance customer service, and ensure a high level of data security. All of these factors contribute to creating a strong foundation for economic stability and company security in the digital age.

We will conduct a SWOT analysis of the activities of companies in the engineering sector of the economy as part of our study (Table 3).

The first result of the simulation will be the construction of a hierarchical flowchart for achieving the IM0 “Development of E-commerce in the framework of ensuring the economic security of the business” (Figure 2).

Further, it is necessary to characterize the context of modeling and fulfillment of the IM0 goal. To do this, we will form a suitable diagram in the framework of our study (Figure 3).

Based on the results of the SWOT analysis, it was found that the biggest weaknesses are the digitizing of business processes and ensuring economic security.

Table 3. The SWOT matrix of the analysis of enterprises in the engineering sector of the economy (source: developed by the author)

S	W
Productive capacity	Digital illiteracy
Unique types of services and products	The problems of using modern technologies
Innovative activity	Low level of economic security
O	T
Market expansion	Corruption
Industry 5.0	Inflation
Digitalization of society	Hacker attacks

Let us characterize each of the functional blocks of the innovation model in the framework of our study:

IM1. Reorganization of electronic commerce. Creation of a unified communication environment between all participants of the electronic market. Integration of all companies involved in the production of products and services in a certain market sector. Integration takes place on the basis of creating a single information environment for managing the production process, a system of contracts and mutual settlements within the framework of ensuring economic security. A single cyberspace of the electronic market is being formed.

IM2. Ensuring cybersecurity. Mechanisms for ensuring cybersecurity in the information space are the

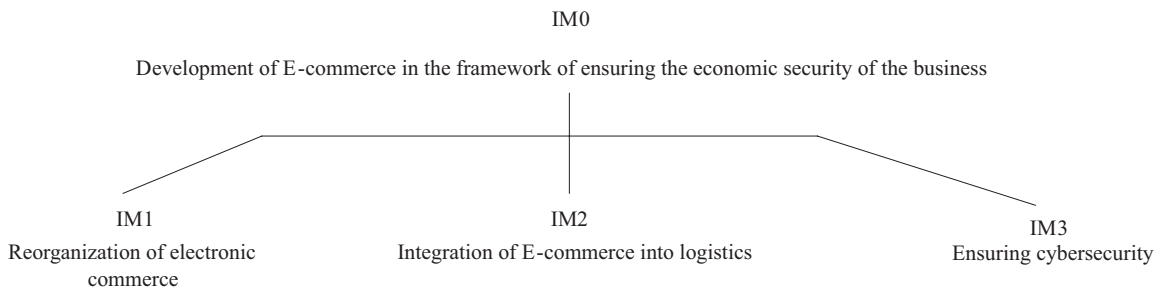


Figure 2. Hierarchical block diagram for achieving the IM0 development of E-commerce in the framework of ensuring the economic security of the business (source: developed by the author)

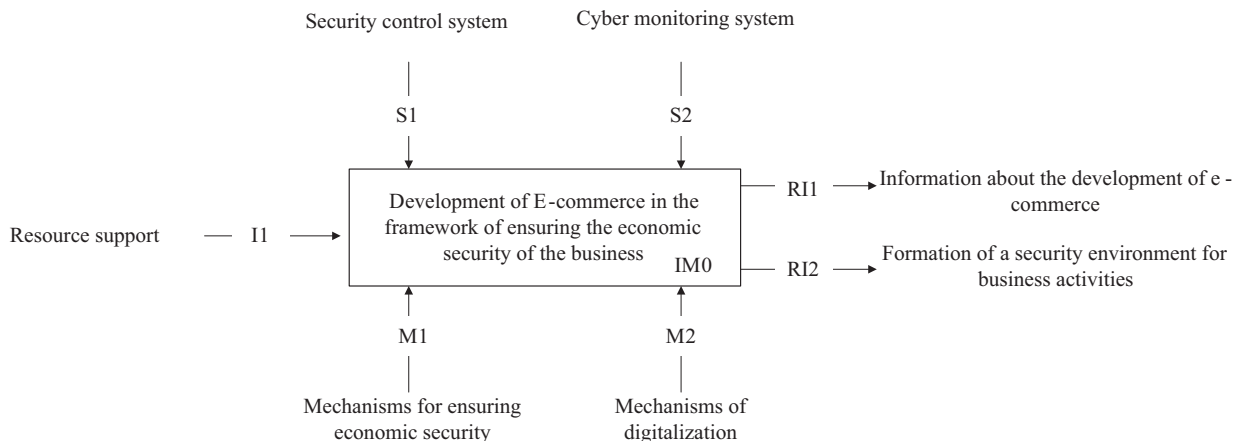


Figure 3. IM0 execution context and entity diagram (source: developed by the author)

technological basis for the application of e-governance, they are the protection of access of individuals, enterprises, institutions, and organizations to electronic services in the information space.

IM3. Integration of E-commerce into logistics. To comply with the requirements for the effectiveness of the e-commerce system of enterprises, it is objectively necessary to review the organizational structure and individual elements of managing the logistics support of the e-commerce system of enterprises. Implementation of a service approach to managing the logistics of the e-commerce system of enterprises as synergistic efforts of internal customers of the e-commerce system among themselves and uniting with external consumers of the system as part of ensuring the economic security of the business (Figure 4).

Let us characterize the blocks of sublevel decomposition of the innovation model IM1:

IM11. Improving sales within the online marketplace. Maturity of the distribution system in the online market: a study of the extent to which the distribution channel has already been used by an industrial enterprise and its competitors.

IM12. Improvement of online channels. Proximity of customers to online channels: analysis of the extent to which the target group of an industrial enterprise has sufficient proximity to distribution channels and the extent to which there is online demand.

IM13. Replacing the usual method. The replacement of the traditional way of marketing or its combination with online sales in the engineering sector provides significant advantages in additional coverage of consumers of the relevant target group and will allow adapting to competition and responding flexibly to meeting consumer needs (Figure 5).

Let us characterize the sublevel decomposition blocks of the IM2 innovation model:

IM21. The effectiveness of access control. Access control is a key mechanism for ensuring cybersecurity in the information space. Access control mechanisms can be classified by levels of implementation of security mechanisms and by stages of work and components within the framework of ensuring the economic security of a business.

IM22. The architecture of the infrastructure of electronic identification. The architecture of the e-identity infrastructure assumes the possibility of using several e-identification tools. This will facilitate the spread of services based on electronic identification.

IM23. Response to cyber incidents/cyber attacks are carried out by cyber security entities in successive stages such as preparation, detection and analysis, containment, elimination, recovery, and analysis of the effectiveness of measures to respond to cyber incidents/ cyber attacks as part of ensuring the economic security of business (Figure 6).

Let us characterize the sublevel decomposition blocks of the IM3 innovation model:

IM31. Electronic management of the supply subsystem – is aimed at improving the efficiency of work by selecting competent suppliers, optimizing the procurement process, developing a procurement management process, using standard operating procedures, researching the procurement market, developing a procurement strategy and tactics as part of ensuring the economic security of the business.

IM32. Electronic management of the warehouse subsystem – involves the improvement of warehousing

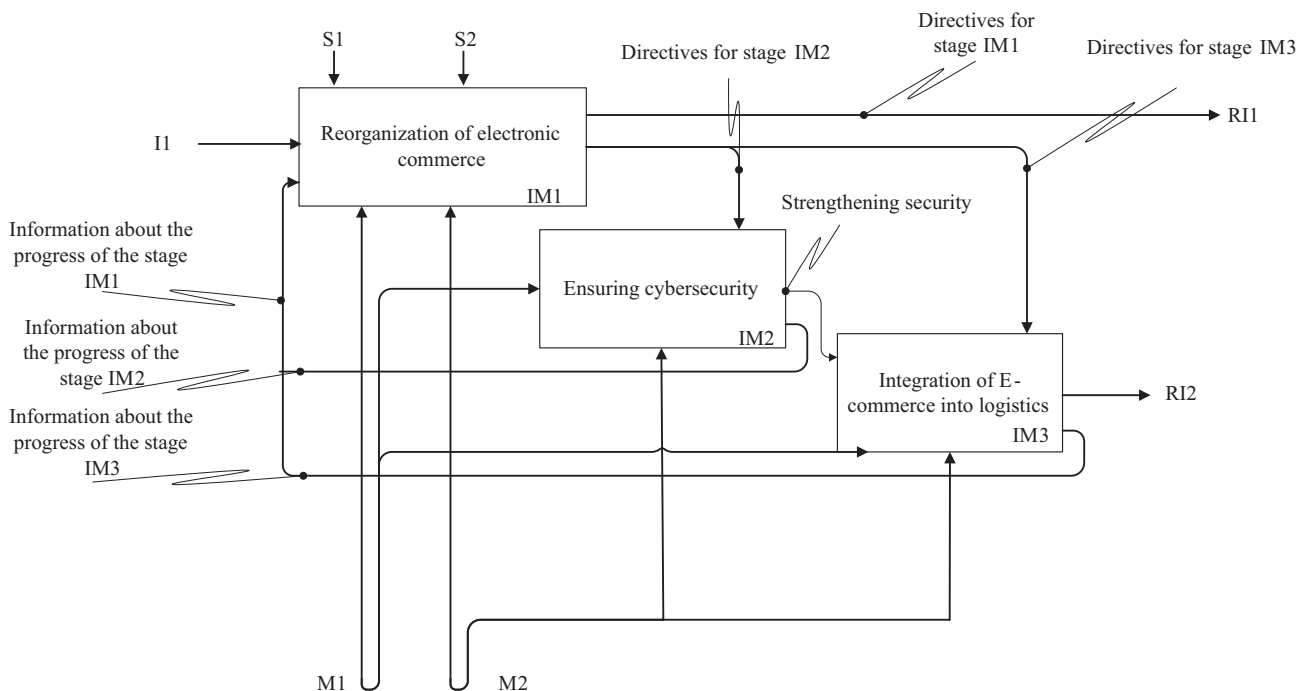


Figure 4. The main innovative model for the development of e-commerce within the economic security of business (source: developed by the author)

processes through the introduction of warehouse technologies, improving the quality of warehouse services, their standardization, and rational placement.

IM33. Electronic control of the transport subsystem. Ensures the development of rational supply chains, transportation routing, optimal transport loading;

ensuring the unity of the transportation process with the production and storage processes; and accounting security (Figure 7).

Thus, not only the main model was presented, but also its sublevels, each of which is characterized by special functional building blocks.

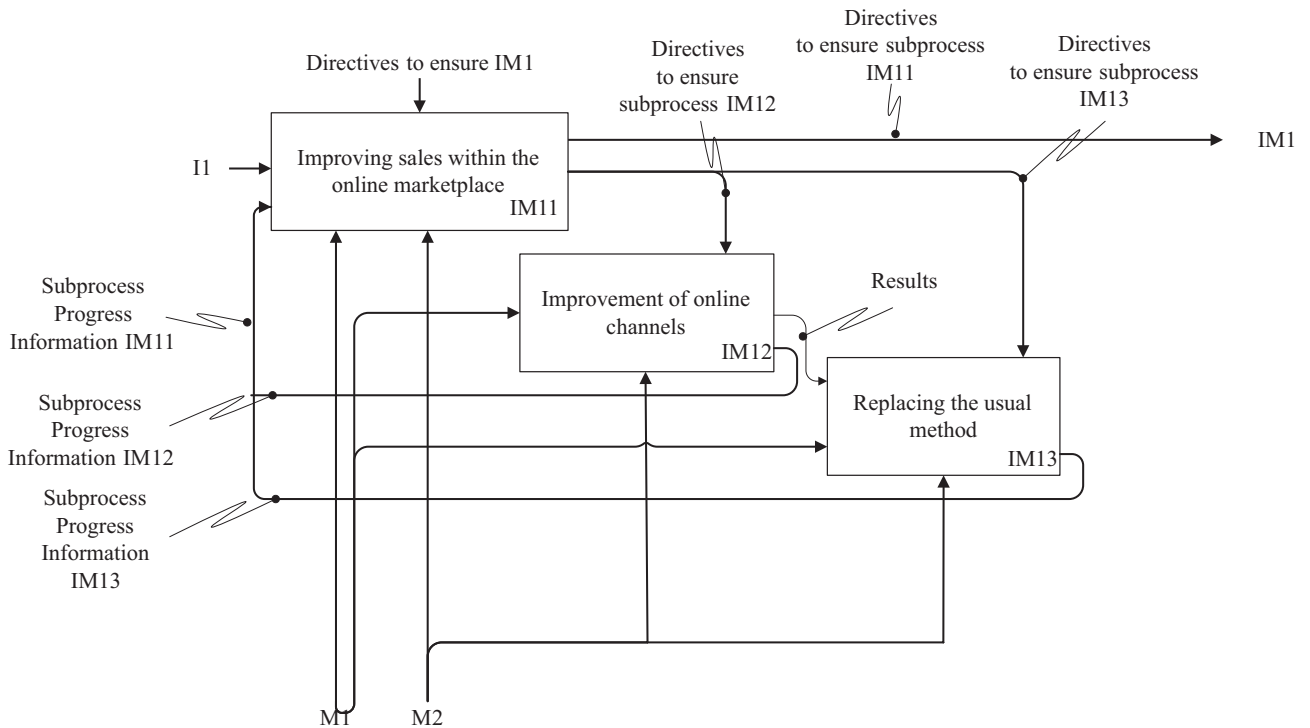


Figure 5. Decomposition according to the layered model of ensuring the execution of the functional block IM1 (source: developed by the author)

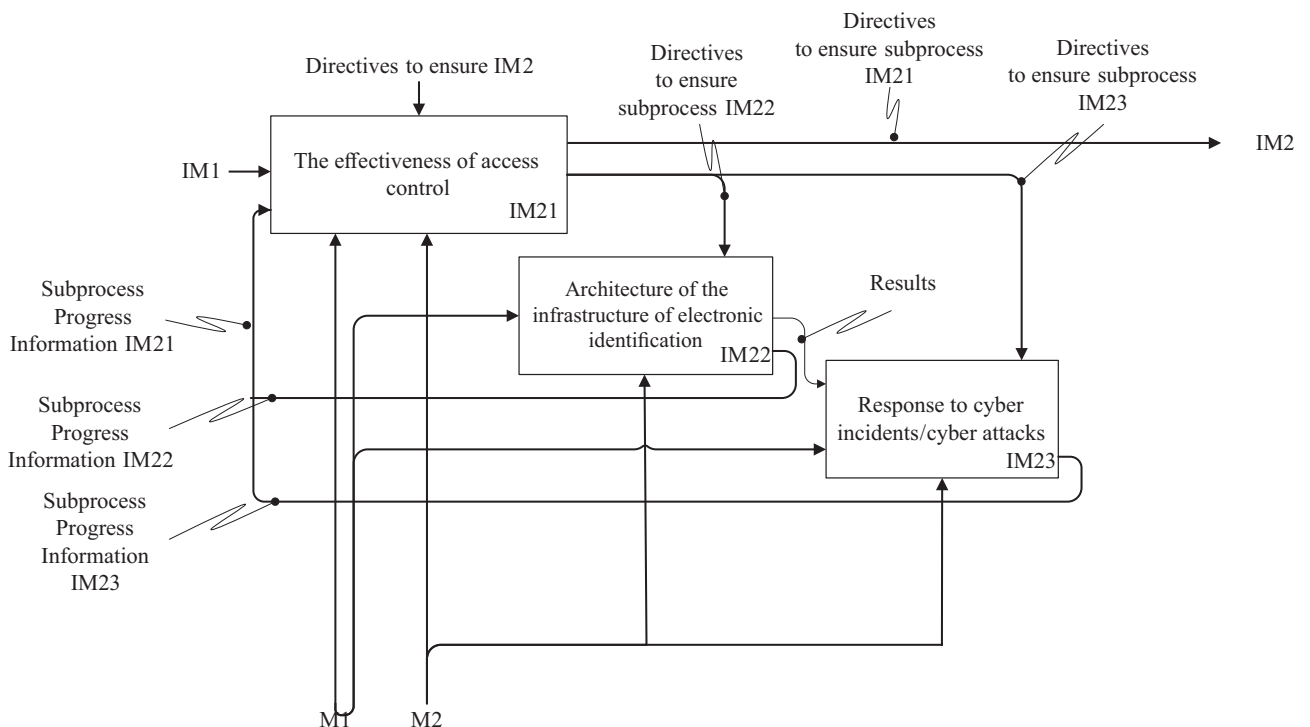


Figure 6. Decomposition according to the layered model of ensuring the execution of the functional block IM2 (source: developed by the author)

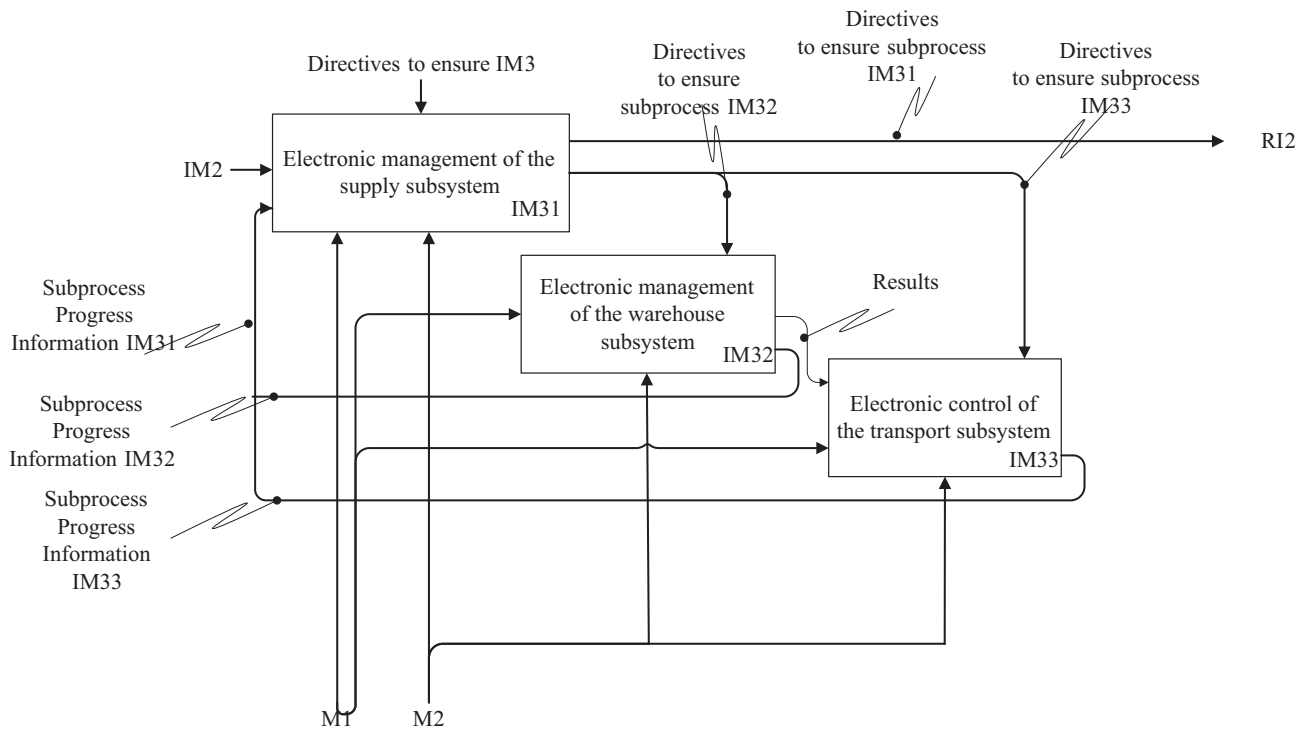


Figure 7. Decomposition according to the layered model of ensuring the execution of the functional block IM3 (source: developed by the author)

4. Discussions

When discussing the results of our study, they should be compared with similar ones in this field. For example, Li et al. (2016) and Sylkin et al. (2019b) as a result presented a conceptual model of effective management of logistics support of the e-commerce system of enterprises of the construction industry, which allows combining the influence of external factors of the informatization of the enterprise's electronic business and internal factors of the operation of the logistics system of the enterprise's e-commerce management. This made it possible to structure the elements of managing the logistics support of the e-commerce system of enterprises, which subsequently allowed them to be used in the practical activity of managing the e-commerce system of enterprises in the engineering sector of the economy.

Sylkin et al. (2018), Al-Tit et al. (2020), and Kusuma et al. (2020) as a result presented ways of reorganizing business processes in the e-commerce system of enterprises in the engineering sector, which are based on the principles of the theory of system limitations, which, unlike existing approaches, allows expanding or eliminating bottlenecks in the logistics support of the e-commerce system of enterprises.

Al-Tit (2020), Corbitt et al. (2003), and Grabner-Kraeuter (2002) as a result presented a correlation-regression analysis for each of the clusters according to the level of development of the e-commerce system of enterprises. This analysis demonstrated that for enterprises with a very low level (cluster 4) of the development of the electronic commerce system, the costs of maintaining electronic

communication networks, which are part of administrative costs, are the primary factors affecting the profitability of operating profit.

Kopytko et al. (2022), and Sylkin et al. (2019b) as a result provided recommendations for improving the security of the e-commerce system of enterprises, based on the use of the D2C sales model as a key part of the development of the e-commerce system of enterprises in the engineering sector of the economy. This made it possible to apply an approach to forecasting the effectiveness of actions aimed at the development of logistics support for electronic commerce, based on the data extrapolation method.

Our study has both similarities and differences from others. Similarities include:

1. We agree with the opinion and analysis on the importance of e-commerce for business development.
2. Similar to other studies, ours is also looking for ways to improve and increase the efficiency of e-commerce development.

As for the differences, we include the following list:

1. The methodological approach presented in the article is different from previous studies and its difference is manifested in the functionally oriented method and the graphic language of modeling business processes.
2. Measures and information filling of models. The toolkit through arrows and blocks allowed a new look at the development of e-commerce and ensuring the economic security of business.

The key problem that was raised in our study was to determine a new approach to the formation of an

e-commerce development model in the context of ensuring economic security. This is exactly what was done. The novelty of the results lies in the very approach to modeling the development of e-commerce and ensuring economic security. The resulting model will be useful to both practitioners and other scientists. At the same time, the key theoretical consequence is revealed through the described methodical approach to modeling.

The scientific innovativeness of the presented research results consists in the presented methodological approach to determining the ways for the development of e-commerce in the framework of ensuring the economic security of a business. The key difference between our research results is the proposed methodological approach, which better graphically models the blocks and processes that we seek to implement. It allows you to see existing problems and processes in a new way.

Conclusions

The emergence and rapid development of the Internet brought drastic changes to the forms of economic activity of the vast majority of enterprises. The basic concept of the Internet, which consists of fast and cheap data transfer (between two personal computers that have access to the Internet), helped business entities speed up interaction within the framework of production and sales processes. Thus, the activities of enterprises began to transform and pursue the goal of saving not only financial but also time resources. In addition, the Internet provided a wide range of opportunities for the security and development of business in various areas, namely, it allowed to develop of the sales activities of enterprises through qualitatively new product sales channels. Over the past ten years, e-commerce has undergone rapid technological development, and its arsenal of tools has been replenished with new types. One such type is voice commerce, which arose from the development of mobile telephony and the evolution of mobile handheld devices. Experts predict that the popularity of voice commerce will spread significantly due to its convenience and ease of use, as well as due to the large number of mobile users.

The obtained results of our research should be clarified. To begin with, let's establish that as a result, we got a model and its sub-level decompositions, which better allowed us to fulfill the set goal. We presented a new methodical approach for the development of e-commerce and detailed its operation. The specifics of introducing business only in the European region were taken into account.

The proposals and recommendations contained in the dissertation are aimed at increasing the efficiency of economic security management within the e-commerce system of enterprises. Developed and proposed for implementation, innovative models of the functioning of the e-commerce system of enterprises provide an opportunity to improve process management and combine the advantages of e-commerce for business.

The study has a limitation by taking into account the specifics of the business and the economic security system of only enterprises in the engineering sector of the economy. This kind of limitation can affect the result of the research in that the approach cannot have practical application for other types of business and security, except for the engineering sector of the economy.

Further research should be devoted to expanding and building countermeasures against threats within the economic security and business environment. In our opinion, the threats represent a significant problem in the framework of ensuring business security and should be explored in more detail in further works and articles. Prospects could include analyzing the impact of artificial intelligence and machine learning on automating and personalizing customer experiences, developing blockchain technologies to ensure transparency and security of transactions, and exploring new cybersecurity methods to protect user data and business systems. An important direction could be to analyze the integration of e-commerce with other digital platforms and services, such as social networks, mobile applications, and the Internet of Things.

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