







## The Influence of Digitalization on the Innovative Strategy of the Industrial Enterprises Development in the Context of Ensuring Economic Security



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### ABSTRACT

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*digitalization, digital economy, digital transformations, strategy of innovative development, innovative provision, innovative activity, industrial enterprises, economic security*

The purpose of the article is to study the impact of digitalization on the innovative strategy of the enterprise development in the context of ensuring economic security. Within the article, peculiarities of the digitalization development in Ukraine are examined. The main obstacles that hold back the development of innovative technologies and digital platforms in Ukraine are identified. The problems of the country's industrial development and the difficulties of implementing the principles of the digital economy in the existing conditions are substantiated. It was determined that industrial development of the country is decreasing, which leads to a low level of digitalization and innovative development of industrial productions and reduces their level of economic security and competitiveness. The impact of digitization on the innovative development of industrial enterprises was considered based on the calculation of efficiency indicators of the innovative activity for selected systems of the production process. Based on the calculations made using the correlation-regression analysis, the influence of the selected factors on the resulting indicator was determined. The areas that influence slowing down of the digital development process of industrial enterprises are singled out.

## 1. INTRODUCTION

It should be noted that digitalization concepts in the economy of Ukraine and digitalization on the global scale are fundamentally different from the point of view of the implementation. In Ukraine, digitalization is focused on the creation of appropriate services that are based on the collection and processing of information about the state and development of physical objects and do not include the issue of changing the situation in the production system, approaches to production, design, operation and sale of these objects, which are foreseen in the Industry 4.0 concept. It should be noted that the majority of specialists in the industry of Ukraine under Industry 4.0. concept provide for the purchase of imported equipment and components. If considered on the global scale, the leading enterprises are already implementing the achievements of the sixth technological order using bioengineering, nanomaterials, nanotechnologies, then Ukraine is still on the third technological order, in which more than 50% of manufactured goods and services are located, despite the high intellectual potential in the state. If we compare the exports of Poland and Ukraine, then Poland is ahead of Ukraine in the industries in which it was a leader, namely mechanical engineering and aircraft construction. Today, Poland mostly exports goods with a high added value, while Ukraine exports raw materials. Thus, according to UNIAN, the decline of industrial production in Ukraine accelerated to 7.5%. This is connected both with the global

pandemic, which affected all spheres of the economic activity of countries, not bypassing the activity of industrial enterprises of Ukraine. Digitalization of the Ukrainian industry has a multifaceted effect, from the introduction into technological processes, methods of production organization to the digitalization of production means, which have better quality characteristics. Today, digital technologies of industrial enterprises mostly cover only large enterprises that have a powerful production base and a high level of competitiveness. For Ukraine, the main problem is technological backwardness of industry in comparison with other countries of the world [1].

The introduction of innovations in industry today is more characterized by importing equipment, components, and software. The share of industrial enterprises cooperating with scientific institutions and laboratories is 8.4%, which indicates the insufficient level of scientificity and innovativeness of production [2].

Therefore, today digitalization, which has gained momentum in recent years, requires from the management of modern enterprises new, more flexible approaches to the management policy implementation in the field of the innovative development of enterprises and ensuring their economic security. The implementation of modern digital, communication and information technologies in all areas of the production process is not possible without understanding the essence and mechanism of the digital economy at the enterprise level, since it is the subject of a more global system of interconnection (state, region, other economic entities),

thereby creating its own business environment. Digitalization leads to a more open and accessible system of information and analytical support for the activities of enterprises, requiring new mechanisms for ensuring economic security due to the increased risks of fraudulent use of available information. In recent years, in a global context, the community's attention has been focused on the effective use of modern digital technologies that allow the access to global databases and global logistics flows. Every year, global research organizations conduct thorough research on the issues of innovative development and implementation of digitalization in all spheres of production in an international aspect to use the experience of advanced countries.

In the further presentation of the article, industrial enterprises of Ukraine were taken for approval. However, military operations are taking place on the territory of Ukraine, and the situation regarding the activities of industrial enterprises can change at any time, and most often in the direction of worsening conditions for their activities. Here are some statistical data on the destruction of industry in Ukraine during the war.

Thus, according to the European Bank for Reconstruction and Development and the International Monetary Fund, the industrial sector is significantly shrinking in Ukraine as a result of its complete destruction or partial destruction. About 60% of the Gross Domestic Product of Ukraine is accounted for by the nine regions on the territory of which hostilities are taking place / took place, while in relation to the industrial sphere, the share is 44.5% of the share of GDP, and the fall of industrial production in 2022 is predicted by experts to levels of 25-35% in relation to the previous year 2021.

Such statistical data, which were made public with the support and activities of international experts, further intensify the study of the problems of ensuring the economic security of enterprises under the conditions of digitalization and innovative direction of the enterprises' development.

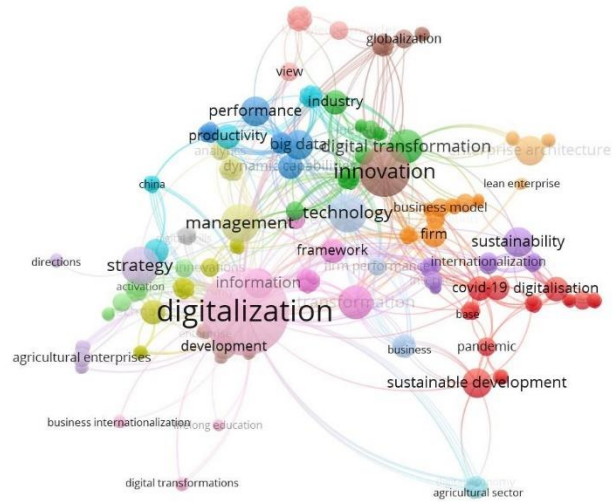
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## 2. LITERATURE REVIEW

Scientific studies of domestic and foreign scientists from all over the world are devoted to the issue of digitization and innovative development of enterprises, as well as their role in ensuring economic security (Figure 1). Thus, when researching the mentioned topic, it should be noted that the first article was published in 2006. Further, the dynamics of the appearance of articles in the international scientific metric database Scopus was as follows: 2006 – 1 article, 2014 – 1 article, 2016 – 2 articles, 2017 – 2 articles, 2018 – 9 articles, 2019 – 29 articles, 2020 – 35 articles, 2021 - 52 articles, 2022 - 44 articles. The increase in the number of publications every year confirms the relevance and timeliness of research. Analyzing the activities of scientists, according to the results of the analysis of the publications of the Scopus database, the world centers of scientific research in the field of innovative development of enterprises, taking into account the processes of digitalization: Ukraine, Italy, Poland, South Africa, Spain, England, Germany, Greece, etc. (Figure 1).

The basis of the scientists' research Mironova [3] is the theory of fuzzy sets and the matrix approach used in modeling the choice of strategies for stimulating the innovative

development of industrial enterprises. The authors build the matrix of strategies, which is based on the diagnosis of the aggregate potential of industrial enterprises and the level of its implementation in the innovation sphere. On the basis of the proposed methodical approach, the scientists substantiated strategic directions of the innovative development of three industrial enterprises in Poland.



**Figure 1.** Graphic map of keywords in publications, in which titles the word “digitalization”, “management”, “enterprises”, “strategy”, “development” is met

Source: compiled by the author based on the analysis of the Scopus database and using the tools of the VOSviewer program

In the article of Doroshkevych et al. [4], methods and models of choosing tactical approaches to the strategy implementation to increase the efficiency level of strategic management of the enterprise when implementing the strategy using various tactical approaches are examined. According to the results of the analysis of the methods, the authors prove the need to combine them in order to increase the efficiency of the mathematical apparatus, which is designed to reduce the subjectivity inherent in heuristic methods.

The purpose of the research by Korytko et al. [5] is to improve the strategy of the innovative development of industrial enterprises based on the assessment of the enterprise's intellectual capital, which will allow analyzing quantitative indicators of the structural elements of intellectual capital and determining the state and level of the development of each element. The implementation model of the innovative strategy for the development of an industrial enterprise proposed by scientists provides for the selection of the innovative strategy for the development of an industrial enterprise.

The authors of the article Borowski [6] are convinced that reducing the negative impact on the environment and society while maintaining sustainable development affects the formation of innovative development strategies and the impetus for the introduction of the most modern innovative technologies. The researchers found that energy companies use passive adaptation strategies, but as they strengthen their positions in the market, they begin to implement the innovative strategy of active adaptation.

Within the framework of the study Turginbayeva et al. [7], the author investigates the issue of increasing the innovative

potential of the state policy in the context of the entrepreneurship development. Financial aspects of the innovative strategy are analyzed. The article proves that the innovation policy becomes important in the conditions of increasing the innovative activity of commercial and state enterprises and structural restructuring of the country as a whole.

Researchers Srivastava and Agrawal [8] have found that in India, rural, cottage and agribusiness enterprises form a prominent part of the economy, but still lag behind in adopting innovative business strategies. The government focuses more on promoting large industries, supporting and introducing innovative ideas in the form of innovative products, structures, processes and marketing activities.

Practical significance of the study by Yermak and Bugaenko [9] lies in the analysis of the key trends of the dairy market and the study of the main trends of technological innovations in the Ukrainian dairy industry. The authors proposed the approximate mechanism for the implementation of innovative strategies of enterprises, taking into account the "smart farm concept".

According to the results of the research by Novykova et al. [10], it is proven that in today's complex conditions, the assessment of the external environment impact is becoming more and more important, since its state and direction of the development to a certain extent determine innovative capabilities of the enterprise. It has been investigated that based on the results of the evaluation of the innovative activity management, as well as the distribution of responsibility and authority by management functions in the process of practical implementation of the mechanism of managing innovative activity, planning of target resource and performance indicators is carried out, the achievement of which is possible thanks to proper motivation. The authors are convinced that the formation of effective management of the innovative activity of construction enterprises, its strengthening and deployment must begin with an assessment of the influence of external environmental factors on the effectiveness of management activities regarding the formation and use of the innovative potential of a construction enterprise.

The basis of the research by Zalutka et al. [11] is the provision of methodological and practical recommendations for the development and implementation of the strategic management system of innovative activities of the enterprise. The authors determined that the effective innovative activity of enterprises with dynamic economic development is possible under the condition of timely implementation of innovative projects that satisfy and meet the requirements of the external and internal environment and contribute to the growth of one's own potential with the orientation of the enterprise's activity on a long-term perspective of development. According to scientists, this contributes to increasing the importance and role of strategic management of innovative activities of domestic enterprises.

The research of the authors Kopytko et al. [12] on the essence and main characteristics of innovative enterprises in the context of research on the security aspect deserves attention. Scientists have identified fundamental problems of the innovative activity as a factor in strengthening economic security of the enterprise in the conditions of globalization and integration of the world economic space. The authors proposed to evaluate the economic security level of the enterprise according to the indicators of its innovative development.

The authors of the article Huseynov and Huseynov [13]

evaluate the structure of costs for innovative technologies, the state of operation of oil and gas wells, the implementation of geological and technological works, methods of development, as well as methods of yielding influence and influence on the excess oil production. The authors researched the reserves and ways of their rational use.

The researches Domljan and Domljan [14] emphasize that in order to support its companies to become more efficient, innovative and competitive, Bosnia and Herzegovina need appropriate government policies. Scientists prove that turning innovative ideas into products and services that drive growth and create jobs is a very difficult task.

The researchers Tulchynska et al. [15] proposed the applied aspects of the resource provision of innovation and investment strategies for the modernization of microeconomic systems in the conditions of digitalization. The authors proposed a methodical toolkit to optimize the resource provision for the design of modernization of microeconomic systems in the conditions of digitalization using the competitive selection model of modernization projects for the implementation of the selected resource provision strategy. Also, we consider the methodological approach proposed in the article of Viknianska et al. [16] to the economic analysis and management of enterprises in the conditions of transformation of economic systems to be useful in practice, as well as the algorithm for assessing spatial problems of the economic security system of industrial enterprises proposed in the article of Zybareva et al. [17].

The paper of Bielińska-Dusza and Hamerska [18] focuses on the fact that strategic innovativeness, which is a long-term process that takes into account the interpenetration of different types of innovation along with strategic thinking, can be an effective tool for achieving high operational efficiency and maintaining competitive advantages in the market. The authors are convinced that the innovativeness of enterprises depends on many variables, including innovation decisions, available resources and competencies, as well as the sector of their activity. Therefore, according to scientists, it should be considered in a strategic dimension, both at the level of strategic innovativeness of the enterprise and at the level of the general strategy.

The research Alpysbayev et al. [19] is focused on the identification of destabilizing factors of the economic security and the development of recommendations aimed at increasing the development efficiency of Kazakh enterprises. Among the destabilizing factors restraining the work of industrial enterprises, the authors identified insufficient demand for manufactured products, shortage of own financial resources, intensifying market competition and macroeconomic uncertainty.

The authors of the article by Zlotenko et al. [20] determined the optimal structure of financing investment activities of industrial enterprises in the context of ensuring the economic security of such activities. Scientists have proposed a model for optimizing economic security based on minimizing losses in the sources formation of financing investment activities, which allows the company's management to make balanced strategic decisions and provides sufficient justification for the measures in the economic security sphere.

Despite a significant number of publications on the mentioned topic, the issue of the digitalization impact on the innovative strategy of the development of industrial enterprises in the context of ensuring economic security requires further research and analysis.

In order to achieve the set goal and eliminate the existing gaps in the scientific works of the authors conducting research in this issue, the authors solved the following tasks:

- the relevance and timeliness of the research is proven, taking into account modern publications in the study of the impact of digitalization on the innovative strategy of enterprise development in the context of ensuring economic security;
- the use of correlation-regression analysis is substantiated, which makes it possible, unlike other methods, not only to calculate the factors of influence on the profit of enterprises of innovative costs for digitalization in the sphere of supply, production, transportation, sales and warehousing, but also to determine the level of influence of each of the isolated factors on the gross profit of the enterprise;
- testing was carried out and a methodical approach was proposed in relation to the enterprises of Ukraine;
- proposed directions for leveling existing obstacles that slow down digitalization processes at industrial enterprises of Ukraine.

### 3. METHODOLOGY

The implementation of digital technologies is carried out through the human factor in the innovative and intellectual provision of the enterprise's activities. The development of the enterprise contributes to ensuring its economic security, therefore, introduction of innovations and digital technologies contribute to the development of these processes. The use of digital platforms for business development facilitates the coordination of participants' actions in business processes, promotes the formation of the trust level between them, allows sellers and buyers of goods or services to find each other, facilitates the exchange of research and development in various fields. When using digital platforms, the level of the intermediary services use between sellers and buyers decreases, which affects the pricing policy of enterprises. The use of digital platforms expands the horizons of the cooperation between enterprises (for example, Uber, Airbnb, Booking, Amazon, Alibaba and many others). Such businesses should be considered part of the digital economy, as they are owners of digital platforms, not producers of goods and services. These companies are an example of innovative digital technologies that have spread and created corresponding business models. The advantages of the innovative strategy of introducing digitalization are the individuality of the demand satisfaction and closer contact with the buyer, in matters of the pricing policy, and can serve as a source of additional profit. Digitization helps reduce the level of transaction costs due to the use of blockchain technologies, while forming a new production potential based on the formation of a new segment of services and improving business culture. With the digitalization development, the issue of ensuring commercial secrecy and economic security of enterprises becomes acute, as information about consumers and producers becomes more open and accessible [21].

In this case, enterprises and owners of digital platforms face the task of creating such platforms that would be able to ensure the confidentiality and preservation of data of all participants in the business process. If we consider the digitalization impact on the innovative development of enterprises, it is advisable to single out such production components as: the use of digital technologies by business, digital skills of personnel, and a comprehensive indicator of the effectiveness of the

innovation system. At the enterprise level, these indicators can be used to determine the effectiveness of digitalization and its impact on the development of the enterprise and economic security. Based on the application of the expert assessments method, the data on the activities of enterprises and economic-mathematical methods, it is possible to determine the impact level of each of the specified factors on the gross profit of the enterprise.

Indicators are determined based on the multivariate correlation-regression analysis between gross profit and innovativeness of production, supply, transportation, sales and storage systems. The multiple regression equation will look like this:

$$y = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + \dots + a_nx_n, \quad (1)$$

where,  $X_1, X_2, X_3 \dots X_n$  – these are the factors that affect the resulting indicator; in our case, the resulting indicator is the company's profit, and the factors influencing it are the company's innovation costs for digitization in the sphere of supply, production, transportation, sales and warehousing.

$a_1, a_2, a_3 \dots a_n$  - regression coefficients, which characterize the degree of the factors influence on the performance indicator.

Thus, the authors suggest using a linear regression function in correlation-regression analysis. The use of this method makes it possible to estimate the impact of each indicator (see formulas 2-6) on the resulting characteristic, which in our case is the gross profit of the enterprise, using regression coefficients.

To calculate the overall effectiveness of innovative development based on the business processes digitalization, it is advisable to single out five components, which will be used to evaluate the innovative development of the enterprise.

It is proposed to single out the production systems, into which innovative developments based on digitization have been introduced, namely the supply system, the production system, the transportation system, the sales and warehousing system. That is, the entire cycle from the production to delivery to consumers should be concentrated at the enterprise.

As already noted, when justifying formula (1), the factors affecting the company's profit were chosen as the innovative costs of the company for digitalization in the sphere of supply, production, transportation, sales and warehousing. These costs were chosen as a result of a study of innovative costs of enterprises taking into account the use of digital technologies. For the correlation-regression analysis, not the innovation costs themselves in a certain field of activity of the manufacturing enterprise, but efficiency coefficients (see formulas 2-6) were used, which allows to carry out a correlation-regression analysis using a linear function (see formula 1).

The efficiency coefficient of the innovative supply system is calculated according to the formula:

$$C_{ci} = \frac{P_g}{\sum I_{cs}} \quad (2)$$

where,  $P_g$  – gross profit of the enterprise

$I_{cs}$  – the amount of innovation costs of the supply sector.

Efficiency coefficient of the innovative production system:

$$C_{ip} = \frac{P_g}{\sum I_{icp}} \quad (3)$$

where,  $P_g$  – gross profit of the enterprise

$I_{icp}$  – the amount of innovation costs of the production sphere.

Efficiency coefficient of the innovative transportation system:

$$C_{in} = \frac{P_g}{\sum I_{ct}} \quad (4)$$

where,  $P_g$  – gross profit of the enterprise

$I_{ct}$  – the amount of innovative costs of the transportation sector.

Efficiency coefficient of the innovative sales system:

$$C_{ss} = \frac{P_g}{\sum I_{ss}} \quad (5)$$

where,  $P_g$  – gross profit of the enterprise

$I_{ss}$  – the amount of innovation costs of the sales sphere.

The efficiency coefficient of the innovative storage system:

$$C_{sts} = \frac{P_g}{\sum I_{sts}} \quad (6)$$

where,  $P_g$  – gross profit of the enterprise

$I_{sts}$  - the amount of innovation costs of the warehousing sector.

A comprehensive indicator of the efficiency of the innovative production system taking into account digitalization:

$$F_{in} = \sqrt[5]{C_{cs} \cdot C_{ip} \cdot C_{in} \cdot C_{ss} \cdot C_{sts}} \quad (7)$$

where,  $C_{cs}$  - efficiency coefficient of the innovative supply system

$C_{ip}$  - efficiency coefficient of the innovative production system

$C_{in}$  - efficiency coefficient of the innovative transportation system

$C_{ss}$  - efficiency coefficient of the innovative sales system

$C_{sts}$  - efficiency coefficient of the innovative storage system.

Calculation of the effectiveness of the innovative development of the production process components, taking into account digitalization, allows us to analyze the extent to which enterprises effectively implement developments. According to the authors, the innovative activity of enterprises contributes to their development, thereby increasing their economic security level.

It should also be noted that: firstly, the use of correlation-regression analysis with a linear regression function for each enterprise makes it possible to single out the specific innovation costs that are most influential on the resulting indicator, which in our case is the gross profit of the enterprise; secondly, the use of correlation-regression analysis, for example, in contrast to integral assessment methods, greatly reduces the calculation error, which increases the objectivity of the results obtained.

#### 4. RESULTS AND DISCUSSIONS

In new conditions of the innovative development of the

economy and digitization of social life, enterprises receive appropriate advantages, improve due to the implementation of these gains in their activities. The innovative development of industrial enterprises today is closely related to the search and implementation of digital technologies in their production and economic activities from the production and management spheres. To increase the competitiveness level and ensure economic security, enterprises need to use intellectual and creative abilities of employees in all areas of the production process - technological, personnel, financial and economic, innovative, communication. The dynamics of the main indicators characterizing the innovative activity of industrial enterprises for the period 2000-2020 is presented in Figures 2-4.

At the formation stage of a modern market economy, it is important to assess the digitalization and innovative development of the enterprise, its competitiveness and economic security. The extent to which domestic enterprises are in the global environment and are able to compete in it depends on the level of their innovative development. Today, large enterprises are trying to completely close the entire cycle of production and delivery of their products to consumers independently, as this allows for a more flexible pricing policy. Digital transformation in industry can be considered as directions of the accelerated development of economic systems, which are built on the effective information connections, optimization of information flows, which are necessary for solving strategic tasks of business development. The applied task of digitalization of the innovative development of enterprises is to reduce the use of labor resources, increase labor productivity, apply optimal schemes of business processes, model various business processes and chains between various enterprises on digital platforms. However, today most enterprises have an underdeveloped digital infrastructure. Therefore, the analysis of digitalization and innovative development in business processes is a strategic direction of the enterprise development.

Approbation of the proposed measures was carried out on the example of industrial enterprises of Ukraine, namely Interpipe Ukraine Limited Liability Company (LLC "Interpipe Ukraine"), ArcelorMittal Kryvyi Rih Public Joint Stock Company (PJSC "ArcelorMittal Kryvyi Rih"), Southern Mining and Processing Plant Joint Stock Company " (JSC "Southern Mining and Processing Plant"). The choice of these enterprises for further calculations is due to the fact that these enterprises are typical representatives of the industrial sphere, while they actively introduce innovative developments and areas of digitalization of business in their activities, and are also profitable. Also, the choice of outlined enterprises is connected with the fact that the results of their activities are made public in public access. To date, in connection with military actions on the territory of Ukraine, the majority of industrial enterprises have closed access to financial reporting in order to increase their own information security. Thus, according to the initial data, the enterprises JSC "Southern Mining and Processing Plant" and LLC "Interpipe Ukraine" receive a larger profit. The initial data for the calculation are given in Table 1.

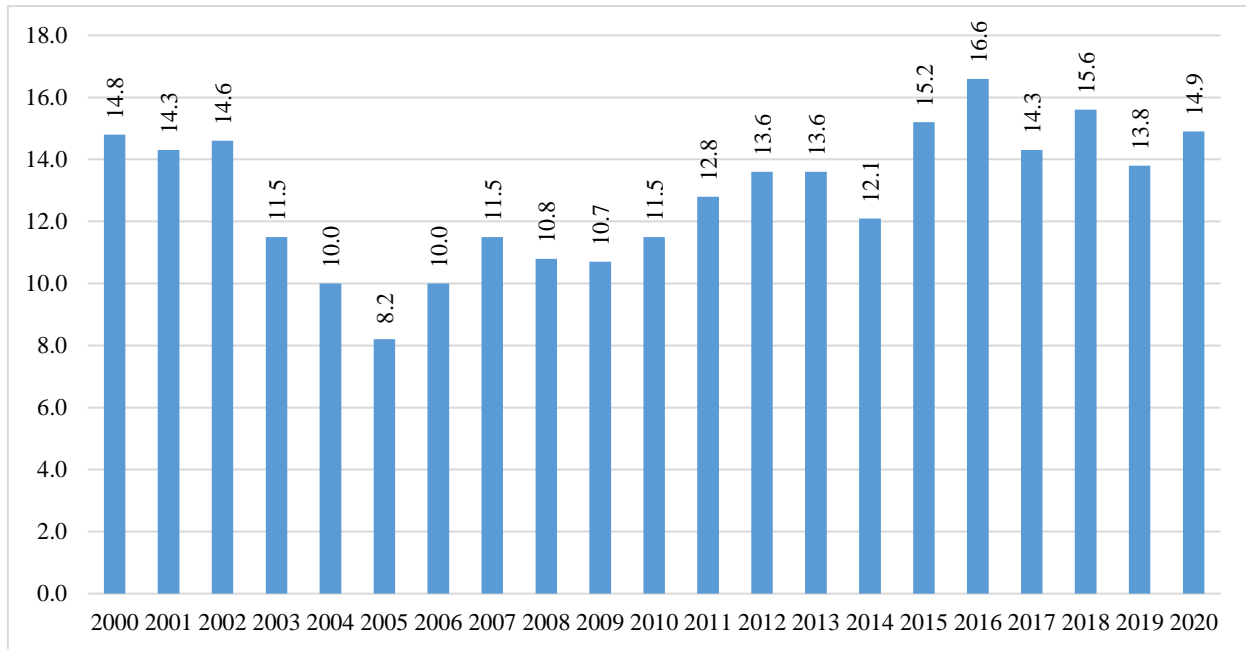
From those listed in the Table 1 of the data, we can note that there were significant changes in indicators at enterprises. First of all, this is due to the influence of both internal and external factors. The COVID-19 pandemic has led to a decrease in the supply and activity of industrial enterprises in Ukraine. However, JSC "Southern Mining and Processing Plant",

regardless of such negative global trends, sold its products to the maximum possible extent, taking into account the restrictions. This also had an impact on the increase in the costs of all the investigated enterprises regarding the introduction of innovations in the transportation and distribution system. Expenditures on the storage system, with the exception of LLC “Interpipe Ukraine”, were also increased.

In 2021, LLC “Interpipe Ukraine” and PJSC “ArcelorMittal Kryvyi Rih” had a significant decrease in gross profit compared to the previous year, which is explained by their greater dependence on such a resource as gas, the price of which increased significantly in 2021. The decrease in profit was reflected in the decrease in the costs of enterprises for innovation. Thus, in 2021, LLC “Interpipe Ukraine” reduced

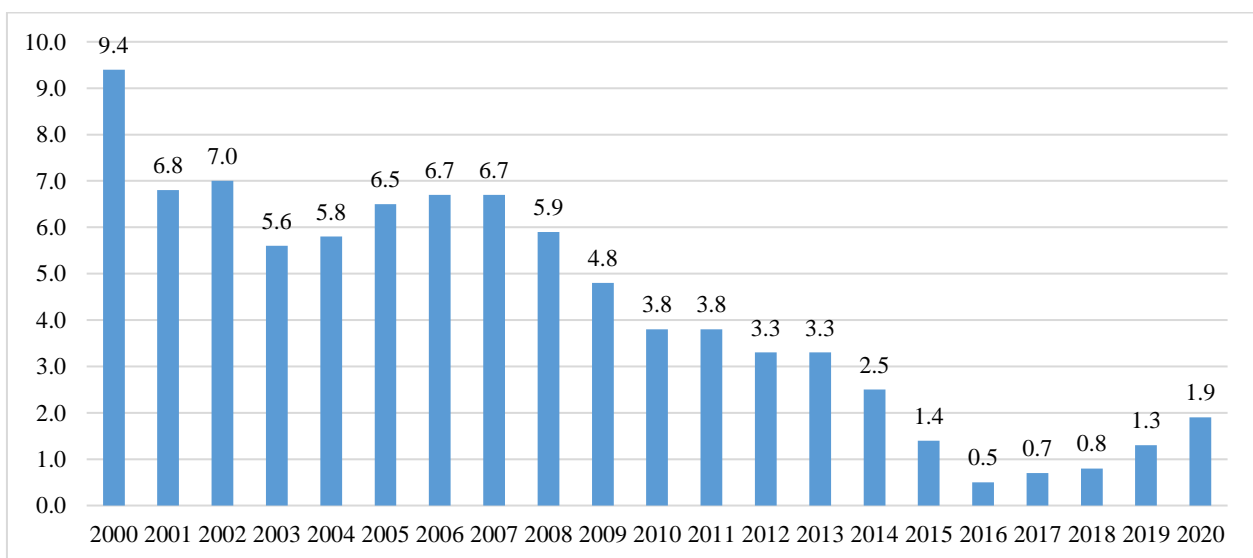
innovation costs for production, sales and storage compared to the previous year. PJSC “ArcelorMittal Kryvyi Rih” reduced innovation costs in the last studied period for the system of supply, production and sales.

Of course, it is difficult to cover the entire cycle of business processes due to the large amount of information and its unavailability, however, highlighting the main stages allows you to determine the effectiveness of measures implemented at enterprises. The calculation of the isolated coefficients allows us to conclude that the studied enterprises implement the principles of digitization and innovative activity in their activities, which allows them to ensure the appropriate level of their economic security and the level of competitiveness on foreign and domestic markets.



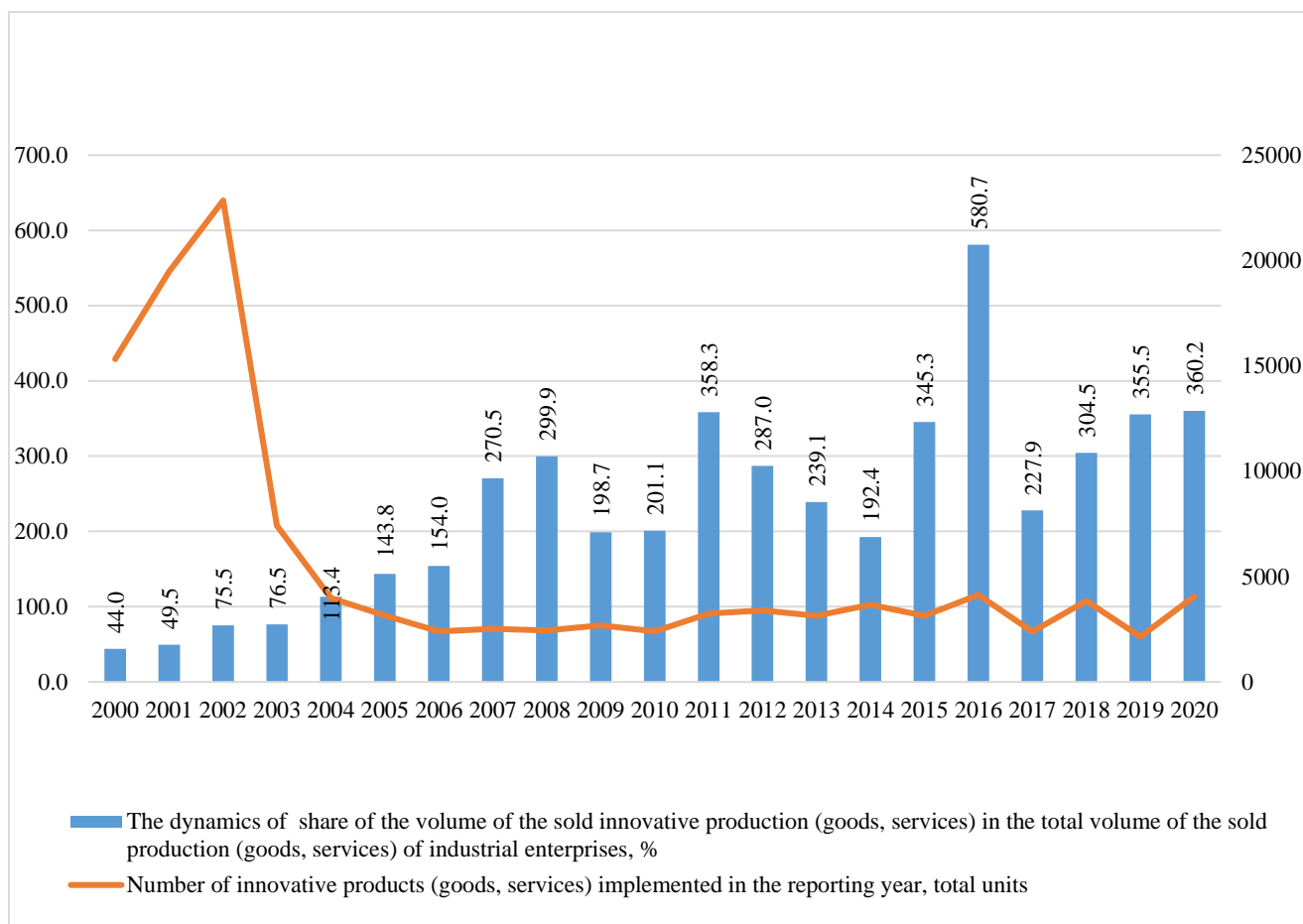
**Figure 2.** The dynamics of the share number of industrial enterprises implementing innovations (products and / or technological processes) in the total number of industrial enterprises, %

Source: Systematized by the authors based on the data from the State Statistics Service of Ukraine [22]



**Figure 3.** The dynamics of the volume share of the sold innovative production (goods, services) in the total volume of the sold production (goods, services) of industrial enterprises, %

Source: Systematized by the authors based on the State Statistics Service of Ukraine [22]



**Figure 4.** The dynamics of innovation expenditure, million USD

Source: systematized by the authors based on the data from the State Statistics Service of Ukraine [22]

**Table 1.** Initial data characterizing innovative activity and digitalization processes of industrial enterprises

Indicator	Year	LLC "Interpipe Ukraine"	PJSC "ArcelorMittal Kryvyi Rih"	JSC "Southern Mining and Processing Plant"
Gross profit, gross income, USD	2020	693450	252325	385150
	2021	525650	116300	633950
Supply system innovation costs, USD	2020	3075	1275	10000
	2021	5775	1075	8000
Innovative costs of the production system, USD	2020	16025	3400	8000
	2021	13025	2225	15000
Innovative costs of the transportation system, USD	2020	1250	1500	3000
	2021	2000	3250	4000
Innovative costs of the sales system, USD	2020	800	2250	2000
	2021	550	1900	2250
Innovative costs of the storage system, USD	2020	775	1125	3000
	2021	500	1550	7500

Source: created by the authors based on enterprise reporting [23-25]

**Table 2.** Initial data characterizing the innovative activity and digitalization processes of industrial enterprises

Industrial enterprise	Year	Efficiency coefficient of the innovative supply system	Efficiency coefficient of the innovative production system	Efficiency coefficient of the innovative transportation system	Efficiency coefficient of the innovative sales system	Efficiency coefficient of the innovative storage system
LLC "Interpipe Ukraine"	2020	84,05	43,27	51,37	86,68	89,48
	2021	60,94	40,36	52,57	95,57	105,13
PJSC "ArcelorMittal Kryvyi" Rih	2020	42,05	25,23	63,08	100,93	69,61
	2021	150,07	108,19	202,27	290,76	177,56
JSC "Southern Mining and Processing Plant"	2020	38,52	33,49	110,04	140,05	128,38
	2021	49,72	33,37	97,53	97,53	84,53

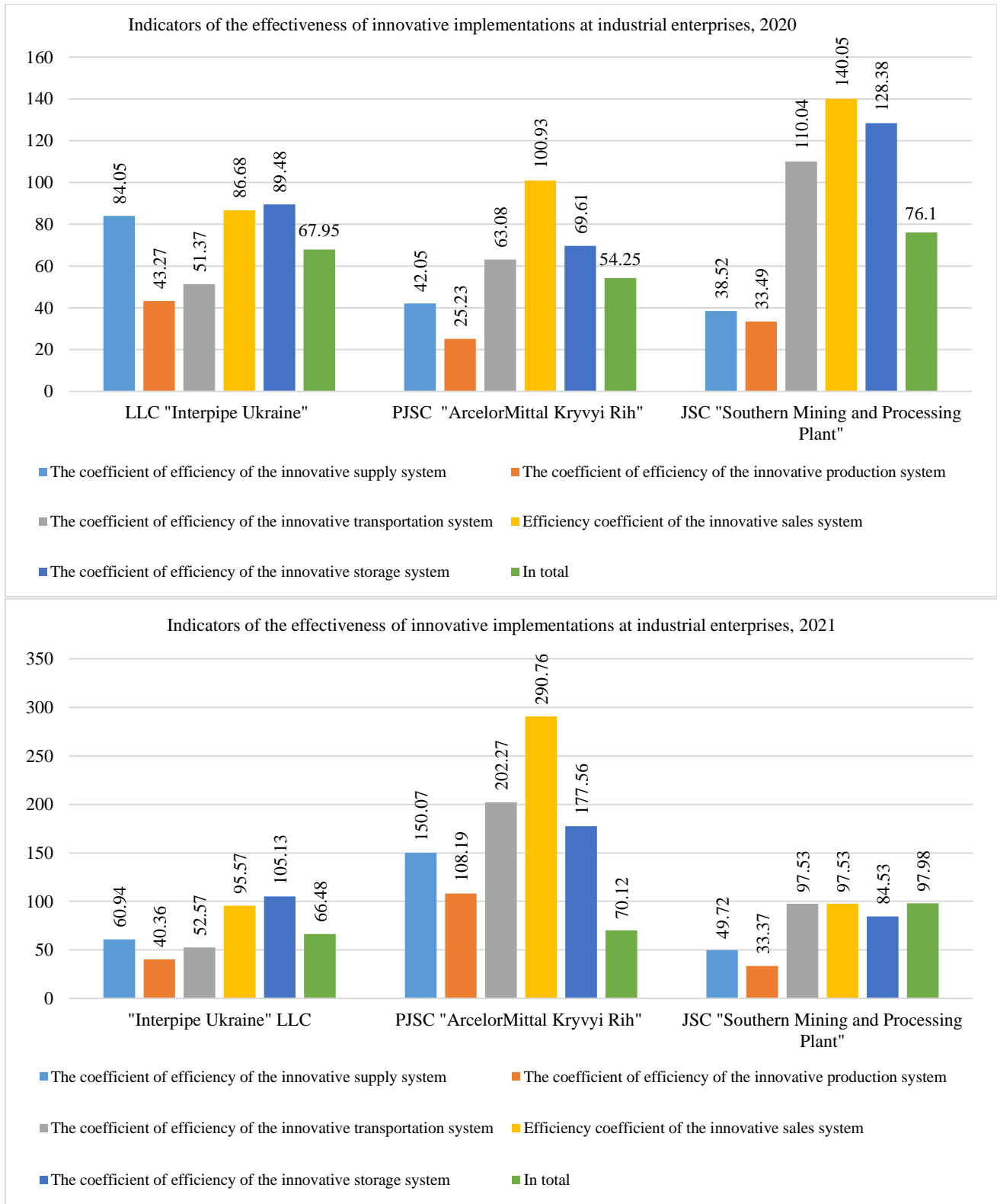
Source: created by the authors based on the enterprise reporting [23-25]

The application of the multi-factorial correlation-regression analysis in comparison with statistical correlation makes it possible to determine the influence level of each of the specified factors on the results of the enterprises' activities (gross profit). The multiple regression equation for JSC "Southern Mining and Processing Plant" will look like this:

$$y=25358+0,0458 \cdot 1+0,7953 \cdot 2+0,0903 \cdot 3+0,7217 \cdot 4 \quad (8)$$

By analogy, calculations are made for all enterprises. Based on the calculations, it was established that the influence of the specified factors on the resulting indicator is significant, the overall correlation coefficient  $R^2=0.85$ . The coefficients are calculated in Table 2, Figure 5.

A comprehensive indicator of the effectiveness of innovative implementations at industrial enterprises according to selected systems (Figure 4):



**Figure 5.** Indicators of the effectiveness of innovative implementations at industrial enterprises, 2020-2021  
Source: created by the authors based on the enterprise reporting [23-25]



LLC "Interpipe Ukraine":

$$F_{in2020} = \sqrt[5]{84.05 \cdot 43.27 \cdot 51.37 \cdot 86.68 \cdot 89.48} = 67.95$$

$$F_{in2021} = \sqrt[5]{60.94 \cdot 40.36 \cdot 52.57 \cdot 95.57 \cdot 105.13} = 66.48$$

PJSC "ArcelorMittal Kryvyi Rih":

$$F_{in2020} = \sqrt[5]{42.05 \cdot 25.23 \cdot 63.08 \cdot 100.93 \cdot 69.61} = 54.25$$

$$F_{in2021} = \sqrt[5]{150.07 \cdot 108.19 \cdot 202.27 \cdot 290.76 \cdot 177.563} = 70.12$$

JSC "Southern Mining and Processing Plant":

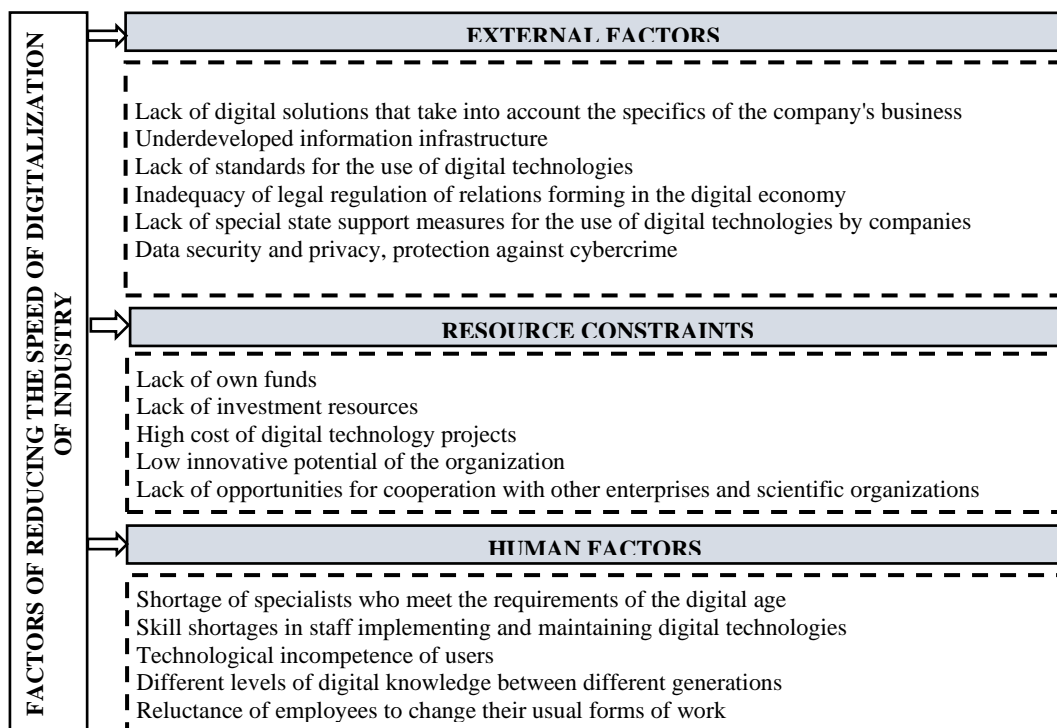
$$F_{in2020} = \sqrt[5]{38.52 \cdot 33.49 \cdot 110.04 \cdot 140.05 \cdot 128.38} = 76.10$$

$$F_{in2021} = \sqrt[5]{49.72 \cdot 33.37 \cdot 97.53 \cdot 97.54 \cdot 84.53} = 97.98$$

Thus, it can be argued that the innovative development of enterprises based on the application of digital technologies has a significant impact on the profit of the enterprise, contributes to its development, and as a result, ensures economic security. At the same time, it is advisable to analyze the definition of the level of economic security through the development of enterprises, since digitalization and innovations affect its formation. According to the researched enterprises, the development of digital technologies is carried out not only in the production system, but also in the management system. Thus, due to the implementation of the SmartManager system, the enterprise managed to fully control the cycle of processing all documentation, starting from its receipt or creation to the completion of execution or archiving at all levels of management. Digital transformation has covered all levels and divisions of enterprises in all key aspects of business processes - from the design of new products and technological processes

to the completed production and delivery of finished products to consumers. One of the important steps in the activities of the studied enterprises in the direction of digitization was the transition to electronic documentation (from design processes to production), personnel service, financial and economic and warehouse services, sales and logistics departments. Such a transition made it possible to improve management control, reduce the time of interaction between structural units, and increase the productivity of employees.

Technical services (technological, design, warehouse) carry out their document flow according to the principle of IT-Enterprise PLM, which is used by companies in the IT sector. The use of such a system for the enterprises under study contributes to the formation of technological routes, the formation of material consumption norms, the time norms and rates necessary for planning at various levels are calculated. The products of the investigated enterprises are supplied to foreign markets, while all documentation is translated into foreign languages. From the point of view of ensuring data security, when automating the document flow, for the reliability of saving archives and current documentation of all departments, appropriate software is used that facilitates these processes. Most of the technical documentation has already been translated into electronic format and paper media is gradually being abandoned, which helps to save money and time for its processing and storage. Human resources and financial and economic services have also maximally transferred the entire work format to the digital dimension, which simplifies data processing, contributes to speeding up the assessment of large amounts of information, electronic interaction with various financial and control bodies. Since digitalization processes are developing not only in enterprises, but also in state and administrative institutions, it also simplifies the interaction between enterprises and institutions. Marketing, sales and logistics services are among the first to implement digitalization in their activities.



**Figure 6.** The main factors that slow down digitalization processes at industrial enterprises of Ukraine

Source: developed by the authors

Today, digital platforms and sites are the tool that is used to find customers and partners around the world. The formation of logistics chains allows enterprises to more efficiently manage the processes of delivering their products to the final consumer. Taking into account the volumes and specifics of industrial enterprises, logistics costs in their cycle of delivery to consumers are quite significant [21]. Today, there are special digital platforms, electronic applications that are created specifically for logistics companies and allow you to quickly and efficiently plan transportation routes, interact with other companies and carriers, which greatly simplifies logistics processes. This is especially relevant during the period of global restrictions, such as during COVID-19, when most enterprises and institutions were forced to switch to online and digital platforms. Not all production processes can be transferred online yet, but with the development of digitalization and innovations in the future, such innovations will be relevant for all spheres of the economic activity. The main obstacles to the faster introduction of digital technologies in the industry of Ukraine can be identified as follows in Figure 6.

The lack of both financial and human resources can be attributed to the main factors that slow down the processes of digitization in industry. Low level of digital awareness, non-compliance of specialists' qualifications with the needs of professions with the newest composition, lack of desire to learn new things, especially among older people. Lack of effective state support for processes at the level of industry and enterprises. Lack of an effective data security system, development of cyber-crime and unfair competition. In terms of regulatory and legal support, there is no regulation of relations that arise when using digital technologies. The high cost of digitization projects for enterprises, which requires appropriate financial resources, which enterprises do not have. The inability to implement digital innovative technologies reduces the ability of enterprises in the international arena to find partners and customers. Because digital platforms require appropriate funds, software and professionals who know how to work with such products. Therefore, it is necessary for enterprises to attract investments specifically for the development of the production digitalization.

At the state level, it is necessary to implement directions for the digital technologies' development in all spheres of the economic activity. To introduce measures for the digital technologies' development, promote their accessibility to all segments of the population, training and upgrading of skills of employees in new digital technologies. At the enterprise level, ensure the confidentiality and reliability of data storage, with the help of attracting relevant specialists and purchasing the necessary software, which will contribute to ensuring both economic and information security of the activities of industrial enterprises.

## 5. CONCLUSIONS

The use of innovative and digital technologies contributes to the development of industrial enterprises and ensuring their economic security. The principles of digitalization and innovative development of the economy are the main ideas regarding global economic development at all management levels. The use of digital technologies makes it possible to reduce time and improve the quality of processing a large number of analytical data arrays, helps to find information

faster, and facilitates the mutual exchange of information between all participants in business processes. Allows more effective management of transport, material, and labor flows, which improves management decision-making. The main advantage of digitalization is the implementation of the possibilities of automating the management processes of the entire system or its components. The use of such technologies allows scaling up activities without loss of efficiency, which increases the effectiveness of the enterprise management. Digital technologies are the driving force for accelerating the development of both an individual enterprise and the state as a whole, increasing labor productivity, and contributing to the formation of new markets and sectors of the economy. However, positive trends can be achieved only if the foundations of the innovation implementation mechanism based on the use of digital technologies are systematically built. The digitalization development leads to the reshaping of the labor market and requirements for new professions and competencies of employees. Therefore, at the level of the state, regions and enterprises, it is necessary to take into account these factors and promote the improvement of the qualifications of their employees or the training of new professions.

The relevance of the research and its approbation is also determined by the analysis of the dynamics of the implemented innovative products in Ukraine, which remained almost at the same level for twenty years.

The authors proposed a method and carried out its approbation for determining the impact of digitalization on the innovative strategy of enterprise development in the context of ensuring economic security, using the example of such industrial enterprises as LLC "Interpipe Ukraine", PJSC "ArcelorMittal Kryvyi Rih" and JSC "Southern Mining and Processing Plant". It has been proven that the need to introduce innovations and digital technologies contribute to ensuring the economic security of enterprises and their development as a whole.

The advantages of the innovative strategy of introducing digitalization for enterprises are the individuality of demand satisfaction and closer contact with the buyer, the reduction of the level of transaction costs, the optimization of information flows, which are necessary for solving strategic business development tasks, etc.

To substantiate the impact of digitalization on the innovative development of enterprises, the methodology of correlation-regression analysis was used between the profit of the studied enterprise and such influencing factors as the efficiency of the innovative system of supply, production, transportation, sales and storage. Digital technologies were used in all the listed innovative systems that were selected for calculations and analysis, and the costs were attributed to innovative costs.

We see the analysis of innovation and investment provision of economic security of industrial enterprises in the conditions of digital transformation as a perspective for further research.

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