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## THE INFLUENCE OF DIGITALIZATION ON THE DEVELOPMENT OF INDUSTRIAL ENTERPRISES

**Purpose.** To study the impact of digitalization on the development of industrial enterprises.

**Methodology.** The study used general and special methods of cognition: system analysis and synthesis, which allowed considering the impact of digitalization on the processes and subsequent costs of enterprises; structural and functional method for research and comparison of digitization and robotics; deduction, logical research, graphical way of presenting information to display significant research results.

**Findings.** The study proved that digitalization is a strategic category rather than a technological one. Such levels of digitization as digitizing, digitization, digital transformation are considered. An analysis of the state of digitalization is proposed, which in the future may become a navigation tool for practitioners in decision-making on digital innovation and digital strategy and provide an opportunity to relate them to identified problems and opportunities in different industries with different challenges. The method of increasing the advantages of enterprises such as robotics and its relationship and impact on the level of digitalization is considered.

**Originality.** An analysis of the manifestations of digitalization of enterprises, which are considered on the criteria of reducing costs, creating new value of goods and services provided by enterprises, is conducted. In the conditions of digital redistribution of markets, enterprises are offered to use digital tools as much as possible and to invest in innovations that will allow achieving uniqueness of the offered service or product in the future.

**Practical value.** The results of the study can be used by economists, scientists and practitioners to develop further prospects for the use of digital tools to enhance their capabilities in marketing, training and innovation.

**Keywords:** *digital format, digitalization, technological development, digital innovations, enterprises' competitive advantages*

**Introduction.** The transition of Ukrainian enterprises to the digital format of work is becoming increasingly necessary, obvious and urgent for most companies. Over time, the digital divide between high-tech companies and companies that remain committed to outgoing technologies is becoming more acute.

Undoubtedly, only those enterprises that manage to adapt to digital changes in a relatively short period of time can continue their business activities. This in turn will lead to strong competition in the market, which in the future will force companies to accelerate the digitization process in accordance with the conditions of doing business and consumer preferences.

The proactive position of enterprises is a thing of the past, while at present both the external environment (contractors and buyers) and the internal environment (the most advanced employees) already require digital interoperability. The share of enterprises that intensively use innovative and advanced technologies in their work and development depends on the speed of digital transformation.

Due to the rapid response of enterprises to the innovations of digitalization, we can see an increase in competitive pressure on enterprises that use traditional approaches to doing business or continue to operate in two dimensions.

The correlation between the impact of digitalization and productivity leads to predictable consequences that reflect the gap between the most successful companies and less successful ones that are trying to survive.

The economic essence of competition of enterprises in the digital environment is emphasized by the willingness of enterprises to transform and introduce digital innovations and monitor technological progress in their daily activities.

The urgency of digitalization of industrial enterprises based on the introduction of digital technologies as a basis for

ensuring its financial stability and efficiency in the context of the crisis in the national economy, caused by the COVID-19 pandemic, is growing rapidly.

**Literature review.** Scientists Legner C., Eymann T., Hess T., Matt C. studied digitalization of enterprises. In their works they considered “digitalization” as a social process that reflects the pace of change in society due to digital technological development, which includes many technologies at different stages of maturity, the synergy of which will generate new technologies [1].

As noted in [1] there were several stages of digitalization, which have irreversibly changed both enterprises and society.

The first stage was the conversion of analog information into digital, which caused a wave of automation of work procedures.

The second stage of digitalization led to the fact that the Internet flooded society and became the main communication channel, which led to significant changes in the logic of calculating the value of the enterprise.

The third stage includes similar social, mobile, analytical and cloud technologies that bring the results of calculations closer to reality. The authors suggested that they are connected and mutually reinforce each other [1].

Trushkina N., Rynkevych N. reveal theoretical and practical aspects of digitalization of business processes of enterprises [2]. The authors noted that digitalization will lead to radical changes in the complex of business processes of enterprises, starting from product development and ending with customer service [2].

Shkodina I., Serdyuk T. in their works analyzed the peculiarities of the introduction of international business digitization at enterprises [3].

Bagatska K., Heydor A. studied the problems of digitalization, the impact of digital technologies on business development and organization of business processes of enterprises [4].

Digitalization should be considered as a complex systemic phenomenon in the development of enterprises. We agree with the views of scientists that digitalization is not only the full implementation of technology, but also a thorough transformation of business strategy, a radical update of the current business model of the enterprise [5].

Technological innovation advances digitalization, and strategy promotes digital transformation [6].

Digitization issues were discussed by world leaders at the G20 summit in Osaka (Japan), which highlighted key priorities, including supporting the digitalization of micro, small and medium enterprises [6].

Digitalization can be a catalyst for the creation of 700 thousand additional jobs in Ukraine (excluding the export industry) [6].

According to M. Shmelev, the success of digitalization of the enterprise rests on two “bookends”: first, the willingness to change in terms of technological component; secondly, the business strategy of the enterprise, focused on ensuring its competitiveness [7].

We agree with Lazebnyk L. that when deciding on the introduction of digital technologies to optimize business processes, it is important for companies to adequately assess the specifics of their implementation, as well as the potential and actual level of efficiency of their use [8].

**Unsolved aspects of the problem.** Analytical review of literature sources of domestic and foreign researchers, indicates the identified needs for digitalization at industrial enterprises. The needs are as follows: the formation of effective methods for diagnosing the readiness of enterprises to digitize processes; search for acceptable digitization methods for enterprises, taking into account the specifics of the activity.

But the methods and approaches proposed by scientists are debatable, and have some limitations on the use of industrial enterprises. Unfortunately, the available methods of strategic diagnosis and decision making do not provide the results of a sufficient degree of reliability.

**The purpose** of the article is to study the impact of digitalization on the development of industrial enterprises.

**Methods.** The main research methods of this article are: the method of system analysis and synthesis, which allowed considering the impact of digitalization on the processes and subsequent costs of enterprises; structural and functional method for research and comparison of digitization and robotics; deduction, logical research, graphical way of presenting information to display significant research results.

**Results.** Digitalization, as a strategic variable that companies take into account when working in a particular market, provides an understanding of the company’s business success through the process of changing market conditions from ideal competition to monopolistic, that is from monopolistic competition to oligopoly and from oligopoly to pure monopoly.

In our opinion, modern market structures are characterized by competition through digital innovations that complement and do not contradict the classic price competition. Digitization is only successful if it leads to higher productivity, lower costs and, on this basis, provides the same or higher quality at a lower cost.

Digital innovation is driven by several socio-cultural trends. The main trends are related to the reduced sensitivity of individuals to data protection and the idea of sharing assets. Social media has become one of the main influences of business and personal life.

The willingness of customers to provide their personal data to external software companies has increased significantly in recent years. Nowadays, users share personal information in social networks; for example, users actively discuss personal topics and publish personal data.

In addition, customers use mobile applications to process their biometric, medical and geographic data without being sure how the data is protected from misuse.

This behavior of users is considered common due to trust, habit or ignorance, and therefore creates the illusion of confidentiality of personal data.

Digital innovations primarily focus on the main vector of their activities on the benefits and values for customers including innovations, in particular in the use of smart devices and the transformation of business systems of enterprises taking into account social trends.

Smart devices that can now be connected via the Internet are the main products at the market, which can be seen in the growth of the digital solutions market. With the help of smart devices, one can obtain data that will be necessary and important in the future for the provision of relevant digital services.

Data are taken from natural and man-made objects and are constantly available, regardless of location. Digital innovators evaluate and process this data, always keeping in mind the value to customers.

Digital transformation has entered the business life of enterprises in various industries and has become key in development and competitiveness, by achieving greater business results through new technologies.

In addition, digital transformation is not only the introduction of new technologies and the process of setting up products and services, but also rethinking business models of the enterprise, optimizing processes and managing organizational change.

Digital transformation for each individual enterprise is not an exceptional solution for additional investments and the introduction of innovative technologies.

In our opinion, the digital transformation is a new approach to solving problems of combining management decisions and tasks in terms of working with human resources, business efficiency and redesign of processes in the enterprise.

Analyzing the content of digitization, one should note digitizing – the ability to convert analog information to digital. Digitizing can be considered as a “destructive dangerous creation” as a result of which users are provided with access to digitized products [8].

Digitizing is a tool with which it is possible to conveniently convert data into digital format and, thus, expand the capabilities of the enterprise to use them through scalability, asynchronous and spatial access.

At the level of digitizing, data that have limitations in the activities of the enterprise can serve as a tool to further reduce the cost of doing business.

Digital transformations at enterprises are aimed at reducing enterprise costs, networking (connectedness or connectivity) and creating value for products and/or services in terms of digitization, digitizing, digital transformation. Networking is a process of formation of network structures, which consists of both digitizing and digital transformation, but the key role is played by digitizing [8].

Kane G. C. in his works writes that digitizing, digitization and digital transformation can be observed at the following levels: activity, organizational process or organizational and ecosystem level [9].

In the future, digitalization will bring significant changes in the organizational structures of enterprises and in the processes of interaction both inside and outside the enterprise.

In our opinion, digitalization provides additional opportunities for companies to cooperate with various entities, where innovations in the market of products or services with digitally transformed support can provide additional opportunities to attract new customers and thus ensure growing market demand for the service or goods.

Thus, the creation of new partnerships at the level of digital transformation can be ensured through the use of knowledge of technological developments, and thus facilitating the rapid connection and access to constantly updated data sources, which in turn support cross-service capabilities.

We propose to consider a matrix of digital solutions in the strategies of enterprises that are transformed in accordance with the chosen strategy (Table 1).

The creation of new value of the proposed products or services comes from the digital transformation of the enterprise and is a consequence of the direct impact of digitalization on the transformation of the business model and processes of the enterprise.

Businesses can be transformed in terms of process management within the organization, this phenomenon does not depend on whether they include digital processes or not.

The value creation of goods or services in relation to the digitalization of the enterprise is connected to how digital strategies and transformation contribute to the search for new ways of value creation.

Thus, digitalization refers to digital changes at different levels of enterprise development. Digitization at enterprises is carried out through measures that exist exclusively at the orga-

nizational level and affect both the inter-organizational context and the current ecosystem [10].

Digitization involves the use of technology in socio-economic and institutional contexts and the dissemination of information data among enterprises, which affects the level of competition and further interaction [11].

Digitalization can be a common tool for innovation in business and entrepreneurship. It provides opportunities for the creation and development of new social networks, as a result of which additional partnerships can be formed.

Thus, the proposed analysis may in the future be a navigational tool for practitioners in selecting and purchasing the latest digital technologies for the development of digital know-how and digital strategy. This will allow them to be involved in reducing costs and connectivity, creating new value in different industries with different contextual conditions of complexity.

In Ukraine, the use of digital technologies is largely due to the need to make significant investments (Table 2).

The introduction of digital technologies in the world indicates the insufficient implementation of modern ERP-production systems, which will automate primarily service operations in production (Table 3).

In modern industry, the greatest potential for increasing the benefits of enterprises is digitalization in terms of purchasing robotics.

As it is known, industrial production is a process of combining materials to create objects based on the data of three-dimensional models, usually in layers (as opposed to the method of molding), for which 3D printing is actively used.

Table 1

Matrix of digital solutions in the strategies of industrial enterprises

Known digital solutions and their derivatives	Growth strategy	Cost reduction strategy
Digital resources needed for development:		
- databases	Yes	No
- data processing algorithms	Yes	No
- 5G technologies	Yes	No
- Internet of Things	Yes	Yes
Digital shortcomings that can be identified in the transformation process:		
- replacement of jobs with machines	No	Yes
- replacement of jobs by algorithms	No	Yes
- additional training of employees in connection with automation	No	Yes
- additional training of employees in connection with the release	No	Yes
- new IT jobs	Yes	No
Digital funding is needed for the development of:		
- cryptocurrencies	Yes	No
- digital mutual settlements (fintech mutual settlements)	Yes	Yes
- raising funds in the economy in the implementation of the technological trend	Yes	No
Digital consumption by potential customers:		
- pricing based on artificial intelligence	No	Yes
- consumption assessment	Yes	No
- formation of consumption	Yes	No
- the transition of trade into virtual reality	Yes	No
- the transition of trade into augmented reality	Yes	No
Digital decision-making within the enterprise:		
- Artificial Intelligence	Yes	No
- additional artificial intelligence	Yes	No
- virtual reality	No	No
- augmented reality	Yes	No

Table 2

Intensity of use of digital technologies in sectors of economy of Ukraine, %

Economic sector	Business digitization index	Internet technology	Cloud technologies	ERP systems
Mining industry	29	86	17	26
Manufacturing industry	35	92	26	27
Energy and mining industry	27	84	16	18
Construction industry	25	82	22	9
Trade/market relations	36	90	27	34
Telecommunications/Internet technology	43	92	39	46

Table 3

Intensity of digital technology use by countries, %

Country	Business digitization index	Internet technology	Cloud technologies	ERP systems
Austria	39	98	21	40
Brazil	—	97	—	27
Great Britain	35	95	35	19
Germany	38	95	16	38
Italy	35	96	22	37
Norway	42	94	48	30
Korea	45	99	—	28
Turkey	33	95	10	14
Finland	50	100	66	39
Japan	46	95	47	—
China	46	90	48	42

Wohlers Associates has been publishing annual reports for 25 years, confirming growing trends in manufacturing technology in 32 countries. Demand for industrial work is constantly increasing – this is noted in the International Federation of Robotics: the ongoing trend towards automation and further technical innovation has contributed to a 19 % average annual increase in supply for the period from 2013 to 2021 [12].

If in 2010 about 118,000 units of digital robotics were installed in the world, by 2015 their number reached 249,000 units, and in 2020 – 444,000 units. Asian countries: China, Japan, Taiwan, the Republic of Korea (Figs. 1, 2) are particularly active in these processes.

As we can see from Fig. 1 Asia and Australia are leaders in the installation of industrial digital robots. Their indicators have not changed in the last 4 year, but it should be noted that the period from 2013 to 2017 was hyperactive for the countries of the region.

A positive trend in the installation of industrial robots is observed in the European Union and the United States.

The results of the analysis of the average annual growth in the number of industrial digital robots are presented in Fig. 2, as of 2020. The largest increase was observed in China (154 thousand units). Japan, like all other countries in the East, lags behind China, but the average annual increase in the number of industrial digital robots reaches 55.2 thousand units. The United States and Korea are almost on the same level (40.4 thousand units, 37.8 thousand units, respectively). The average annual increase in the number of industrial digital units in other countries is less than 10 thousand units.

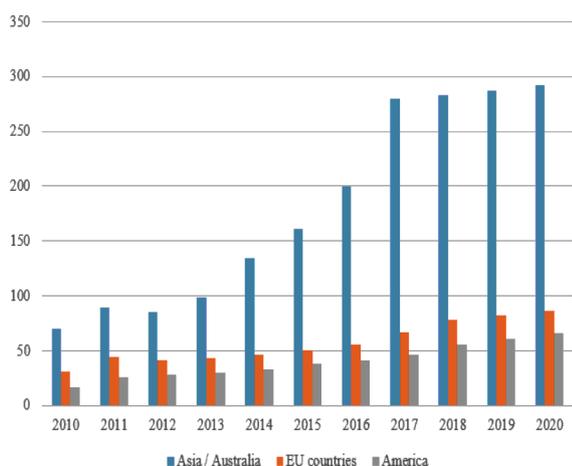


Fig. 1. Installation of industrial digital robots in the regions of the world, thousand units

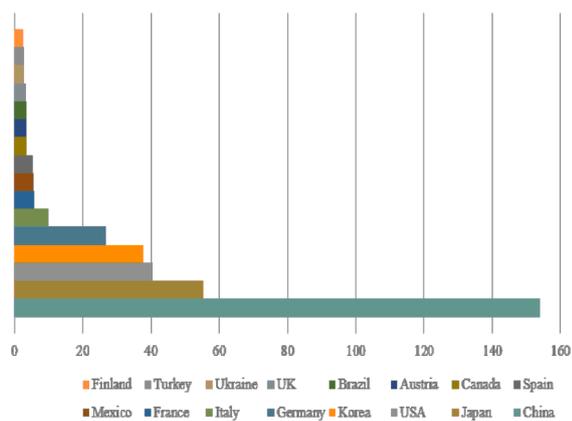


Fig. 2. The average annual increase in the number of industrial digital robots by country in 2020, thousand units



Fig. 3. Volumes of installation of digital solutions (robots) by industry during 2015–2020, thousand units

Increasing the purchase and use of digitalization in the performance of production tasks, which were previously performed manually, will lead to an increase in investment in robotics and digitalization.

This factor will contribute to future increases in productivity to 30 %, a significant share of the increase will be achieved through digitalization in the automotive and electronics industries, which are already actively using robotics and digital solutions in production [13].

As we can see from Fig. 3 the automotive industry over the past five years has managed to significantly increase the volume of installation of digital robots at enterprises (+ 18 thousand units).

We can observe this trend by the example of the electronics industry (+14 thousand units), metallurgy and mechanical engineering (+23 thousand units) and in other sectors of the economy. The chemical and food industries are less popular in this respect.

Industrial enterprises are focused on investing in digitizing and the introduction of digitizing, regardless of the activity of the enterprise [14, 15]. The integration of digital production and management processes into a single information system (e.g. ERP systems, or others with improved digital functionality) is of particular interest, i.e. the sale of industrial products via the Internet, including Big Data processing capabilities.

**Conclusions.** As a result of the study, the fundamental difference between the formation of advantages in the digital economy is the choice of a competitive landscape by forming the necessary business model.

Considering business models and processes in the enterprise, we can conclude that industrial enterprises are increasingly preferring new ways and methods of resource management, creating new value, as well as assessing business based on various key performance indicators (KPIs) defined by the business model (profit, growth, creation of social value, etc.).

A key recommendation for industrial enterprises is that in order to gain benefits in the context of digitalization and redistribution of markets, the use of digital tools to expand their capabilities in the sphere of marketing, training and innovation remains relevant.

In the future, this right will enable companies that are on the path of digitalization and transformation to outperform their competitors, combined with the uniqueness of the newly created/transformed service and/or product.

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## Вплив цифровізації на розвиток промислових підприємств

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**Мета.** Дослідити вплив цифровізації на розвиток промислових підприємств.

**Методика.** У дослідженні були використані загальні та спеціальні методи пізнання: системного аналізу й синтезу, що дозволило розглянути вплив цифровізації на процеси та наступні затрати підприємств; структурно-функціональний метод для дослідження й порівняння об'ємів цифровізації та роботизації; дедукції, логічних досліджень, графічний спосіб подачі інформації для відображення значущих результатів дослідження.

**Результати.** У процесі дослідження доведено, що цифровізація є категорією, більшою мірою, стратегічною, ніж технологічною. Розглянуті такі рівні цифровізації як оцифрування, цифровізація, цифрова трансформація. Запропоновано аналіз стану цифровізації, що в майбутньому може стати навігаційним інструментом для практиків при прийнятті рішень з цифрових інновацій та цифрової стратегії й пов'язувати їх з виявленими аспектами проблем і можливостей у різних галузях з різними умовами складнощів. Розглянуто метод нарощування переваг підприємств, такий як робототехніка, та його взаємозв'язок і вплив на рівень цифровізації.

**Наукова новизна.** Проведено аналіз проявів цифровізації підприємств, що розглядаються за критеріями зниження витрат, створення нової вартості товарів і надаваних послуг підприємствами. Запропоновано підприємствам в умовах цифрового переділу ринків максимально застосовувати цифрові інструменти та інвестувати в нововведення, що дозволить у майбутньому досягти унікальності пропонованого сервісу чи продукту.

**Практична значимість.** Результати дослідження можуть використовуватися економістами-науковцями та практиками для розвитку подальших перспектив застосування цифрових інструментів з метою розширення їх можливостей у галузі маркетингу, навчання та інновацій.

**Ключові слова:** цифровий формат, цифровізація, технологічний розвиток, цифрові інновації, конкурентні переваги підприємств

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