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INNOVATIVE DEVELOPMENT OF UKRAINE IN THE ERA OF DIGITALIZATION: DEVELOPMENT OF OPEN INNOVATIONS

Abstract. The article examines digitalization as a key factor of Ukraine's innovative development and its influence on the competitiveness of industrial enterprises in the context of globalization and post-war recovery. It is emphasized that digital transformation is not limited to technical processes but represents a systemic socio-economic phenomenon that reshapes business models, organizational structures, communication systems and consumer interactions. The study identifies unresolved challenges hindering the spread of digitalization in Ukraine, such as the high cost of implementation, shortage of qualified personnel, insufficient standardization and cybersecurity risks. At the same time, the paper stresses the positive dynamics of digital transformation, which stimulates the emergence of new products, services and management solutions, enhances efficiency and promotes integration into the global digital space. The theoretical foundations are grounded in systemic, institutional and innovative approaches, while the methodology combines statistical analysis, content analysis of strategic documents, and comparative study of domestic and international practices. Empirical findings show that Ukraine has slightly improved its position in the Global Digital Competitiveness Ranking, moving from 60th to 58th place in 2018–2023, mainly due to the development of digital skills, e-participation and enterprise agility. The research highlights priority directions of digitalization: automation of processes, the use of big data analytics, cloud technologies, Internet of Things, artificial intelligence and cybersecurity. The article concludes that further progress requires the creation of a favorable institutional environment, investment in digital infrastructure and human capital, as well as state support for enterprises during their digital transformation. The prospects of research lie in developing mechanisms for assessing the impact of digitalization on competitiveness and designing policy recommendations to strengthen Ukraine's innovative potential in the global economy.

Keywords: digitalization; software; innovative development; transformations; innovations; scientific institutions.

INTRODUCTION

In today's conditions, digitization is associated with the newest direction of information technologies, which, in fact, correlate with modern areas of production. Despite the rapid application of the digital direction in view of the significant potential, it is still in the process of its formation and formation, thereby determining the priority socio-economic directions of development. It is obvious that digitalization to a certain extent determines the competitive position of industrial enterprises, which is characterized not only by efficiency and productivity, but also by the level of innovative development. It allows you to use the latest digital forms of communication, use opportunities through acquired competencies and adapt them to permanent changes in the environment.

Problem statement. In today's conditions of globalization challenges and increasing competition, digitalization is becoming one of the key factors of socio-economic development. It determines the competitive positions of states and enterprises, affecting not only productivity and efficiency, but also the level of innovative development. However, despite the positive dynamics, the process of digital transformation in Ukraine is still at the stage of formation and faces a few unresolved problems: the high cost of implementing digital technologies, the shortage of qualified personnel, the insufficient level of standardization and protection of digital solutions.

From a scientific point of view, the problem lies in the lack of a unified approach to interpreting the category of "digitalization", which is considered both as a technical process of converting information into a digital format and as a complex transformation of business processes and social relations. This complicates the development of a clear methodology for assessing the impact of digitalization on innovative development and the competitiveness of the national economy.

From a practical point of view, digital transformation in Ukraine does not yet provide an adequate level of integration of digital technologies into key sectors of the economy, which slows down the formation of "digital enterprises" and reduces the effectiveness of state policy in the field of innovative development. This problem becomes especially important during the post-war recovery period, when the competitiveness of industrial enterprises, the development of the financial market, the modernization of the education system and social infrastructure depend on the speed and quality of digitalization. Thus, the task of scientifically understanding digitalization as a systemic process that encompasses economic, technological and social aspects, as well as developing mechanisms for its effective implementation in Ukraine, arises. Solving this problem has both theoretical significance — the formation of a holistic understanding of the digital economy, and practical — creating the prerequisites for increasing the country's competitiveness in the global environment.

Analysis of recent research and publications. In scientific works of recent years, the problem of digitalization has been considered from various positions — from theoretical and conceptual definitions to applied aspects of the implementation of digital technologies in business processes. A significant contribution to the formation of theoretical foundations was made by S. Korol [3], L. Ligonenko [4], J.-P. de Klerk [5], who focused on the transformational nature of digitalization, its impact on organizational structures and the competitiveness of the economy. Researchers emphasize that digitalization is not only a technical process, but also a fundamental restructuring of the interaction between enterprises, consumers and society.

Ukrainian scientists have also made a significant contribution to the development of the issue. A. Koptelov [6] considers digitalization as the creation of new products in a digital environment, and M. Ustenko [7] emphasizes its importance for optimizing business processes and increasing productivity. G. Sokolova [8], A. Gurenko [9], O. Hrybinenko [10] investigate the specifics of digital transformation in Ukraine, noting the role of big data, artificial intelligence and cloud technologies in the formation of new business models. Foreign authors, in particular Andersson van der Geyden [13], [14], emphasize the importance of digital management, culture and strategy as key factors in the innovative development of enterprises. Despite significant scientific achievements, there is still no single approach to defining the essence of digitalization, which causes a certain terminological uncertainty (from "digitization" to "digital transformation"). The issues of forming effective digitalization mechanisms at the level of industrial enterprises of Ukraine, integrating digital technologies into strategic management and assessing their impact on competitiveness in the global environment remain insufficiently studied. This determines the relevance of further research and emphasizes their scientific novelty.

The purpose of the article is to substantiate the importance of digitalization as a factor in the innovative development of Ukraine and determine its impact on the competitiveness of industrial enterprises.

THEORETICAL FOUNDATIONS OF THE RESEARCH

The theoretical foundations of digitalization research are based on a combination of systemic, institutional and innovative approaches, which allow us to consider it as a multidimensional process and at the same time as a socio-economic phenomenon. Digitalization in modern conditions acts as a catalyst for innovative development, as it stimulates the creation of new products, services and business models, optimizes management and production processes, increases the competitiveness of enterprises and contributes to the integration of Ukraine into the global digital space. Its implementation requires an appropriate institutional environment, including regulatory and legal regulation, digital infrastructure and human capital development, and the interdisciplinary nature of digitalization necessitates the synthesis of knowledge from economics, management, information technologies, sociology and law. In this context, digitalization is considered a key factor in sustainable development and the basis for the formation of an innovative model of the Ukrainian economy.

RESEARCH METHODOLOGY

The study of the innovative development of Ukraine in the context of digitalization is based on a combination of qualitative and quantitative methods of analysis. The work uses statistical, theoretical and generalization methods to scientifically substantiate the results. Directly in the research process, general scientific methods and techniques were used, scientific abstraction, grouping, classification, comparison, induction, deduction, analysis and synthesis. The object of the study is the processes of digitalization in the economy of Ukraine, which affect the innovative development of industrial enterprises and the competitiveness of the state. The main assessment criteria are the level of digital competencies, the degree of automation of business processes, the use of analytics and big data, the implementation of cloud technologies, the Internet of Things, artificial intelligence and cybersecurity. To collect data, we used an analysis of statistical sources (in particular, the IMD Digital Competitiveness Index), content analysis of scientific papers and strategic documents ("Industry Development Strategy 4.0"), as well as a comparative analysis of foreign and domestic digital transformation practices.

RESEARCH RESULTS

In today's conditions, digitalization is a key prerogative of permanent changes. It is characterized by a process that includes transformation, the introduction of digital technologies, which aim not only to optimize, but also to automate business processes, which will thus lead to the improvement of communication links and increase the efficiency of the enterprises themselves [1, p. 50]. The "Industry Development Strategy 4.0", developed by the Association of Industrialists and Entrepreneurs of Ukraine, interprets digital transformation as social or technological changes that are associated with the penetration of digital technology into all aspects of human interaction [2]. Such transformational changes make it possible to find digitalized approaches and concepts of a managerial nature to solve classic tasks.

The author, S. Korol, says that "the formation of the digital economy in Ukraine should become a driving force for increasing GDP and improving the standard of living of the population. Using digital technologies, every sector of the economy can develop faster, better and more efficiently. This determines the wide interest of scientists in the concept of digital economy and digitization" [3, p. 68].

L. Ligonenko believes that digitalization is a necessary process for the development of modern enterprises in the conditions of the neo-economy. It is designed to simplify and speed up work with large databases, to ensure the automation of all types of activities (main and auxiliary operational, investment, financial), to improve communication with customers, suppliers and partners and all institutions of the external environment, to form new principles

of interaction within the enterprise — between divisions, employees, management, transition to new organizational forms of management (network and virtual economy) [4, p. 21].

Digitalization, according to Zh.-P. de Klerkom, consists in the use of digital technologies and data (digitized (digitized) and existing in digital form initially) with the aim of obtaining profit, improving business, changing/transforming business processes (different from the purely digitization of the latter) and creating an appropriate environment for their implementation, based on the use of digital information. For the purpose of carrying out economic activity, digitalization is considered primarily as enabling, improving and/or transforming business operations and/or business functions, and/or business models/processes, and/or the entire activity as a whole through the application of digital technologies and a wider the use of digital data transformed into knowledge in order to obtain certain advantages. If digitization refers mainly to data systems, then within the framework of the digitization process, the main attention is paid to information and interaction systems strengthened with the help of digitized data and processes [5].

Considering the above, it is difficult to agree with the opinion of A. Koptelov, who, distinguishing digitization (“digitization”) from digitalization (“digitalization”), defines the latter as the process of creating a new product that initially exists in digital form and cannot be transferred to a physical medium without significantly reducing its quality [6].

At the same time, M. Ustenko rightly says that digitalization represents fundamental transformations that are expressed in the deep penetration of digital technologies into business processes, their optimization, increased productivity and improved communication interaction with consumers. The key feature of such transformations is significant improvements in the efficiency of business processes, reduction of monetary and time costs for their support [7, p. 184].

G. Sokolova, researching aspects of the development of the digital economy in Ukraine, determined that “digitalization is characterized as the creation of a digital (based on bytes and bits — minimally addressable units of information) version of analog things on paper documents, video and photo images, sounds” [8].

A. Gurenko notes that the main feature of digitalization is the creation of conditions for more comfortable and efficient interaction between business and consumers [9, p. 739]. Currently, the main factors in the development of digitalization processes are the emergence of the latest digital technologies, the formation of new needs and requests of consumers (orientation on saving time, searching and purchasing goods according to clear parameters); creation of new values, properties of goods; change in the conditions of the competitive environment [9, p. 740].

O. Hrybinenko understands by digitalization the transformation, the penetration of digital technologies regarding the optimization and automation of business processes, increasing productivity and improving communication interaction with consumers. The conceptualization and management of business processes face certain fundamental problems, namely the relationship between multiple business process management (BPM) and their contribution to corporate value [10].

M. Ustenko notes that digitalization of business is becoming an inevitable trend, ignoring which becomes a sign of backwardness and non-compliance with modern requirements. Strategic measures to increase the competitiveness of any economic entity should be implemented in the plane of its digital dimension [7, p. 188].

T. Lazorenko and I. Sholom note that the digitalization process is characterized by transformation, the introduction of digital technologies for the purpose of optimizing and automating business processes, improving communications with consumers, and increasing the efficiency of economic activity. “Industry Development Strategy 4.0”, developed by the Association of Industrialists and Entrepreneurs of Ukraine, explains digital transformation as

social or technological changes that are associated with the penetration of digital technology into all aspects of human interaction [1].

In view of the above, we state that the definition of “digitalization” is interpreted by scientists as the process of using, applying, transferring and converting information into a digital format; system of data collection, storage, analysis, application of artificial intelligence; transformation of the penetration of digital technologies, regarding the optimization of business processes.

By the concept of digitalization, we understand the definition characterized by transformational changes aimed at the symbiosis of digitization and software.

Therefore, digital transformation or digitization is a holistic rethinking of the business model, transformation of all processes and transition to the use of new tools in the directions and spheres of banks, financial market, market, production, economy, professions, education, business and society.

Let’s consider the specified areas and areas in more detail:

1. Digitization of banks. Over the past few years, the banking system has undergone major changes. The preference for digital services and exceptional customer interaction has been driven by the restructuring of the financial market, including the development of cryptocurrencies, bitcoins and blockchains.

The main directions of the modern banking system in terms of digitalization are:

- Digital transformation of bank transfers. This process becomes automated: now you don’t need bank personnel to make a transaction.
- Rethinking the banking business model. A good example is the use of blockchain technology (from the English “Blockchain”), which allows to reduce fraud in the banking sector. It is already used in such operations as payments, transfers of direct investments, management of trade and production, mortgage, credit reports, etc.
- Cloud technologies in the banking sector. Thanks to the provision of network access, banks have many new opportunities: cooperation with partners for the development of digital products, optimization of business processes.

2. Digitalization of the financial market. Experts of PwC, which provides consulting and auditing services, believe that the digitization of the financial market is caused by two factors:

- Complete adaptation of generation C to the digital environment. Consumers are always ready to share their personal experiences, impressions and experiences in social networks.
- Emergence of new economic advantages. Digitization has transferred capital to social networks and websites.

3. Digitalization of the market.

4. Digitization of production. The key question for production owners is how quickly and flexibly they can respond to changes in the market and customer needs. To this end, they are increasingly seeking to make the development stages of new products parallel. This requires consistent implementation of all digitization options — from the first idea to the commissioning of a production machine.

Another promising direction is network production. Sinumerik Integrate provides the industry with a wide range of solutions for networked machines and their connection to high-level IT systems.

5. Digitization of the economy, two main directions in which digitization is moving can be distinguished — this is the increase in productivity and the creation of “digital enterprises”. Digitization of data in business reduces costs, increases profits and increases the pace of economic development. As soon as companies become digital, they realize that they can promote their technologies in various sectors of the economy. This, in turn, requires less effort, because digitalization helps to overcome barriers and enter a new segment of the economy.

6. Digitalization of business. The process of digital transformation touched all areas of business: from how the company acquires and retains new customers, to how the management imagines and manages the company's reputation on the Internet.

7. Digitization of education. The field of education is also undergoing irreversible changes. The most important trend nowadays is obtaining additional education.

The main vectors of education development are:

- Speed — learning keeps up with the times, because the usual accumulation of knowledge has long lost its relevance.
- Enthusiasm and motivation are fundamental principles in education, where teachers become coordinators, guiding students online and offline.
- Availability of materials in real time, which simplifies the process of obtaining new knowledge.
- Interdisciplinary content is a direction that blurs the strict boundaries between production, business and other areas; therefore it requires combining knowledge from different spheres of life.

8. Digitization of professions Digital processes challenge traditional workplaces. This applies to HR specialists. Digitization of this area reduces the workload of hiring and training interns. Digitization refers to the following stages of recruitment and training: video presentations; passing a quest instead of interviews; training through special portals.

9. Digitalization of society. Digitization began to dictate new principles in all areas of our lives, from the work of the banking system to health care. Society itself was no exception.

One of the trends is the decentralization of cooperation. Now shopping and many other tasks can be done while connected to the Internet. For example, the use of cryptocurrency, which replaced checks and cash. The merging of the digital and physical worlds is observed. This is the implementation of artificial intelligence in devices that are in millions of homes around the planet. We will also likely see the replacement of the regular computer with more efficient tools and interfaces that require only voice commands.

Summarizing the interpretation of the definition of “digitalization” in Ukraine, we can note that over the past five years, interest in this category has grown significantly, especially this year, which indicates the timeliness and necessity of its implementation.

The conducted analysis of the dynamics of research on the definition of “digitalization” in Ukraine over the past five years indicates that the domestic interest in this category began very recently, in particular in 2018, but the most research falls on the year 2023.

In general, we can say that in the last 3 years there has been a significant interest in the direction of digitalization, which is due to competitive advantages, including: providing additional value of the product through quality service; high level of communication; improving the company's image; price reduction through automation of processes and digitization of business processes; transparency of internal and external processes of the enterprise; increasing customer loyalty to the company [4, p. 22].

At the same time, digitalization contributes to the expansion of the information space, creating new information products, and helps to reduce information costs. This significantly accelerates and simplifies the search for information, its mutual exchange and promotes the strengthening of cooperation between companies, which affects the methods of operational activity of business entities, people's search for favorable conditions for life, as well as the quality of interaction between the country's population and its government. Changes in economic processes, the reorientation of production from the creation of material goods to the provision of services, the globalization of the economy are noted by scientists as the most

fundamental signs of the development of a new type of society in the era of the formation of informatization and digitalization processes [11, p. 27].

Ukraine advances and develops every year and improves its position in digitalization, moving up two places from 60th to 58th, which is due to the acquisition of talent, especially the availability of digital / technological skills (40–27), electronic participation (53–39th) and agility of companies (47th to 33rd) (Table 1).

Table 1

**The Dynamics of the Level of Digitalization in Ukraine,
Estimated Based on a Set of Key Indicators for 2018-2023**

The assessment is general and by individual factors	Years					
	2018	2019	2020	2021	2022	2023
The overall assessment is based on the rating	59	59	60	58	60	58
Knowledge	40	44	45	39	40	38
Technological environment	60	60	62	61	61	59
Openness to the future	61	61	61	61	62	61

Source: developed by the author on the main ones <https://www.imd.org/>

In the context of industrial enterprises, digitalization promotes innovative development. According to Andersson van der Heyden [13], [14], during digital transformation at the enterprise, it is worth focusing attention on key aspects of the development of the business environment, namely: digital environment; digital management; digital culture and digital strategy.

The innovative development of Ukraine in the conditions of digitalization opens up many opportunities for enterprises, scientific institutions, organizations in creating competitive advantages and reaching a new level of efficiency and flexibility. It includes the implementation of digital technologies and information systems for the optimization and improvement of business operations, among which the main ones are those listed in the Table 2.

Table 2

**The Main Components of the Innovative
Development of the Country in the Conditions of Digitalization**

Component (indicator)	Characteristics of the indicator
Process automation	The use of automation to optimize routine tasks and reduce human intervention, which includes the use of robots, software solutions to automate data processing, electronic document management, and more.
Use of analytics	Collection and analysis of large volumes of data to obtain valuable information, where analytics allows you to make informed decisions, forecast trends and improve strategies.
Cloud technologies	The use of cloud platforms to provide access to data and resources from any location facilitates the storage and processing of large volumes of information.
Internet of things	Implementation of sensors and connection of objects to collect data and optimize certain processes.
Artificial intelligence	The use of artificial intelligence technologies to automate decision-making, forecasting and support in the management of certain processes.
Cyber security	Ensuring the protection of digital assets and data in the digital environment is a critical aspect as the number of digital threats increases.
Electronic communication and collaboration	Using tools to facilitate communication and collaboration in a team, even if the participants are in different locations.

Source: developed by the author based on the main researched sources [6]–[14]

Despite significant positive developments in the country's innovative development in the field of digitization, there are a number of unsolved problems: high costs at the early stage of operating information systems; relatively large costs of a transactional and transformational nature, which are associated with the transition to the use of digital technologies by all economic agents; shortage of professional personnel, associated with the established disproportion between the demand for highly qualified specialists and their insufficient training by educational institutions; the absence of the necessary uniform standards, technical regulations and relevant legislative norms that regulate relations between participants in the field of digital technologies; insufficient level of protection of digital technologies against illegal encroachments [15].

Digital technologies, the rapid growth of which in recent years has significantly changed not only the technological landscape, but also the socio-economic picture of Ukraine, creates new opportunities for conducting business and attracting a wide range of participants to it. Thus, new conditions are created for the diversification of economic activity, including in the field of entrepreneurship. It is quite possible to expect that such a trend of economic development will be able to ensure a more stable and harmonious picture of Ukraine in the future.

CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

Today, the economy of Ukraine has both an applied and theoretical as well as a legislative basis to strengthen its position among the countries of the world. However, its digitization is still mainly innovative in nature. Therefore, a mandatory requirement for the national economy is the combination of theoretical research with the modern needs and opportunities of stakeholders.

So, in the conditions of the new economy, during fierce competition, rapid aging of technologies, professions, ideas, penetration of the Internet into all parts of the economy, digitalization has reached a new level of importance for business organizations. To maintain the competitiveness of the organization, enterprises need to use the possibilities of digitalization in all possible directions and forms: customer experience; partnership and collaboration; working with data; implementation of innovations; HR-strategy and culture; value management, etc.

Determining new guidelines for the development of industrial enterprises through digitalization is a priority task, which is determined by today's challenges. Current communication links, motivation systems, outdated technologies and standard solutions that took place in the recent past have lost their relevance. In the conditions of permanent changes, they need an innovative component of development, which forms the foundation of competitiveness. A high level of digitization of enterprises can provide opportunities to enter a new market, respond to changes in the market situation, and bring strategies and methods of assessing business risks to a new, more likely level. The driving force of such changes should be digitalization, which will allow enterprises, in particular industrial ones, to reach a new level of development.

According to the level of digitalization of the economy and society in various countries included in the Global Digital Competitiveness Rating, Ukraine has improved, moving up two places from 60th to 58th, which is due to talent acquisition, availability of digital / technological skills, e-participation and agility of companies. Such minor improvement steps allow not only to optimistically predict the level of innovative development of industrial enterprises through the prism of digitalization, but also to adjust goals, objectives and strategic orientations.

However, this process also carries certain risks, such as increased unfair competition and dumping. For a successful digital transformation, Ukraine needs to create a favorable regulatory environment, support the development of digital infrastructure, and invest in human capital. Only under such conditions will digitalization become the driving force of sustainable development of the country.

Therefore, digitalization is a key element of competitiveness in the modern market environment, and innovative development of the country in this context is a necessary condition for successful adaptation to the digital world.

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**ІННОВАЦІЙНИЙ РОЗВИТОК УКРАЇНИ В ЕРУ ЦИФРОВІЗАЦІЇ:
РОЗВИТОК ВІДКРИТИХ ІННОВАЦІЙ**

Анотація. У статті розглядається цифровізація як ключовий фактор інноваційного розвитку України та її вплив на конкурентоспроможність промислових підприємств у контексті глобалізації та післявоєнного відновлення. Підкреслюється, що цифрова трансформація не обмежується лише технічними процесами, а являє собою системне соціально-економічне явище, яке змінює бізнес-моделі, організаційні структури, системи зв'язку та взаємодію зі споживачами. У дослідженні визначено невирішені проблеми, що перешкоджають поширенню цифровізації в Україні, такі як висока вартість впровадження, нестача кваліфікованого персоналу, недостатня стандартизація та ризики кібербезпеки. Водночас у статті наголошується на позитивній динаміці цифрової трансформації, яка стимулює появу нових продуктів, послуг та управлінських рішень, підвищує ефективність та сприяє інтеграції у світовий цифровий простір. Теоретичні основи базуються на системних, інституційних та інноваційних підходах, а методологія поєднує статистичний аналіз, контент-аналіз стратегічних документів та порівняльне дослідження вітчизняної та міжнародної практики. Емпіричні дані показують, що Україна дещо покращила свою позицію у Глобальному рейтингу цифрової конкурентоспроможності, перемістившись з 60-го на 58-ме місце у 2018–2023 роках, головним чином завдяки розвитку цифрових навичок, електронній участі та гнучкості підприємств. У дослідженні виділено пріоритетні напрямки цифровізації: автоматизація процесів, використання аналітики великих даних, хмарні технології, Інтернет речей, штучний інтелект та кібербезпека. У статті зроблено висновок, що подальший прогрес вимагає створення сприятливого інституційного середовища, інвестицій у цифрову інфраструктуру та людський капітал, а також державної підтримки підприємств під час їхньої цифрової трансформації. Перспективи дослідження полягають у розробці механізмів оцінки впливу цифровізації на конкурентоспроможність та розробці політичних рекомендацій щодо посилення інноваційного потенціалу України у світовій економіці.

Ключові слова: цифровізація; програмне забезпечення; інноваційний розвиток; трансформації; інновації; наукові установи.

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