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DIGITAL TRANSFORMATIONS IN THE CONDITIONS OF INDUSTRY 4.0 DEVELOPMENT

Abstract. The article considers and analyzes the importance and main scientific approaches to determining the essence of digital transformation in the conditions of Industry 4.0 development. The opinions of domestic and foreign scientists on the definition of the essence of this concept are presented and it is determined that digitalization has an important role in the activities of modern enterprises. The definition of «digitalization» is proposed, that means the process of transition to digital business, which is the use of digital technologies to change business processes in the company and provide new opportunities for additional income and development prospects of business entities. It is determined that digitalization is a very popular and necessary process of transition to new business models in the activities of companies. The essence of the category «Industry 4.0» is considered and the main technologies and tools that contribute to the gradual transition to digitalization are presented. It is noted that Industry 4.0 is part and a leading trend of the Fourth Industrial Revolution. It is investigated that the transition to Industry 4.0 using digital tools is quite a trend, as these key technologies such as IoT, Big Data, cloud services, artificial intelligence today play a key role in the process of digitalization of companies. The main recommendations for adapting the business to digital transformations are given. The key directions of the development of digital technologies of Industry 4.0 are considered and presented. The industries that need digital transformation and those areas of business that are actively implementing digital products in their activities are identified. It was also found that the use of digitalization processes allows companies to optimize existing business models, gain new opportunities for business development, expand the scope of activities, and have tools to increase their efficiency and competitiveness.

***Keywords*:** digital transformation, digitalization, digital technologies, Industry 4.0.
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ЦИФРОВІ ТРАНСФОРМАЦІЇ В УМОВАХ РОЗВИТКУ ІНДУСТРІЇ 4.0

Анотація. Проаналізовано і розглянуто значення та основні наукові підходи до визначення сутності цифрових трансформацій в умовах розвитку Індустрії 4.0. Представлено думки вітчизняних і закордонних науковців щодо визначення сутності цього поняття і визначено, що діджиталізація має досить важливу роль для діяльності сучасних

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підприємств. Запропоновано власне визначення поняття «діджиталізація» — процес переходу до цифрового бізнесу, який полягає у використанні цифрових технологій для зміни бізнес-процесів у компанії та надання нових можливостей для отримання додаткового доходу і перспектив розвитку суб'єктів підприємництва. Визначено, що діджиталізація є досить популярним і необхідним процесом переходу до нових бізнес-моделей у діяльності компаній. Розглянуто сутність категорії «Індустрія 4.0» і наведено основні технології та інструменти, які сприяють поступовому переходу до діджиталізації. Зазначено, що Індустрія 4.0 є частиною і провідним трендом Четвертої промислової революції. Досліджено, що перехід до Індустрії 4.0 із використанням цифрових інструментів є досить трендовим явищем, оскільки зазначені ключові технології, такі як IoT, Big Data, хмарні сервіси, штучний інтелект, сьогодні відіграють одну з ключових ролей у процесі діджиталізації діяльності компаній. Наведено основні рекомендації щодо адаптації бізнесу до цифрових перетворень. Розглянуто і представлено ключові напрями розвитку діджитал-технологій Індустрії 4.0. Зазначено галузі, які потребують цифрового перетворення і ті напрями бізнесу, які активно впроваджують діджитал-продукти у власну діяльність. Також з'ясовано, що використання процесів діджиталізації надає змогу компаніям оптимізувати наявні бізнес-моделі, отримати нові можливості для розвитку власного бізнесу, розширити сферу діяльності і мати інструментарій для підвищення власної ефективності та конкурентоспроможності.

***Ключові слова*:** цифрова трансформація, діджиталізація, цифрові технології, Індустрія 4.0.

Формул: 0; табл.: 1; рис.: 2; бібл.: 16.

Introduction. Every year, digital transformation takes an increasingly important place in our lives. Digitalization penetrates almost all areas of industry and services, makes irreversible changes in the management of companies, improving their financial and economic activities, and making them more flexible and competitive in the market. This is the use of powerful software, hardware, and digital tools which forms the company's competitive advantages in the market. Digitalization opens many new opportunities for organizations for further effective development and is an effective mechanism for implementing of positive changes in the company. Therefore, the processes of digitalization are quite relevant and require more thorough research in modern conditions.

Analysis of research and problem statement. Digitalization in combination with the concept of development of Industry 4.0 is a relatively new area of research in Ukraine and the number of scientific achievements in this area is quite small. Research in this area was conducted by scientists: D. Bowersox, G. Westerman, D. Bonnet, C. Dahlman, S. Schaible, V. Scuotto, D. Mazzone, S. Brennen, D. Kreiss, T. Ochs, U. Riemann, and others. Among domestic scientists, it is possible to note V. Apalkova, T. Bohdan, S. Voitko, S. Volosovych, L. Lihonenko, D. Lukyanenko, A. Maslova, V. Pleskach, M. Tarasiuk, S. Tsyhanova, O. Yurchak, and others.

The result of the research. Today, the digital transformation and its development in the context of Industry 4.0 plays an important role in the functioning of every company. It is the use of digital technologies and tools of Industry 4.0 that allows us to constantly develop and improve our activities. Now, business models of companies that a few years ago were considered successful and profitable cease to bring the necessary results and become inefficient. To constantly develop and increase their profits, companies need to rethink their actions and follow current trends in consumer interaction and the development of internal business processes [1].

The need for digitalization is due to the desire to constantly improve processes, and on the part of companies — to improve their competitive position in the market, which in turn has a positive impact on the country's economy and its investment attractiveness. In the digital world, the winners are those companies that could offer a value that fully meets consumer demand [2].

There is currently no commonly accepted definition for the term digitalization. Moreover, the terms digital transformation and digitalization are often used interchangeably. Selected definitions in the context of digitalization are shown in *Table* [3, p. 4; 4, p. 23—25].

Table

Definition of digital transformation in terms of different approaches

Author	Definition
BMWi [5]	Digitalization is a concept that covers all sectors of the economy, while social activities are actions aimed at analyzing, collecting, and information processing with a subsequent change of existing business processes. Emerging changes provide benefits and opportunities and create new challenges for companies.
Donald Bowersox	Digital business transformation is a process of rethinking the business of internal operations and the formation of a developed supply chain. The task of digital transformation is to establish such processes that would fully automate the processes and accelerate the potential of the company itself.
George Westerman	Digital transformation is the use of the latest technologies to improve the work and activities of the enterprise. The use of digital tools, analytics, and smart technologies allows improving the company's business processes.
Dominic Mazzone [6]	Digitalization is a deliberate and long-lasting digital evolution of the company, its business processes, and models.
PwC	Digital transformation is the transformation of the entire business world through the creation of new technologies based on the Internet, which has a global impact on humanity.
Veronica Scuotto	Digital conversion is the transition to digital technologies to change the company's business processes to benefit from the use of the latest technologies.
Charles-Edouard Bouee and Stefan Schaible [7]	Digital transformation is a series of changes in all sectors of economy and adaptation of their participants to new realities of digital world.
Scott Brennen and Daniel Kreiss [8]	Digitalization is a process of digitization, conversion of analog data into digital form.
Thomas Ochs and Ute Riemann [9]	Digital transformation is the integration of digital technologies and tools in everyday life by converting to the digital format of everything that can be digitalized.
Carl Dahlman [10]	Digitalization is a combination of general-purpose technologies with economic and social activities using digital tools. Digitalization combines physical infrastructure (networks and Internet coverage), access devices (smartphones and computers), and information systems that provide a functional function (IoT, Big Data, cloud computing, etc.).

Source: compiled by the authors based on [3, p. 4; 4, p. 23—25].

In the context of the following definitions, we propose our definition within the research topic. So, *digital transformation (digitalization) — the process of transition to digital business, which is the use of digital technologies to change business processes in the company and provide new opportunities for additional income and development prospects.*

The process of digital transformation today is the driving force of changes in almost all areas and industries, as well as open opportunities for the introduction of new technologies and the construction of digital business models. Most researchers identify three main ways in which digitalization can change business processes and company models:

- optimization of existing business models;
- transformation of business models (business expansion, or reorientation);
- development of new business processes (new technologies, products, or services).

The above steps can be described as the digital transformation of goods and services and digital decision-making processes considering the development of Industry 4.0 in Ukraine [11, p. 14—15].

Industry 4.0 is a broad term that encompasses different perspectives, industries, corporate functions, technologies, and fields. Now Industry 4.0 serves as an important model to companies around the world for the vertical integration of smart machines, products, and production resources into flexible manufacturing systems At the same time, the focus and understanding of Industry 4.0 are constantly evolving due to the high level of activity and continual development of new

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approaches, concepts, and solutions on the part of businesses and research institutions, as well as the associated debate in the media, in government and throughout society as a whole.

Scientists in most developed countries note that Industry 4.0 has become a global trend and is primarily associated with digitalization. Other themes associated with the term included smart products, production optimization, automation, and new business models. According to the research «Industry 4.0 in a Global Context», we can say that Industry 4.0 consists development of IP-networks (networking and digitalization, 26%), smart products (20%), production optimization (20%), automation (18%), and creation of new business models (16%) [12, p. 19] (*Fig. 1*).

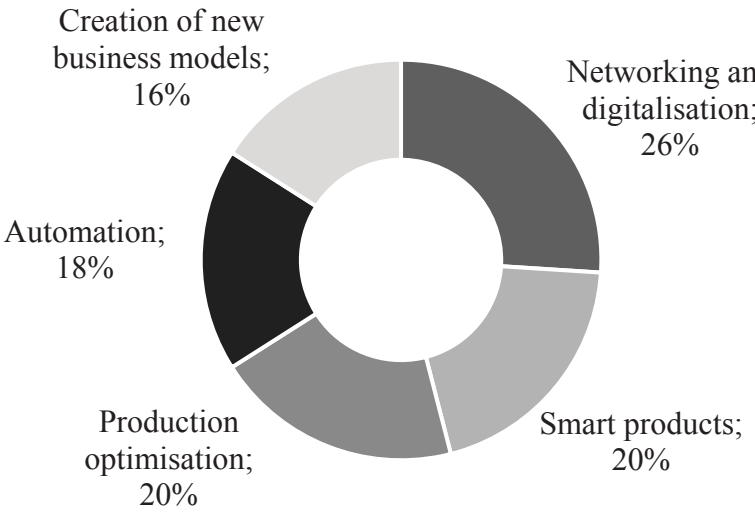

Fig. 1. **Understanding of Industry 4.0**

According to recent research by Ernst & Young, digitalization has the greatest impact on business process components, such as internal infrastructure management, value proposition, and customer interaction. For the most part, changes in the form of new offers, products, and services with elements of digital processes are quite effective factors in the process of digital business transformation [11]. The digital restructuring of companies is carried out precisely to implement these digital technologies, more advanced than analog, which lead to increased revenue and reduced costs. This in turn promotes the emergence of completely new players in the market, more flexible, with completely new models of business management, and, accordingly, more competitive than traditional companies.

To remain competitive and cost-effective, companies need to combine digital business processes and Industry 4.0 technologies. In 2020, a Fortune survey found that roughly half of the chief executive officers believe the crisis will accelerate the move towards stakeholder capitalism, and 77% say it will force their companies to speed up their digital transformations.

As companies seize the opportunity to integrate purpose with profit and invest in digital transformation to help deliver on their purpose, leaders can use digital transformation to create value along three inter-related paths [13, p. 7] shown in *Fig 2:*

- transform business: reorient digital transformation investments and initiatives to drive sustained, long-term value for the company and beyond;
- empower stakeholders: use technology to respond to the needs and priorities of a broader set of stakeholders, including employees, consumers, partners, governments, and society;
- change systems: create new collaboration and value-creation models across ecosystems to address global challenges through new markets and enable systemic change.

Companies can and must do better, as clearly shown by COVID-19's combination of dramatic demand shocks and the need to operate remotely. The shift to digital technologies must be structural, going beyond incremental efficiencies to transform operating and business models so that companies can continue to deliver for customers [13].

In 2021, the digital transformation remains the focus, and companies need to focus on the use of digital technologies and practices that go beyond pure business continuity, using an

interconnected digital network of people, equipment, and data to achieve new levels of productivity and flexibility [14].

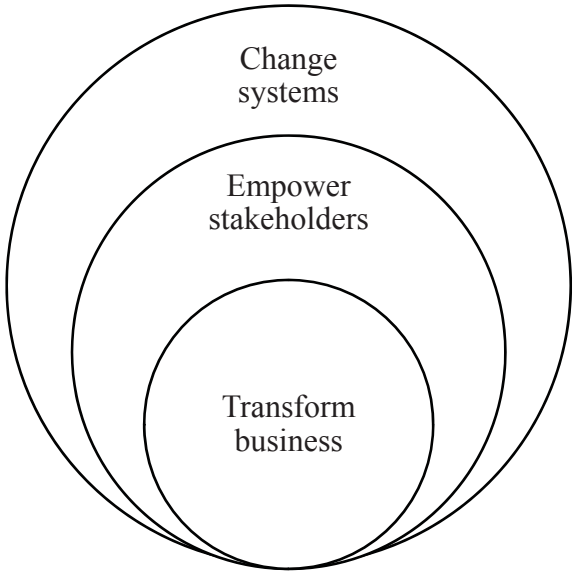

Fig. 2. **Three opportunities to drive purpose-led digital transformation**

As Industry 4.0 evolves, a new structure of doing business for companies and digitalization is especially important. In general, the concept of Industry 4.0 is quite new to the world, as it means the transition to more modern and progressive business models. Industry 4.0 is one of the biggest structural changes of the last hundred years, as it changes all aspects of the functioning of any industry and country. It includes digital technologies that help companies to develop in their sector and have a high chance of taking a leading position [15, p. 206].

Industry 4.0 is often confused with the Fourth Industrial Revolution. These are different things. Industry 4.0 is part of the fourth industrial revolution and concerns the digitalization of various industries: energy, transport, infrastructure and logistics, banks, retail and distribution, telecommunications, health, education, e-government, etc., where there are trends and directions of digitalization [11].

Industry 4.0 is a continuation of Industry 3.0, which is also based on information technology and processes, so they are sometimes confused and perceived as the next stage of the Third Industrial Revolution. However, while Industry 3.0 provides automation and computerization, Industry 4.0 offers important new elements — IoT platforms, big data, artificial intelligence, 3D printing, and more. It is also about the evolution of business models of companies, Industry 4.0 can increase productivity, speed, and quality of production of goods and services [15, p. 207].

Experts identify four basic technologies, which implementation provides revolutionary changes [11]:

1) Internet of Things (IoT). This technology is necessary for the exchange of information not only between people but also between different devices, machines, sensors, etc. Today, the role of the IoT is to fully automate and digitize the business processes of companies, where human participation is completely minimized.

2) Data-Driven Decision or Big Data. The amount of information that accumulates because of digitization can be efficiently processed only by a computer using cloud computing and artificial intelligence technologies.

3) The Cloud. Today, companies generate a fairly large amount of different information, the storage of which requires the appropriate architecture, reliability, availability, and the ability to quickly process it from annual access points. Cloud services that fully meet the above requirements are best suited for this.

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4) Digital ecosystems. Digital platforms that are open to both customers and partners. These can be different types of digital systems for business process management or a combination of digital and physical business models, etc.

According to the forecasts of the World Economic Forum, most technologies of the Industry 4.0 will become regular in 2027. Therefore, today the introduction of digital technologies and services of Industry 4.0 should be one of the highest priorities of companies and governments [11, p. 22—23].

Consider in more detail the main trends and forecasts of global Industry 4.0, and what authoritative sources write about it. In general, all forecasts can be summarized in a few important and general trends [16]:

1) First of all, it is influence of COVID-19, which accelerated the digitalization process in all areas. This is especially true of technologies for remote control, social distance, and other requirements that are obvious enough to immediately accept the challenges of quarantine restrictions. Accordingly, these include mobile and cloud technologies, IoT, cybersecurity, MES, EAM / APM.

2) Secondly, it is a stable operation of companies which is associated with their market environment and supply chains. The next block of technologies concerns the digitalization of the supply chain and everything related to the rapid and flexible response to changes in the environment. Therefore, the use of blockchain, IoT, Big Data, and 5G in the future will contribute to full and even deeper digitalization.

3) The third category of technology in its development is less related to the COVID-19 but is characterized by maturity. This is primarily the use of artificial intelligence, digital duplicates, AR/VR, and technologies for unmanned vehicles.

So, Industry 4.0 (the main purpose of which is to establish interaction between the real and virtual world, improve the quality of work, services, business activities, increase the competitiveness of economic entities and save resources) promotes the emergence of new technologies, artificial intelligence, robotics and smart products, etc.

Based on these forecasts, we see the importance and necessity of the transition to digital technology now. Therefore, companies need to invest in the development of their digitalization processes to be competitive and more developed in the future.

Conclusions. So, the digital transformation is a new stage in business process management in a company that can radically change traditional ways of doing business. Using digitalization processes, companies can optimize existing business models, gain new opportunities for business development, expand the scope of activities, and have tools to improve and enhance key performance indicators of business and increase their competitiveness.

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