

UDC 338.24-044.332 : 336 : 334.716 (477)

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**THE DEVELOPMENT OF INDUSTRY 4.0
AS THE BASIS FOR ADAPTIVE MANAGEMENT
OF THE FORMATION OF THE FINANCIAL AND ECONOMIC POTENTIAL
OF AN INDUSTRIAL ENTERPRISE IN UKRAINE**

**РОЗВИТОК ІНДУСТРІЇ 4.0
ЯК ОСНОВА АДАПТАЦІЙНОГО УПРАВЛІННЯ
ФОРМУВАННЯМ ФІНАНСОВО-ЕКОНОМІЧНОГО ПОТЕНЦІАЛУ
ПРОМИСЛОВОГО ПІДПРИЄМСТВА В УКРАЇНІ**

The processes of digital transformation today are driving forces of change in almost all spheres and industries, and also open up opportunities for the introduction of new technologies and the construction of digital business models. The aim of the article is to characterize the digital transformation of enterprise management and digital decision-making processes taking into account the development of Industry 4.0 in Ukraine. Digital transformation of business is a very necessary and relevant process, which serves as a driver for changes in the company, changing the needs of customers, the actions of competitors, and promotes the emergence of new technologies and services. The gap between Ukraine and most European states is significant, and, according to experts, it will take 3 to 5 years to overcome it, provided the economic situation is stable, as well as the inflow of investments. Instead, Ukraine has a fairly large potential and a developed IT sector, which is the driving force in the implementation of Industry 4.0 technologies. The synergistic digital transformation of domestic governance, business, and industry, that involves the transition to European business standards in the context of the development of the information economy, digitalization, industrialization, digital transformations, informatization of society, and globalization of the economy, should become a challenge for Ukraine. These processes require improvement of competitiveness, income and infrastructure of enterprises; acceleration of digitization of the most promising sectors; wider use of IT products and services by domestic companies; strengthening the country's defense sector. As a result of business adherence to the leading principles of digital transformation, there is a gradual change in business processes and the transition to digitiza-

tion using Industry 4.0 tools and models. Based on the project of the national development strategy 4.0, the article presents a SWOT analysis of the digital transformation of enterprise management and digital decision-making processes, taking into account the development of Industry 4.0 in Ukraine.

Key words: formation of financial and economic potential, industrial enterprises, adaptive management, digital transformation, Industry 4.0 technologies.

Процеси цифрової трансформації на сьогодні є рушійними силами зміни в майже усіх сферах та галузях, а також відкривають можливості для впровадження нових технологій і побудови цифрових бізнес-моделей. Метою статті є охарактеризувати цифрову трансформацію управління підприємств та цифрові процеси прийняття рішень з урахуванням розвитку Індустрії 4.0 в Україні. Цифрова трансформація бізнесу є досить необхідним та актуальним процесом, який слугує драйвером до змін в компанії, змінюючи потреби клієнтів, дії конкурентів та сприяє появі нових технологій та сервісів. Розрив України та більшості європейських держав є досить великим, і, на думку експертів, для його подолання потрібно від 3-х до 5 років при умові стабільної економічної ситуації, а також притоку інвестицій. Натомість Україна має досить великий потенціал та розвинутий ІТ-сектор, який і є рушійною силою у впровадженні технологій Індустрії 4.0.

Ключові слова: формування фінансово-економічного потенціалу, промислові підприємства, адаптаційне управління, цифрова трансформація, технологій Індустрії 4.0.

Formulation of the problem. The concept of "Industry 4.0" is quite new for the world, as it means the transition to more modern and progressive business models. As a complete program, it originates from the 2011 industrial exhibition in Hanover, at which the German government set the task of expanding the use of information technologies in the industry, and where large-scale digitization of business processes was discussed for the first time [1].

Industry 4.0 is one of the most massive structural changes of the last hundred years, as it restructures and changes every aspect of the functioning of any industry and country. The new paradigm includes advanced digital manufacturing technologies to create a fully digitized company that will be leading in its sector and will have a high chance of being at the forefront [14].

Industry 4.0 is the leading trend of the fourth industrial revolution and plays a major role in its implementation. Today, we live in the era of the completion of the third digital revolution, which began in the middle of the last century, the main features of which were the development of information and communication technologies and the automation and robotization of production business processes. Characteristic features of Industry 4.0 are the fully digitalized processes of the functioning of companies.

The processes of digitization and digital transformation today are the driving forces of change in almost all spheres and industries; they also open up opportunities for the introduction of new technologies and construction of digital business models.

Analysis of recent research and publications. Industry 4.0 standards are being implemented in Ukraine [7], while in 2016 the national movement "Industry 4.0 in Ukraine" was created, which now includes more than 100 companies. "Association

of Industrial Automation Enterprises of Ukraine" (AIAEU), which is the founder of the mentioned movement, carries out tremendous work in implementing the latest standards of digital transformation of business, and also coordinates the actions of market participants according to common development priorities. In 2017, Ukraine approved the national program Digital Agenda Ukraine, where the concept of Industry 4.0 is part of it, and in 2018 the project "National strategy of Industry 4.0" was developed.

Famous foreign scientists and economists paid attention to the issue of digital transformation of enterprises and their business processes, among which significant contributions were made by: D. Bowersox, D. Bonne, J. Westerman, K. Dalham, D. Eder, P. Krey, E. McAfee, D. Neal, G. Westerman, S. Houzet, S. Schaible, S. Schaible, et al. Among domestic scientists, we can mention: V. Apalkova, T. Bohdan, S. Voitka, S. Volosovych, A. Maslova, V. Pleskach, M. Tarasyuk, S. Tsyganova, and others.

As the authors note, today digital transformation is taking place both at the global level and at the level of individual companies. The study of this process is quite relevant, as we see that a number of domestic and international companies are trying to implement the latest technologies and move to new levels of business management taking into account digital processes. By transforming their own business processes, companies, first of all, strengthen their positions in the market and create technological barriers that may not be able to be overcome by their competitors. Now the digital economy is an integral part of the functioning of not only enterprises, but also entire states, as old and established norms are radically changing and completely new, effective and competitive models are emerging. According to a BCG (Boston Consulting Group) study, B2C

sectors are historically leading in the field of digital technology implementation: first of all, the media, which can be said to have radically changed their approaches and almost completely switched to digital models of functioning; retail; insurance, banking, and telecommunications, which are also quite advanced in terms of digitalization.

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 [3]. Digital restructuring of companies is carried out precisely for the purpose of introducing these digital technologies, which are more advanced than analog ones, which lead to increased income and reduced costs. This, in turn, contributes to the emergence of completely new players on the market, more flexible, with completely new business management models, and, accordingly, more competitive than traditional companies.

Highlighting previously unresolved parts of the overall problem. Media and telecom companies are quite breakthrough in this area due to the ease of restructuring their own business models and flexibility, since the processes that take place both externally and internally within the companies can be transformed quite quickly and, unlike classic enterprises, do not require large costs [9]. Digital transformation, for example, of metallurgy, oil and gas sector, mechanical engineering, energy, etc., is aimed only at internal transformation and, unfortunately, does not affect the external environment. Some companies do not even understand what digital business transformation really is, and believe that it is only the automation of internal processes or the addition of some digital services to them [2]. In fact, digitalization plays a rather important role in the activities of enterprises, as it completely rebuilds the usual business models. Digital transformation of business is a very necessary and relevant process, which serves as a driver for changes in the company, changing the needs of customers, the actions of competitors, and promotes the emergence of new technologies and services. Therefore, it is important to investigate the leading directions of the deployment of this process in Ukraine.

The aim of the article: to characterize the digital transformation of enterprise management and digital decision-making processes taking into account the development of Industry 4.0 in Ukraine.

Presentation of the main research material.

As O. Yurchak notes, the term Industry 4.0 is often confused with the 4th industrial revolution. Actually, these are slightly different things. Industry 4.0 is part of the 4th industrial and refers to the digitalization of production processes in industry, but also applies to energy, transport, infrastructure and logistics. On the other hand, the author does not rule out that there are other areas of the economy and social sphere in Industry 4.0 – banks, retail and distribution, telecom, health care, education, e-government, etc., which have their own trends and directions regarding digitalization [7].

According to the definition of C.-E. Bouee and S. Schaible [10], digital transformation is the successive changes of all sectors of the economy and the adaptation of their participants to the new realities of the digital world.

C. Dahlman [11] emphasizes that digitalization is a combination of technologies of general application with economic and social activities using digital tools. Digitization combines physical infrastructure (networks and internet coverage), access devices (smartphones and computers) and information systems that provide functionality (IoT, Big Data, cloud computing, etc.).

With this in mind, most researchers distinguish three main ways of impact of digitalization on changes in business processes and company models:

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

The process of digital business transformation consists of individual interrelated elements, therefore it is very important to pay attention to critically important areas of business. According to a study conducted by the Center for Digital Business Transformation [12], the movement towards digital transformation takes place in three key areas: working with customers, operational processes and business models of the company.

Digital technologies and structured information allow companies to obtain a global synergistic effect, while maintaining the ability to respond to local changes, that is, the so-called "globalization" process occurs, in which both globalization and localization occur simultaneously.

The latest digital systems allow management to better understand the properties of their products, the regional specificity of demand. This provides the ability to make decisions based on actual data in real time, rather than qualitative assumptions. There is also a noticeable increase in the level

of management detail, which allows managers to compare current processes and redistribute production capacity in an optimal way.

Companies in traditional industries, such as metallurgy and air transportation, do not change their business model completely, they are limited to the introduction of new technologies into individual business processes. Thus, one of the companies that participated in the study used digital technologies only in some aspects of its activities. In two years of introducing new technologies, it brought the company 20% of new customers, and made it possible to increase the consumption of its goods by 13% [12].

Industry 3.0 involves automation and computerization, and Industry 4.0 provides new important elements – IoT platforms, Big data, artificial intelligence, 3D printing, etc. It is also about the evolution of the business models of companies, because Industry 4.0 is able to increase productivity, speed and quality in the production of goods and the provision of services [8].

Specialists single out only a few basic technologies, the implementation of which is expected to lead to revolutionary changes and the transition to Industry 4.0 [13]:

1) Internet of Things (Internet of Things, IoT). This technology is necessary for the exchange of information not only between people, but also between various devices, machines, sensors, devices, etc. On an industrial scale, the role of IoT is reduced to full automation and digitalization of business processes, where human involvement is completely minimized and reduced to decision-making and response only to emergency situations.

2) Analytics of big data (Data Driven Decision) or Big data (Big Data). Those volumes of information that accumulate as a result of the "digitization" of the physical world can be processed effectively only by a computer using cloud computing and artificial intelligence technologies.

3) Sophisticated digital platforms that are open for use by both customers and partners. These can be various types of digital systems for managing business processes or a combination of digital and physical business models, etc.

4) Horizontal and vertical systems of data integration (Horizontal and Vertical System Integration). Industry 4.0 is designed to solve this issue and create such conditions that would make it possible to combine the processes of one enterprise into a single system, as well as several enterprises into one system [5].

5) Clouds (The Cloud). Today, a large number of companies generate a significant volume of diverse information, requiring appropriate architecture, reliability, availability, and the ability

for rapid processing from various access points. Cloud services are best suited for this, as they fully meet the aforementioned requirements and provide almost instantaneous access and data processing almost effortlessly [5].

According to forecasts of the World Economic Forum, most of the technologies of Industry 4.0 will become commonplace by 2027, which indicates that today the implementation of digital technologies and services of Industry 4.0 should be one of the highest priorities of the activities of companies and governments of countries.

As German experts note, in order to build an effective Industry 4.0 model, companies should comply with the following requirements [6]:

1. Interoperability is the ability of devices, machines, sensors, sensors and people to interact with each other through the Internet of Things.

2. Transparency, which arises as a result of the interaction given in the previous paragraph. In the virtual environment, digital copies of real systems, objects, etc. are created, which very accurately repeat all those processes that exist in the physical world.

3. Technical support is one of the key principles of Industry 4.0. Digital systems enable people to make decisions through the collection, analysis and reproduction of information that has been accumulated in the previous two stages. This allows machines to replace humans in performing routine processes or processes requiring quick reactions.

4. The final principle is the detailing of management decisions. The idea of this principle is that digital transformation and automation should be so developed and full of information that machines can work without human intervention.

As a result of business adhering to these principles, there is a gradual change in business processes and a transition to digitalization using Industry 4.0 tools and models.

Based on the project of the national development strategy 4.0, we will present a SWOT analysis of the digital transformation of enterprise management and digital decision-making processes taking into account the development of Industry 4.0 in Ukraine (Table 1) [4].

As we can see from this analysis of Table 1, Ukraine has ample opportunities to move to Industry 4.0 fairly quickly and with minimal costs. Based on the issues of this research, the government of Ukraine should pay more attention to this category, and enterprises should transform: review their own business models, attract investments, properly manage their own budget, cooperate with universities and research institutions. Relying on the experience of European countries and having the potential for

Table 1

SWOT analysis of the digital transformation of enterprise management and digital decision-making processes taking into account the development of Industry 4.0 in Ukraine

Strengths	Weaknesses
Globalization, fast-growing IT industry Consolidation of innovators in the movement "Industry 4.0" (100+ companies offering solutions in 4.0) Partial consolidation "government + expert community in Digital Agenda Ukraine + coordination council at MERT" Beginning of a real decentralization reform A high potential of the university base – NASU, involvement of individual representatives to 4.0	Low operational efficiency of the Government (99% from 100 positions in the ranking, according to WEF) Current industrial and innovation strategies, as the basis of Industry 4.0, are absent. The regulatory influence on industrialists is traditionally weak Almost zero government support for developers and innovators of Industry 4.0 (incentives, measures, involvement of IT, export strategy, budgets, etc.) Weak level of involvement in Industry 4.0 in Ukraine has such key stakeholders as IT sector, NASU, mechanical engineering and industrial engineering Short-term focus on the key customers, lack of strategies regarding digital transformation
Opportunities	Threats
The EU market is moving to 4.0 (420 billion euros by 2025, 10 million new jobs) and needs new solutions, products and talents Opportunities for growth on others markets of developed countries EU programs (H2020 and similar) are already available for Ukraine: a source of funding for science and development Production cooperation (integration into DC chains) in world markets, outsourcing and export Opportunities of new technologies that quickly enter different segments (for example, the popularity of robotics among young people) Favorable position of Ukraine on the labor market (educated youth and engineering personnel)	Degradation of innovative ecosystems in industry continues The imbalance in the economy is growing – the transformation into a raw material country continues (the share of the processing industry is falling) The lag behind developed countries in most strategic aspects of 4.0 is growing The mistrust of business and expert circles in government programs is growing (due to the weak pace of reforms) Risks of political, military and social instability remain high and affect the overall investment climate

development, the government of Ukraine and the production sector should make maximum efforts for joint interaction, since the processes that are currently taking place in developed countries are the impetus for radical changes, both in the domestic economy and in the economies of the world.

Unfortunately, the gap between Ukraine and most European states is quite large, and according to experts, it will take from 3 to 5 years to overcome it, provided the economic situation is stable and there is an influx of investments. Instead, Ukraine has a fairly large potential and a developed IT sector, which is the driving force in the implementation of Industry 4.0 technologies and growth:

- improvement of competitiveness, income and infrastructure of enterprises;
- acceleration of digitization of the most promising sectors;
- wider use of IT products and services by domestic companies;
- strengthening the country's defense sector.

Conclusions. The synergistic digital transformation of domestic governance, business and industry, which involves the transition to European business standards in the context of the development of the information economy, digitalization, industrialization, digital transformations, informatization of society, and globalization of the economy, should become a challenge for Ukraine. But this requires a clear position of the Government regarding the development of the National Strategy of Industry 4.0 in Ukraine, adequate financing of educational and scientific activities in higher education institutions of Ukraine, support of initiatives from public organizations, interest of ministries and representatives of industrial enterprises in business development in the context of digitization of production processes and modernization industrial capacities of companies, digital transformations in management and management accounting (controlling), including under the conditions of support of leading agents of change, both in domestic and international markets.

References:

1. Voitko, S. (2019). Project and startup management in Industry 4.0. Kyiv: KPI named after Igor Sikorskyi, Polytechnic Publishing House.
2. Kupriyanovsky, V., Sinyagov, S., & Dobrynin, A. (2016). BIM – Digital economy. How did you succeed? A practical approach to the theoretical concept. Part 1. Approaches and main benefits of BIM. *International Journal of Open Information Technologies*, 3.
3. Lisova, R. (2019). Impact of digitalization on business models: stages and tools of digital transformation. *Scientific Bulletin of the Uzhhorod National University. Series: International economic relations and world economy*. 24 (2), 114–118.
4. Project "National strategy of Industry 4.0" URL: <https://www.industry4ukraine.net/publications/national-strategy-for-industry-4-0>
5. Skitsko, V. (2016). Industry 4.0 as industrial production of the future. *Investments: practice and experience*, 5, 33–40.
6. The fourth industrial revolution. What should we expect? URL: <https://delo.ua/business/chetverta-promislova-revoljucija-chogo-namochikuvati-334676>
7. Yurchak, O. (2019). 5 years of Industry 4.0 – where is Ukraine? *Investgazeta*. URL: <https://investgazeta.ua/blogs/5-rokivindustriji-4-0-de-ukrajina>
8. What industrial policy does Ukraine need for the transition to Industry 4.0? URL: <https://www.civicsynergy.org.ua/articles-in-the-media/yaka-promyslova-polityka-potribna-ukrayini-dlyaperehodu-do-industriyi-4-0>
9. BCG «Featured insights and perspectives from BCG» URL: <https://www.bcg.com/ru-ru/featured-insights/thought-leadership-ideas>
10. Boueé, C., & Schaible, S. (2015) Die Digitale Transformation der Industrie. Studie: Roland Berger und BDI. URL: https://www.researchgate.net/publication/315857925_Die_digitale_Transformation_von_Geschäftsmodellen_gestalten
11. Dahlman, C., Mealy, S., & Wermelinger, M. (2016). Harnessing the Digital Economy for Developing Countries. Paris: OECD.
12. Digital Vortex. How Digital Disruption Is Redefining Industries. URL: <https://www.cisco.com/c/dam/en/us/solutions/collateral/industry-solutions/digitalvortex-report.pdf>
13. Industry 4.0 landscape in Ukraine 2017. URL: <https://industry4-0-ukraine.com.ua/2017/09/19/industry-4-0-landscapeukraine-2017-version-1-0>
14. Schiel, von G. Ukraine and Industry 4.0: will we find our growth engine? URL: <https://biz.liga.net/ekonomika/all/opinion/ukraina-i-industriya-40-naydem-li-my-svoydvijok-rosta>

Список використаних джерел:

1. Войтко С. В. Управління проектами та стартапами в Індустрії 4.0. Київ : КПІ ім. Ігоря Сікорського, Вид-во «Політехніка», 2019. 200 с.
2. Купріяновський В. П., Сіягів С. А., Добринін А. П. ВІМ – Цифрова економіка. Як досягли успіху? Практичний підхід до теоретичної концепції. Частина 1. Підходи та основні переваги ВІМ. *International Journal of Open Information Technologies*. 2016. № 3.
3. Лісова Р. М. Вплив діджиталізації на бізнес-моделі: етапи та інструменти цифрової трансформації. *Науковий вісник Ужгородського національного університету. Серія : Міжнародні економічні відносини та світове господарство*. 2019. Вип. 24 (2). С. 114–118.
4. Проект «Національна стратегія Індустрії 4.0» URL: <https://www.industry4ukraine.net/publications/national-strategy-for-industry-4-0>.
5. Скіцько В. І. Індустрія 4.0 як промислове виробництво майбутнього. *Інвестиції: практика та досвід*. 2016. №5. С. 33–40.
6. Четверта промислова революція. Чого нам очікувати? URL: <https://delo.ua/business/chetverta-promislova-revoljucija-chogo-namochikuvati-334676>
7. Юрчак О. 5 років Індустрії 4.0 – де Україна? *Investgazeta*. 2019. URL: <https://investgazeta.ua/blogs/5-rokivindustriji-4-0-de-ukrajina>
8. Яка промислова політика потрібна Україні для переходу до Індустрії 4.0? URL: <https://www.civicsynergy.org.ua/articles-in-the-media/yaka-promyslova-polityka-potribna-ukrayini-dlyaperehodu-do-industriyi-4-0>
9. BCG «Featured insights and perspectives from BCG» URL: <https://www.bcg.com/ru-ru/featured-insights/thought-leadership-ideas>
10. Boueé C., Schaible S. Die Digitale Transformation der Industrie. Studie: Roland Berger und BDI. URL: https://www.researchgate.net/publication/315857925_Die_digitale_Transformation_von_Geschäftsmodellen_gestalten
11. Dahlman C., Mealy S., Wermelinger M. Harnessing the Digital Economy for Developing Countries. Paris: OECD, 2016.

12. Digital Vortex. How Digital Disruption Is Redefining Industries. URL: <https://www.cisco.com/c/dam/en/us/solutions/collateral/industry-solutions/digitalvortex-report.pdf>
13. Industry 4.0 landscape in Ukraine 2017. URL: <https://industry4-0-ukraine.com.ua/2017/09/19/industry-4-0-landscapeukraine-2017-version-1-0>
14. Schiel von G. Ukraine and Industry 4.0: will we find our growth engine? URL: <https://biz.liga.net/ekonomika/all/opinion/ukraina-i-industriya-40-naydem-li-my-svoydvijok-rosta>