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DIRECTIONS OF DIGITALIZATION DEVELOPMENT IN THE INDUSTRIAL SECTOR OF UKRAINE

Tovstyk R.V., Ivanov S.M.
Zaporizhzhia National University
Ukraine, 69600, Zaporizhzhia, 66 Zhukovsky St.
ruslantovstik@gmail.com, flydaiver@gmail.com
ORCID: 0000-0001-5523-2675, 0000-0003-1086-0701

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industrial sector, digitalization, strategy, data space, transformational potential, Industry 4.0, innovation policy

A study of digitization processes in the world economy and, in particular, in the industrial sector was conducted. Digitization is considered to be the newest level of business management organization. Scientific works that consider the transformative potential of the economy digitalization are analyzed. The threats to the process of the industrial sector digitization, which appeared with the beginning of the COVID-19 pandemic and full-scale military aggression on the territory of Ukraine, have been clarified. An outline of the main directions of France's industrial policy has been prepared, and French initiatives designed to form the basis of industrial data spaces in the manufacturing sector have been considered. The steps taken to create a space for the industrial information exchange in Italy are considered in detail. The impact of German cooperation on the most famous initiatives for the development of digitalization in the Netherlands, and other leading European countries was examined. It was concluded that the directions of modernization are mainly focused on the activities of forming data production spaces. The provisions of the Concept for the Development of Digital Competencies in Ukraine and the plan of measures for its implementation has been worked out. The main components of the existing digitization policy of the industrial sector of Ukraine were analized, and on the basis of the conducted research, it is identified of additional five tasks for the development of digitalization of the industrial sector of Ukraine. Completing these tasks will allow industrial sector enterprises to be as mobile as possible, to adapt to new realities with great speed, without losing jobs, and even carrying out their modernization. It is concluded that in the near future, it will be very difficult to ensure the economic efficiency of production without introducing the latest digital technologies, access to which can be obtained by participating in international data exchange initiatives.

НАПРЯМКИ РОЗВИТКУ ЦИФРОВІЗАЦІЇ ПРОМИСЛОВОГО СЕКТОРУ УКРАЇНИ

Товстик Р.В., Іванов С.М.
Запорізький національний університет
Україна, 69600, м. Запоріжжя, вул. Жуковського, 66

Ключові слова:
промисловий сектор, цифровізація, стратегія, простір даних, трансформаційний потенціал, Industry 4.0, інноваційна політика

Проведено дослідження процесів цифровізації у світовій економіці та зокрема у промисловому секторі. Розглянуто цифровізацію, як новітній рівень організації управління бізнесом. Проаналізовано наукові праці, які розглядають трансформаційний потенціал цифровізації економіки. З'ясовані загрози процесу цифровізації промислового сектору, що виявились із початком пандемії вірусу COVID19 та повномасштабної військової агресії на території України. Побудовано схему основних напрямків промислової політики Франції, розглянуто Французькі ініціативи, що покликані для формування підґрунтя промислових просторів даних у виробничому секторі. Предметно розглянуто проведені кроки для створення простору обміну промисловою інформацією у Італії. Досліджений вплив Німецького співробітництва

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на найбільш відомі ініціативи з розвитку цифровізації у Нідерландах, та інших провідних європейських країнах. Зроблено висновок, що напрямки модернізації зосереджені, в основному, на діяльності з формування виробничих просторів даних. Опрацьовано положення Концепції розвитку цифрових компетентностей в Україні та план заходів з її реалізації. Проаналізовані основні складові існуючої політики цифровізації промислового сектору України, та на основі проведеного дослідження визначенні додаткові п'ять завдань для розвитку цифровізації промислового сектору України. Виконання цих завдань дозволить підприємствам промислового сектору бути максимально мобільними, з великою швидкістю адаптуватися до нових реалій, не втрачаючи робочі місця, а й навіть проводячи їх модернізацію. Зроблено висновок, що у найближчому майбутньому, стане дуже важко забезпечувати економічну ефективність виробництва, не впроваджуючи новітні цифрові технології, доступ до яких можливо отримати, беручи участь у міжнародних ініціативах з обміну даними.

Statement of the problem

Over the last decades, the leading role of industry in the world economy has hardly changed, it is still of decisive importance in the development of one or another country. It is the industry that makes it possible to provide jobs to a large number of highly qualified workers over a short period of time, to increase the intellectual potential and profitability of one or another industrial sector. In the modern world, the statement that it is impossible to develop as a modern advanced country without a powerful industrial base is already perceived as a fact, and one cannot but agree with this, because sufficient industry development opens up huge opportunities.

The end of the second decade of the 21st century triggered the processes of radical changes in the world economy, the COVID-19 pandemic, and the subsequent military aggression on the territory of Ukraine, made most of the processes of industrial development impossible. This creates the necessity to update strategic guidelines, accept existing problems, and determine ways to overcome them.

Analysis of recent studies and publications

The digitalization process is a new level of business management organization, which affects the economic development of the country in general and the world in the future. A wide range of implementation problems and pecularities of the digital technologies development in various spheres of the economy are the subject of discussion by many scientists and practitioners. Thus, a large layer of exploratory works with regard to the implementation and development of digitalization is represented by the works of many scientists. In particular, the expediency of introducing Industry 4.0 in the aspect of macroprudential policy was considered by L. B. Prokopovich, O. G. Balanenko, O. M. Maksymishyn, O. G. Balanenko, and O. A. Kolodka, who carried out an objective assessment of the effectiveness of the implementation of the digital economy, its impact on reducing the production cost and improving the quality of the final products, automation of the economy priority sectors, decreasing the level of human-caused errors and corruption liquidation; besides, they provide analysis of macro economic indices before and after introduction of Industry 4.0 [1].

The fourth industrial revolution, as noted by many scholars, is based on the principle of openness of all relevant information and its continuous availability at any time, which can be achieved by combining all links of the value chain; Industry 4.0 is formed on the basis of cyber-physical production systems, a combination of real and digital space [2].

The transformational potential of Ukrainian economy digitalization was considered by V. P. Vishnevskyi, O. M. Harkushenko, S. I. Knyazev, D. V. Lypnytskyi, V. D. Chekina, who analyzed methodological approaches of digital economy monitoring and evaluating, developed the dependence functions of digital costs and real results, and quantified the transformational potential of the Ukrainian economy digitalization [3].

Many studies were also conducted by foreign scientists, in particular, German scientists Heisbauer R., Schrauf S., Koch V., and Kuge S. who investigated the possibilities and challenges of industrial digitalization when integrating them into supply chains [4].

Having studied significant scientific works, at the same time it should be noted that the current dynamics observed in Ukraine and globally, same as in the latest digital technologies' modernization, give a particular importance to the issue of systematization of directions for the implementation and development of the fourth industrial revolution in the industrial sector of Ukraine in the context of today's problems.

Objectives of the article

The purpose of the article is to identify additional tasks for the development of digitalization in the industrial sector of Ukraine based on the analysis of ways to accelerate the processes of Ukrainian industrial sector digitalization in the conditions of modern challenges and trends.

The main material of the research

In recent years, the world economy has experienced tremendous upheavals. Almost all economy sectors experienced the latest challenges that require quick and coordinated actions, and it is impossible to meet these challenges without global transformations. Current examples of these processes include the COVID-19

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pandemic and large-scale military operations in various parts of the planet.

Full-scale aggression against Ukraine in 2022 caused a global shortage and instability of prices for natural resources, which in its turn was a consequence of the obsolescence of technological processes and the dependence of most countries on the largest suppliers of such natural resources. This event once again forced numerous governments to increase the pace of reorientation of the main processes to more ecological ways. The COVID-19 pandemic, on the other hand, has exacerbated the vulnerability and unreliability of the world's global procurement strategies. For example, severe shortages of chips due to logistical disruptions during the pandemic hit the machine building sector the hardest, causing a significant loss of revenue, not even taking into account the additional operating costs associated with shutting down production facilities. At the same time, previously existing problems such as production processes increasing complexity and missing qualified personnel still persist.

The solution to many of these challenges seems to suggest itself: to accelerate the next phase of the industrial sector development and promote the technologies of the fourth industrial revolution (INDUSTRY 4.0) into widespread everyday use. The goal is to go beyond pure production automation, which was characteristic of the third industrial revolution, and reduce, or even eliminate, the disconnection of production systems, which will allow the discovery of new business models based on a new, more complete production data. This process must necessarily go through the transition from bilateral to multilateral cooperation and joint data exchange along the entire chain of the production process to meet the potential needs of the economy in the future.

Considering the processes of digitalization of the European countries industrial sector, we can conclude that, taking into account the opinion of many scientists, the modernization directions are mainly focused on the activities of forming production data spaces, which nowadays is carried out by a large number of international alliances, projects, networks, and also, according to national initiatives. Examples of such projects operating in the European community: SmartFactoryEU, Productive 4.0, Boost 4.0, ConnectedFactories, Qu4lity.

It is also impossible not to mention well-known European initiatives, such as:

– Gaia-X is a project that is the result of many separate platforms that meet a common standard – the Gaia-X standard. Data infrastructure development is based on the values of openness, transparency and trust. So, the result is not a cloud, but a network system that unites many cloud service providers [5].

– The Big Data Value Association (BDVA, from 2021 DAIRO – Data, AI and Robotics aisbl) is an international, industry-driven, non-profit organization with over 230 members across Europe and a well-balanced composition of large, small and medium-sized enterprises, as well as research organizations and user organizations. BDVA's mission is to develop an innovative ecosystem that will ensure a digital transformation in Europe based on data and artificial intelligence, which will bring maximum economic and social benefit, and will also enhance and maintain European leadership in the creation of big data bases and artificial intelligence [6].

Considering the above-mentioned projects and with the purpose to help them, the governments of leading European countries are developing and implementing action strategies and projects for the development of digitalization processes in the industrial sector. Thus, the French Ministry of Industry has adopted and implemented a large number of initiatives to accelerate the digital transformation of the industry in order to approve the basis for industrial data spaces in the manufacturing sector, in particular, they created the sector "Industry of future solutions" in 2021, which is designed to ensure the main directions of French industrial development policy (Fig. 1) [7; 8].

Italy's digital transformation investment plan "Piano Transizione 4.0" was adopted in 2020. The main goal of this plan is to accelerate the digitalization of the industrial sector. Since then, the Italian government has provided a subsidy that has helped undertaking a number of steps to create an industrial information exchange space, including:

– creation of the Italian Gaia-X network, with the name Gaia-X Hub Italia, as well as participation in other European projects on the formation of data spaces;

– establishment of organizations that should provide support for Italian entrepreneurs in the implementation of digital technologies [9].

The industrial sector digitalization in the Netherlands has gained considerable acceleration, thanks to cooperation with Germany and joint innovations in the field of digital data spaces. The most famous initiatives of the Netherlands are:

– data space "Smart Connected Supplier Network" (SCSN) – an initiative designed as a high-scale solution that provides a network approach (four-corner model) consisting of two aspects: one common semantic language for exchange and seamless technical agreements between

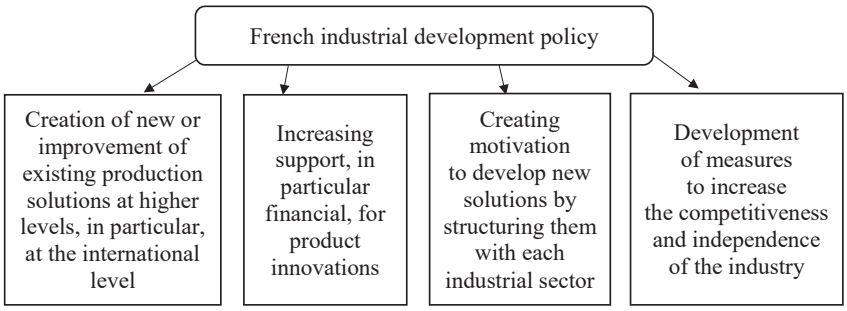

Fig. 1 – The main directions of French industrial development policy

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service providers, to guarantee the principle "One connection – communication with everybody" [10];

– the Dutch-German field laboratory AI4DT, which offers the advantage of the "Digital Doubles" technology – a concept that models products as well as machines and their components with digital tools, including all geometric, kinematic and logical data [11];

– data sharing coalition. The Data Sharing Coalition is an open, international, evolving initiative in which many organizations collaborate to unlock the value of data sharing (cross-industry) [12].

The European Economic Community and the European Commission have been discussing measures to support the integration of data spaces in European industry for a long time, paying attention to the following aspects:

– unification and coordination of current European projects and initiatives;

– expansion of countries participating in data space related works;

– creation of pan-European foundations for cooperation between interested countries, without suppressing their autonomy.

The development of digital transformation in Ukraine is currently represented by the Concept for the development of digital competences and the action plan for its implementation. The main tasks of this Concept are defined as:

– formation and development of digital skills and digital competences in society;

– provision of legal regulations on matters of state policy formation in the field of citizens' digital skills and digital competences development;

– development of complex changes to the legislation;

– definition of the system and description of the components of digital competence, as well as requirements to the digital skills and digital competences' level among different categories of employees;

– ensuring coordination of actions at the level of executive authorities with regard to the development of digital skills and digital competences;

– establishing indicators for monitoring the state of digital skills and digital competences development;

– raising the level of citizens' awareness of the Internet-related threats [13].

Completing the tasks for which the Concept is designed requires a formed list of measures and digital competencies' results. The plan of the Concept implementation measures provides for the Concept development for the main professional groups in the spheres of economic activity and its approval by the end of 2022. Today, most industries are not covered by such plans. Military aggression on the territory of Ukraine has made adjustments to the terms of the Concept implementation, and requires changes to the Concept itself [14].

For Ukraine, digitalization is not limited to the exclusive use of technologies. Taking into account the course for European integration and obtaining the status of a candidate for membership in the European Union, first of all it is necessary to carry out a large-scale transformation of the culture integrated into the enterprise management model. Minimization of costs, decentralization of production, improvement of efficiency and productivity, fast and more efficient decision-making in real time, improvement of the environment protection level, production of sustainable products, reduction of time and costs for product development, improvement of product quality and quick response to changing market conditions, production diversification of a growing number of products at numerous production sites are not the only advantages of digitization [15].

Studying the directions of digitalization development in the industrial sector, as well as, focusing on the challenges faced by the Ukrainian industry during the current events, in order to form a strategy for the development of industrial sector digitalization in Ukraine, it is expedient to add the below tasks to the existing ones, namely:

– increasing the decentralization of enterprises to reduce the consequences of disruption of supply chains;

– development of the national system – data space in industry and its integration with existing European networks;

– ensuring coordination of actions to quickly find suppliers, in case of their loss;

– development of a separate government program to support digital transformation investments in industry;

– cooperation with the world's leading countries to accelerate digital transformation in industry.

Conclusions

The current course of global digital transformation allows us to say that it will be very difficult to ensure the economic efficiency of production in the near future without introducing the latest digital technologies, which can be accessed by participating in international data exchange initiatives.

As a result of the research of France's industry development policy and Italy's digital transformation plan, additional tasks aimed at the development of the digitalization of Ukraine's industrial sector were identified in the work. As a result of the fulfillment of these tasks, enterprises of the industrial sector of Ukraine will quickly adapt to new realities, not losing jobs, but even carrying out their modernization. They will be provided with the necessary arrays of data, will make better management decisions based on them, as well as qualitatively direct the course of development of production capacities and the industrial sector as a whole.

Logistics, which will reduce the role of intermediaries and focus on B2C (business to customer) principles, will also receive its powerful development impetus. The use of natural resources will become more rational, and the economy itself will acquire features of greater transparency, predictability, with a clear system of development.

Thus, the five additional tasks for the development of digitization of the industrial sector of Ukraine identified in the work allow to achieve higher quality results in the information development of enterprises and country.

However, the issue of developing a set of models and methods for digitalization of enterprise management, its production processes, taking into account the support of directions at the level of the state and the world society as a whole, remains relevant.

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