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PROSPECTS FOR ATTRACTING INVESTMENT IN THE DEVELOPMENT OF INDUSTRY 4.0 IN UKRAINE

ПЕРСПЕКТИВИ ЗАЛУЧЕННЯ ІНВЕСТИЦІЙ В РОЗВИТОК ІНДУСТРІЇ 4.0 В УКРАЇНІ

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The study is aimed at identifying opportunities and obstacles to attracting investment in the development of Industry 4.0 technologies in national production during the period of economic recovery after the Russian-Ukrainian war. The study examined the degree of innovation and digital development of Ukraine before the war, its readiness to implement the principles of Industry 4.0 in domestic production, and conducted a SWOT analysis. A key factor in the successful transformation of the national economy in the context of post-war recovery is attracting investment in the development of Industry 4.0 technologies. The authors emphasize the need to create a high level of investment attractiveness of Ukraine's innovative sectors by creating government incentives for the private sector, promoting research and innovation, and developing human resources. In particular, it is necessary to overcome traditional obstacles to attracting investment in innovative areas, such as weak innovation infrastructure.

Keywords: digitalization, Industry 4.0, innovation, investment, investment attractiveness.

Дослідження спрямоване на виявлення можливостей та перешкод для залучення інвестицій у розвиток технологій Індустрії 4.0 на національному виробництві в період відновлення економіки після російсько-української війни. Досліджено ступінь інноваційного та цифрового довоєнного розвитку України, її готовність щодо впровадження засад Індустрії 4.0 на вітчизняному виробництві та проведено SWOT-аналіз. За даними звіту «Readiness for the Future of Production Report 2018» Україна належить до країн, що зароджуються, тобто до країн, які мають слабкі поточні позиції щодо структури виробництва. Найбільш слабкими компонентами України виявились «Технології та інновації» та «Інституційна структура», а найсильнішими – «Комплексність» та «Людський капітал». За рівнем цифрової конкурентоспроможності Україна посіла 54 місце з 64 країн в 2021 році. Найсильнішою складовою цього рейтингу була освіта, найслабкішою – інтеграція ІТ в економіку та наявна технологічна база підприємств. Дослідження показало, що незважаючи на слабкий інноваційний розвиток України значна кількість підприємств інвестувала у розвиток цифрових технологій, більшість з них з метою ефективного аналізу даних та автоматизації ланцюжка поставок. Ключовим чинником успішної трансформації національної економіки в умовах післявоєнного відновлення є залучення інвестицій у розвиток технологій Індустрії 4.0. Автори наголошують на необхідності забезпечення високого рівня інвестиційної привабливості інноваційних сфер України шляхом створення державних стимулів для приватного сектору, сприяння науково-інноваційній діяльності та розвитку кадрового потенціалу. Зокрема, необхідним є подолання традиційних перешкод для залучення інвестицій в інноваційні сфери, таких як слабка інноваційна інфраструктура. Загальна консолідація уряду та бізнесу у вирішенні цих проблем може стати фундаментом для ефективної цифрової трансформації економіки України, зокрема шляхом забезпечення високого рівня інвестиційної привабливості зазначених сфер і відновлення підприємств з впровадження інноваційних технологій.

Ключові слова: цифровізація, Індустрія 4.0, інновації, інвестиції, інвестиційна привабливість.



Problem statement. The state of digitalization of the country's economy, in particular its readiness to implement Industry 4.0 technologies, is one of the important indicators of the country's competitiveness in the international arena and determines its place in the international production chain, specialization and cooperation. The rapid adoption of digital technologies enables businesses to optimize production processes, increase productivity and product quality, making them more competitive in the global market, and contribute to the creation of new jobs and the development of human resources and their utilization. Investments in digital technologies, in turn, drive demand for highly skilled IT and engineering personnel, which helps reduce unemployment and stimulates the development of education. This stimulates the research and development of innovative solutions in areas such as artificial intelligence, the Internet of Things, and blockchain, which not only creates new opportunities for business development but also contributes to the development of the country's innovation and entrepreneurship ecosystem.

All these advantages of digitalization of the economy and implementation of Industry 4.0 technologies create conditions for sustainable economic development and can be a powerful "engine" of Ukraine's economic recovery after the war. Given the significant financial support provided to Ukraine by international partners, it is necessary to effectively allocate the resources raised to implement the "build-back better" program, which will help the country to recover its lost assets relatively quickly and strengthen its position in the international arena.

Analysis of the latest research and publications. The issue of implementing Industry 4.0 technologies in Ukraine has been studied by such domestic scholars as N. Bryukhovetska, O. Chernykh [1], Y. Kravchuk, N. Skorobohatova [2], L. Nozhak, M. Parashchych [3], L. Chekh, O. Korohodova [4], L. Smolyar, O. Ilyash, O. Trofymenko [5], I. Yanenkova [6] and others.

Identification of previously unresolved parts of the overall problem. Given Ukraine's significant losses from the war, the issue of modernizing the economy during its recovery is an urgent and poorly researched one. It is advisable to identify the traditional obstacles to the development of Ukraine's innovative spheres and to invent an effective scheme for overcoming them after the war.

The purpose of the article is to analyze the state of implementation of Industry 4.0 technologies in Ukraine and to identify opportunities for attracting investment in innovative areas by conducting a SWOT analysis.

Summary of the main research material. Ukrainian legislation does not yet provide for a definition of Industry 4.0, but the «Association of Industrial Automation Enterprises of Ukraine» developed a recommendation «Strategy for Industry 4.0» in 2018. This document defines Industry 4.0 as the next stage of digital transformation of manufacturing enterprises, accompanied by accelerated implementation of technologies such as the industrial Internet of Things, big data analytics, artificial intelligence, a new generation of robots, augmented reality, etc., which together will lead to better synergy of IT and OT, changes in business models and significant acceleration of innovation development [7].

Based on the data from the report «Readiness for the Future of Production Report 2018» by the World Economic Forum, we will compare Ukraine's readiness for the transition to Industry 4.0 with the readiness of the leading countries to implement Industry 4.0. The review of this report will allow us to analyze the state of implementation of Industry 4.0 technologies before the quarantine restrictions and the war to identify traditional problems that have been and may still be inherent in Ukraine and that still need to be addressed. Here is a comparison with Ukraine's closest partners: Germany and the United Kingdom (Figure 1).

Thus, the weakest components of Ukraine were «Technology and Innovation» and «Institutional Structure», which indicates the insufficient development of Ukraine's information and communication technology infrastructure and insufficient promotion of technology development by government agencies. It should be noted that Ukraine also has a number of dominant components relative to the others, namely «Comprehensiveness» and «Human Capital». Thus, a relatively high Comprehensiveness score indicates Ukraine's ability to produce a unique domestic product through the proper use of accumulated knowledge in the economy. The advanced human capital indicator highlights the ability of the country's labor force to adapt to changes in the productive labor market and cultivate the necessary skills and knowledge to work in new conditions. It should be noted that both indicators are interrelated, as they indicate the availability

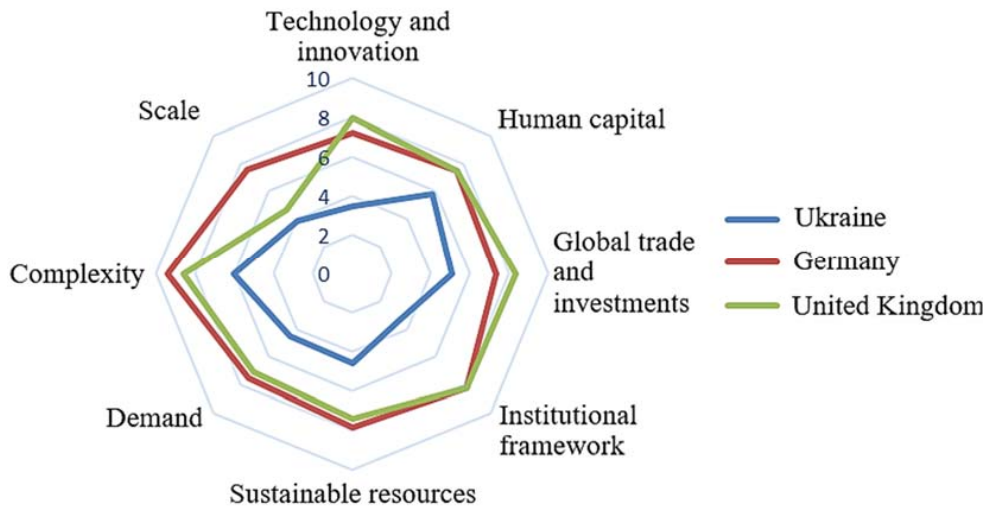


Figure 1. Readiness of Ukraine, Germany and the UK for Industry 4.0

Source: built by the authors based on [8]

of knowledge among domestic entrepreneurs related to Industry 4.0 technologies.

An integral condition for the implementation of Industry 4.0 technologies is the digitalization of economic activities in the country. To assess the current level of digitalization of Ukraine, let's consider its position in the World Digital Competitiveness Ranking in comparison with the leading partners in the implementation of Industry 4.0 (Figure 2).

This ranking, created by the IMD World Competitiveness Center, assesses the ability and readiness of 63 economies to adopt and explore digital technologies as a key driver of economic transformation in business, government, and society as a whole. Thus, there is a direct link between the potential for implementing

the principles of Industry 4.0 and the level of digitalization in the country. According to the trend studied, Ukraine has been ranked higher since 2019, despite the pandemic and restrictive measures in 2020. However, such ratings among 63 countries are still low.

It is advisable to review the components of the above rating of Ukraine for 2021 for a more detailed analysis. The most positive sub-factor in the 2021 digitalization ranking of Ukraine was education, which ranked 18th in quality among the educations of other countries [9]. Thus, due to the quality of education, Ukraine has a great potential to produce educated professionals who will promote the principles of the digital economy, and with it the principles of Industry 4.0. Unfortunately, this is the single

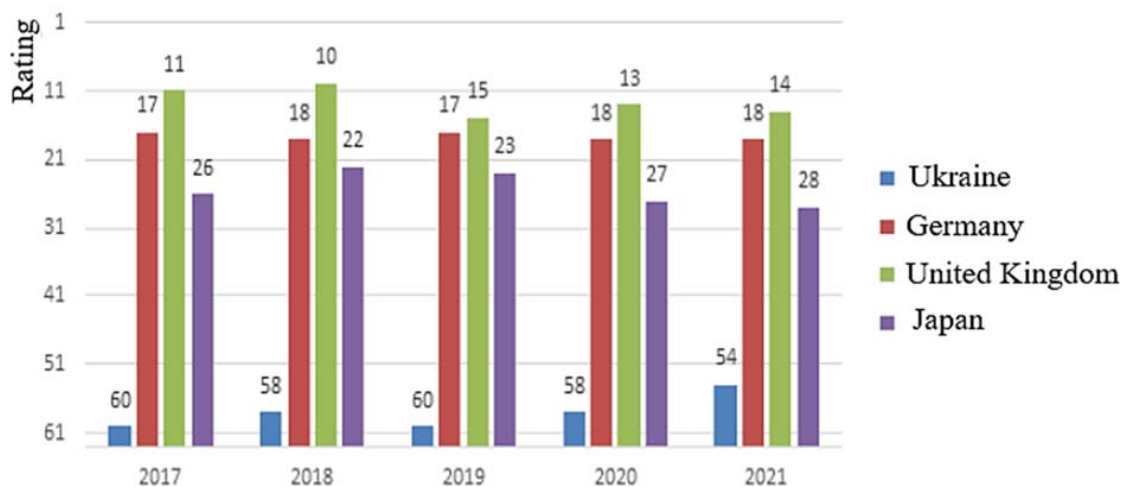


Figure 2. Country rankings according to the World Digital Competitiveness Ranking for 2017-2021

Source: compiled by the authors based on [9]

biggest advantage that the country has. The ranking is particularly sharply reflected in such sub-factors as scientific concentration, capital, technological base, adaptability, and IT integration. It is worth noting that over the past 5 years, these sub-factors have tended to increase, except for the scientific concentration and integration of the IT sector, which, on the contrary, decreased compared to 2017. Given the development of the IT sector in Ukraine and its gradual growth, the decline in the rankings may indicate a non-competitive speed of development of the sector, but not necessarily its actual decline.

The level of digitalization in Ukraine can also be studied by the European Business Association's Digital Transformation Index, which reflects the sentiments of CEOs regarding the introduction of digital technologies in their companies and further investment in this area. This indicator reflects the experience of people who directly do business in the country and have their own vision of real development prospects. The integral index score for 2021 is 2.81 points out of 5 possible. The survey participants are 130 general, operational, and technical directors of member companies [10]. The indicators of the index components are shown in Figure 3.

The index consists of 5 components: the volume and quality of public e-services, the overall level of digital inclusion in Ukraine, the overall level of digital infrastructure development in Ukraine, the overall level of digital transformation of industries, and the overall level of digital transformation of companies. The highest score among the index components

was given to the overall level of digital transformation of companies: 47% of directors rated the level of digital development of their business as moderate, 44% believe the level is high or very high. Only 9% of respondents believe that the level of digital transformation of their companies is low or very low. According to business representatives, the digital transformation of the industries in which they are involved is taking place at a slower pace. For example, the top three barriers to the development of digital transformation in business are overregulation and ineffective legislation, insufficient funding, and low digital literacy. Despite the latter barrier, half of the surveyed CEOs rate their team's digital literacy as high. Other challenges include outdated IT infrastructure and cybersecurity and privacy issues.

Building digital infrastructure and improving access to the use of modern technologies are priority tasks for the state in this context. Despite Ukraine's low digital transformation rates, most directors plan to continue investing in the development of digital technologies, including the development of Industry 4.0 technologies. Here is the priority of digital areas for investment according to the survey results (Figure 4).

Thus, the most attractive technologies for investors are those related to customer interaction, which will help to create the company's image and optimize customer relations, simplifying the interaction process for both parties. In the background are the technologies used in production, which are more related to Industry 4.0 technologies. Thus, data analytics, supply chain automation, cloud technologies, and

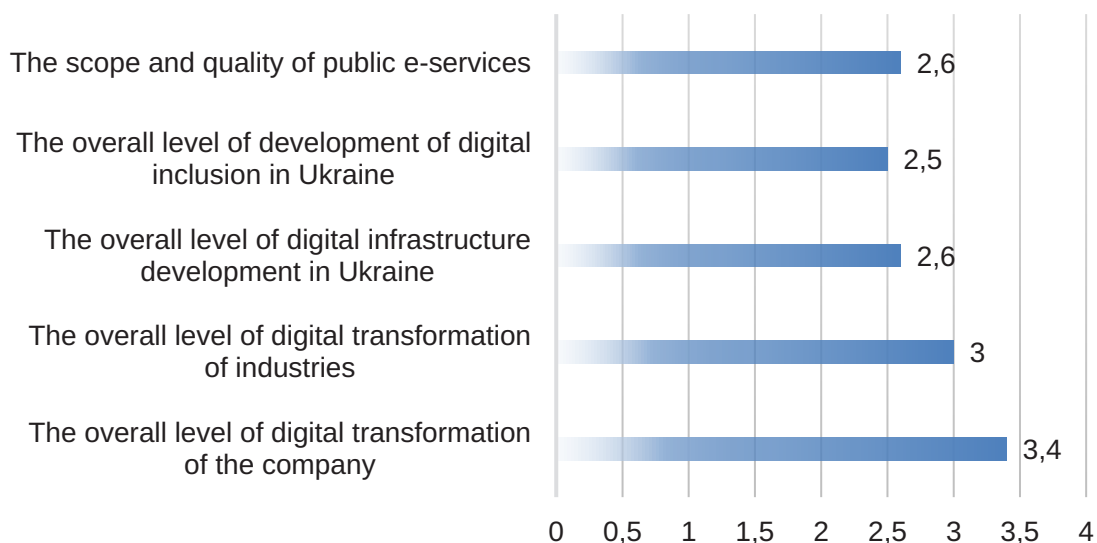


Figure 3. Components of the EBA Digital Transformation Index of Ukraine for 2021

Source: compiled by the authors based on [10]

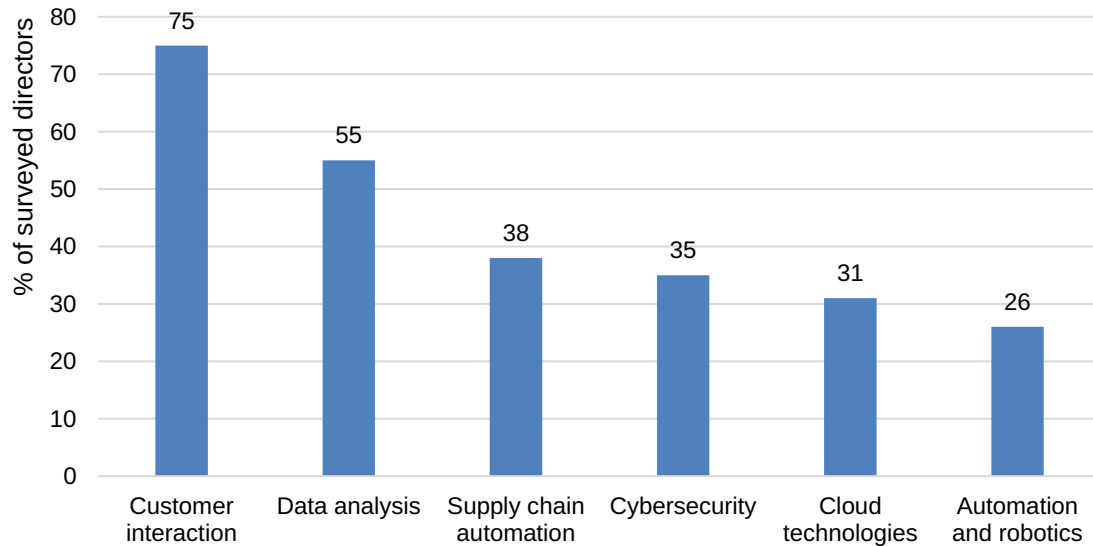


Figure 4. Prioritization of Industry 4.0 areas for investment by CEOs

Source: compiled by the authors based on [10]

robotics are all part of the process of increasing the level of competitiveness of industrial enterprises by optimizing the production chain, as described in the first section. Thus, Industry 4.0 technologies are in real demand by Ukrainian entrepreneurs.

To summarize the study by several indices, we will conduct a SWOT analysis of the implementation of Industry 4.0 technologies in Ukraine, considering all the opportunities and threats that were added during the war and will remain after it (Figure 5).

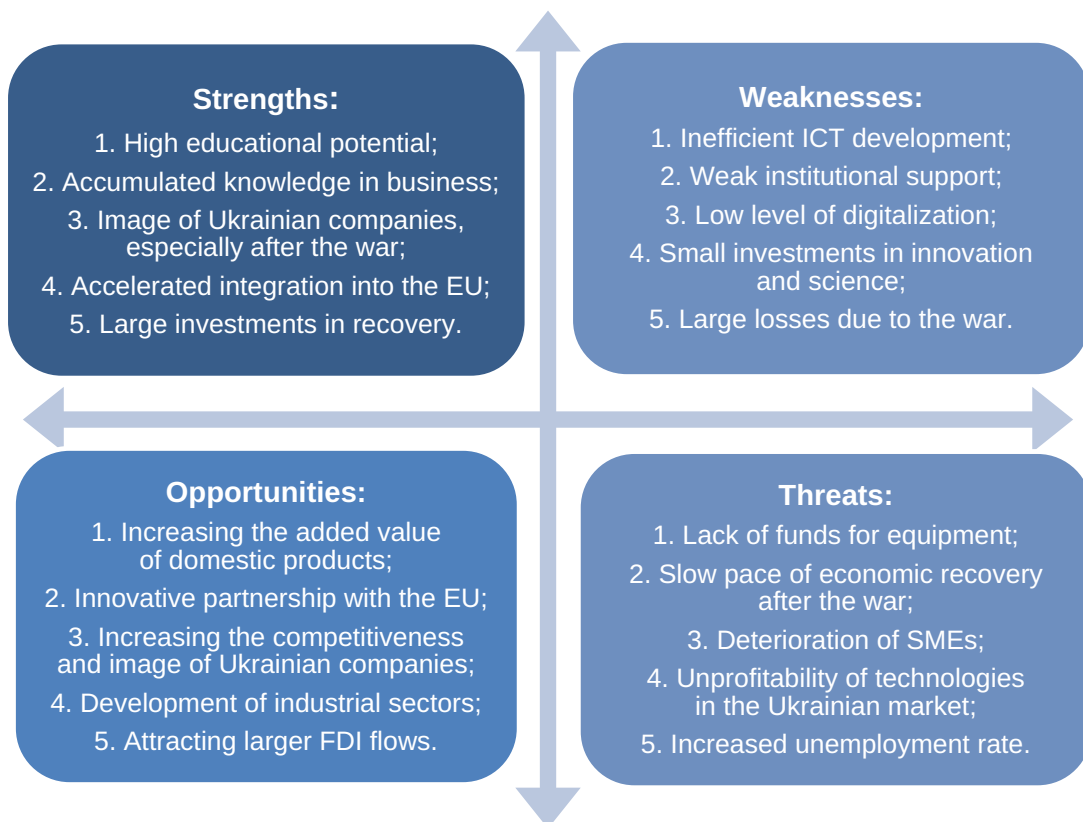


Figure 5. SWOT-analysis of the implementation of Industry 4.0 technologies in Ukraine, including the components that were added during the war and will remain after it

Source: created by the authors based on [7–10]

Strengths include high educational potential, accumulated business knowledge, and accelerated integration into the EU. In terms of opportunities, it is worth emphasizing the innovative partnership with the EU and the development of industrial sectors.

Conclusions. Thus, according to the assessments, Ukraine has a number of strengths and weaknesses in attracting investment in the development of Industry 4.0 technologies. The strengths include educational potential and the ability to use the accumulated knowledge, which was common across all indices, as well as the support of partners during and after the war in economic recovery, which will allow attracting a large amount of investment in innovative areas that were underdeveloped before the war. At the same time, the underdevelopment of ICT and digital infrastructure, insufficient state funding for research, ineffective innovation development policy, and extremely large economic losses due to the war are Ukraine's weaknesses, which slow down the implementation of Industry 4.0 technologies in the domestic manufacturing sector and need to be addressed further.

The opportunities offered by the introduction of Industry 4.0 reflect the very purpose of such technologies. Increasing the share of added value in products, increasing the competitiveness of domestic producers, growing the country's image in the international market, expanding trade and research partnerships – all this is a positive result of the introduction of the latest technologies, which gradually brings the formation of the knowledge economy closer.

The scientific novelty of the article is to improve the methodological approach to assessing the possibilities of attracting investment in the development of Industry 4.0 technologies, which, unlike the existing ones, includes an assessment of country ratings according to the World Digital Competitiveness Ranking, an analysis of the digital transformation index and a SWOT analysis of the implementation of Industry 4.0 technologies.

Further research is needed on the principles of functioning of mechanisms for attracting investment in countries characterized by difficult socio-economic conditions.

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