DIGITALIZATION AS THE BASIS FOR INCREASING THE COMPETITIVENESS OF INDUSTRIAL ENTERPRISES IN THE CONDITIONS OF INDUSTRY 4.0

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Abstract: *This article considers conceptual and practical aspects of the digital economy and industrial digitalization in new conditions. It explores the main trends of digitalization in the context of Industry 4.0, based on which recommendations for implementing digital technologies in the industry of Tajikistan are elaborated. In the course of the study, it was determined that the introduction of digital technologies can reduce transaction costs, accelerate production and management processes, and boost labor productivity, thereby improving the competitiveness of industrial enterprises. This article also identifies the main problems hindering the process of digitalization of the economy of Tajikistan in general, and industry in particular. Based on the results of the study, ways to resolve existing problems are proposed. In particular, the study substantiates the need to solve the problems of developing IT infrastructure and the industrial Internet, improving institutional support and the state regulation system, reducing dependence on foreign technologies and software products, solving problems of human resources for digitalization, and developing automated process control systems. The study also substantiates: the prospects for the development of a new industrial policy; the creation of a state system for supporting and stimulating private information systems; the creation of an ecosystem for the development of digital technologies, in particular through the extension of cooperation between market participants; and the intensification and encouragement the use of Internet technologies to manage production processes, supplies and sales, marketing and communications. It is also important to address issues related to: creating conditions for the development of technologies for collecting, analyzing and using big data; creating a system for generating modern software that allows collecting, analyzing, and building algorithms and using large amounts of data; developing the practice of automation and robotization of industrial production; and optimizing the use of cutting-edge technologies and the development of predictive analytics.*
The study indicates that it is necessary to resolve issues related to technological competencies, the business environment, investment policy, the quality of the business environment and the level of its development, as well as issues of a structural and component nature. To increase the competitiveness of industrial enterprises in the context of Industry 4.0, it is also necessary to: create an effective business foresight system; identify customer needs, including personalized products and services; create the necessary ecosystem with conditions for effective interaction between participants; and use artificial intelligence to predict the scale of the business and a combination of its various types.

Keywords: *industry, digitalization, innovation, competitiveness, competitive advantages, efficiency, sustainable development.*

Introduction

In the context of Industry 4.0, competitiveness functions as a fundamental factor in the development of national industry in Tajikistan. The practice of industrially advanced countries shows that due to such qualities as speed, flexibility and the use of new technologies, digitalization allows competitive advantages to be created and industry to be elevated to a whole new level of development. However, in order to enjoy the benefits of digital technologies and deepen industrial reform for the purpose of switching to digital platforms, it is necessary to create an ecosystem and develop necessary institutional documents. In this context, using the advantages of digital technologies to gain a competitive advantage in industry requires studying the influential factors and conditions necessary for the formation of a digital ecosystem in the production industry.

Under the conditions of the modern economy, one of the main directions for improving the competitiveness of industry in Tajikistan is the introduction of digital technologies and the use of the advantages of digitalization. Digitalization makes it possible to create conditions for improving sustainable competitiveness and to bring technological processes, as well as the entire system of organization and management of industrial production, to a completely new level. The implementation of innovative digital technologies for the manufacturing of high-technology products is crucial for creating competitive advantages and the technological development of national industry. Due to the development of information and communication technologies based on the Internet, mobile communications, the use of modern digital platforms, network technologies, new software, as well as various forms of digital devices and equipment have become available.

Currently, industrially advanced countries implement various digital technologies, such as robotic devices, smart technologies, automated and robotic technological platforms, non-waste and unmanned technologies, as well as production technologies equipped with various detectors and digital sensors. The industrial digitalization process is developing at a rapid pace, and at this stage the digitalization of industry not only improves the competitiveness of the industry, but also creates the basis for improving the competitiveness of regions and the country as a whole, while creating the foundation for the development of the digital economy in Tajikistan. Against this background, the creation of a necessary digital platform in industry is the primary objective of modern society.

The purpose of this study is to determine the properties of digital technologies used in industrial production, as well as the ecosystem and technological platforms, the use of which ensures competitive growth of industry.

Data and methods. The study was based on systematic and integrated scientific approaches using the methods and techniques of statistics and comparative economic analysis.

The concept of economic digitalization and its advantages in industry. Despite the fact that the issues of implementing digital technologies in the economy and industry were raised in the middle of the 20th century, *Being Digital* by Nicholas Negroponte is considered to be the principal work in this area. In this book, which was published in 1995, the author first formulated the concept of an electronic economy, where he substantiated the possibility of the transition from handling atoms to handling bits. The digital economy is capable of bringing about significant economic shifts and influencing whole areas of business, the labor market and people's lifestyles (Brynjolfsson & Kahin, 2000; Bahl, 2016). Digitalization also plays a key role in reducing inequality (Beerepoot & Lambregts, 2015), boosting innovation through the emergence of digital start-ups, and has a positive impact on reducing corruption and improving the efficiency of market institutions (Quinones et al., 2015; Lehdonvirta, 2016).

A review of various concepts shows that the digital economy allows developing countries to achieve significant success in increasing the productivity of capital and labor, reducing transaction costs, as well as the internationalization of business (Dahlman et al., 2016). This study shows that the concepts of digital economy were formed under the influence of concepts such as information economy, electronic economy and information society. In this context, Don Tapscott (1996) pointed out that the digital economy includes information and communication activities that comprise the basic tasks of collecting and processing information, including those based on Internet technologies. It should be noted that these activities have been mentioned in the US Department of Commerce report "The Emerging Digital Economy" (Margherio et al., 1999), and in their 2000 collection *Understanding the Digital Economy* (Brynjolfsson & Kahin, 2000).

Thus, it should be noted that the digital economy includes digital products and services and the IT industry segment, with the help of which economic transactions are carried out. These technologies reduce costs, increase the productivity of labor and equipment, and increase the

competitiveness of goods and services. However, it should be noted that digitalization creates a number of threats that are mainly related to the security of systems and platforms used, as well as the risks that accompany the implementation and use of digital technologies, including in industry.

The advantages of digitalization in industry are associated with the active introduction of new generation technologies, in particular artificial intelligence, cloud computing, big data analytics and machine learning, robotics, augmented reality, Internet technologies, 3D printing, and others which have become available for business and industrial enterprises in recent years. The introduction of digital technologies in industry allows artificial intelligence to be used to monitor the supply system, production processes, sales, and the efficient use of production facilities, and to bring interactions with suppliers and consumers to a new level.

Practice shows that the digitalization of industry can develop in the directions of the digitalization of business models and the digitalization of production processes, which involve the use of digital platforms to organize and manage production operations at industrial enterprises. In this regard, the main trend in the development of modern industry is digital transformation, which serves as the basis for improving the productivity of capital and labor.

Our research has shown that the introduction of digital technologies in industrial production makes it possible to improve the efficiency and quality of decisions and optimize business processes using technology platforms. In this case, we are referring to big data analytics, which allows us to quickly collect information and transfer it to digital platforms for further processing through the entire organizational and production chain. With the help of digital technologies, industrial enterprises will be able to increase production, reduce costs and improve the efficiency of production capacity.

Digitalization in the global industry: Current state and trends

To date, countries such as China, Japan, South Korea, the UK, Germany, France, the USA and Canada are the world leaders in industrial digitalization. According to the Boston Consulting Group, the current level of digital maturity of various industries varies. For example, in the mining and metallurgical sector, it lags behind by 30%–40%. However, the leading companies in this area achieve significant results with digital help – for example, an increase in production by 10%–20% or an increase in drilling efficiency by 20%–30% (BCG, 2021).

According to Markets and Markets (2021) forecasts, the size of the Industry 4.0 market will be $64.9 billion in 2021, and by 2026 it will grow to $165.5 billion at an average annual growth rate of 20.6%. Key factors driving its development include the rapid introduction of artificial intelligence and the Internet of Things, which leads to an increase in demand for industrial robots in the pharmaceutical and medical device manufacturing sector, an increase in public investment in 3D printing and additive manufacturing, and the introduction of blockchain technology in the processing industry (Figure 1).

According to IDC forecasts, by 2022, 65% of global GDP will be digitized. From 2020 to 2023, direct investments in digital transformation will amount to $6.8 trillion (Business Wire, 2020). Global trends in industrial digitalization clearly demonstrate that digitization in industry is characterized by such basic elements as cooperation, intelligence and innovation. In this context, the cooperation of countries for the purpose of industrial digitalization seems to be important, since its fragmentation around the world will not deliver the desired results. Moreover, the digitalization process itself implies the sharing of technology platforms, IT infrastructure, software products, and artificial intelligence. These forms of interaction create open innovation, which serves as the basis for the formation of a digital ecosystem and corporate forms of innovation.

Industrially advanced countries such as Germany, Singapore, China, the UK and South Korea have interesting experiences in this sphere. For example, Germany continues to forge ahead with Industry 4.0, and the UK aims to become a digital power. South Korea has already begun

construction of smart factories in the processing industry. Today, some digital start-ups have moved beyond the boundaries of industry and are moving into larger ecosystems, such as the creation of smart cities. One survey showed that there are currently more than 1,000 smart cities already in existence or under construction around the world. China alone is implementing around 500 smart city development projects. According to existing data, in 2020, global expenditures on the implementation of smart city plans amounted to $124 billion, which was 18.9% more than in 2019. China spent $25.9 billion, which is 12.7% more compared to the same period in the previous year.

Figure 1. Attractive opportunities in Industry 4.0
Source: Markets and Markets (2021)

As of today, there is a global trend in the transition of enterprises to a new generation of digital technologies. Modern industrial enterprises are active users of cloud computing, big data, mobility and social networking technology. The use of digital technologies contributes to the development of major innovations, artificial intelligence, the Internet of Things and blockchain. In this context, the IDC has identified nine aspects where enterprises need to build the right capabilities for Digital Transformation 2.0. These aspects are relevant to the future of digital infrastructure, trust, intelligence, customers and consumers, work, operations, interconnectedness, digital innovation and branches of industry (Figure 2).
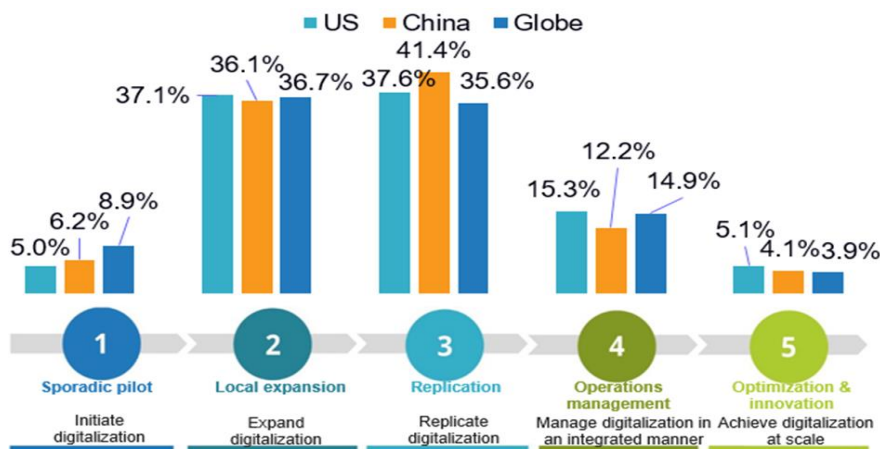

Figure 2. Aspects of digital transformation in enterprises, 2020
Source: IDC (2021)

The European Union uses the Digital Economy and Society Index (DESI) to measure the level of development of the digital economy. This index summarizes the indicators of digitalization and digital competitiveness of the EU Member States. The index includes indicators such as communications, human capital, use of Internet services, integration of digital technologies, as well as digital public services. Figure 3 shows the results of this index in 2020.
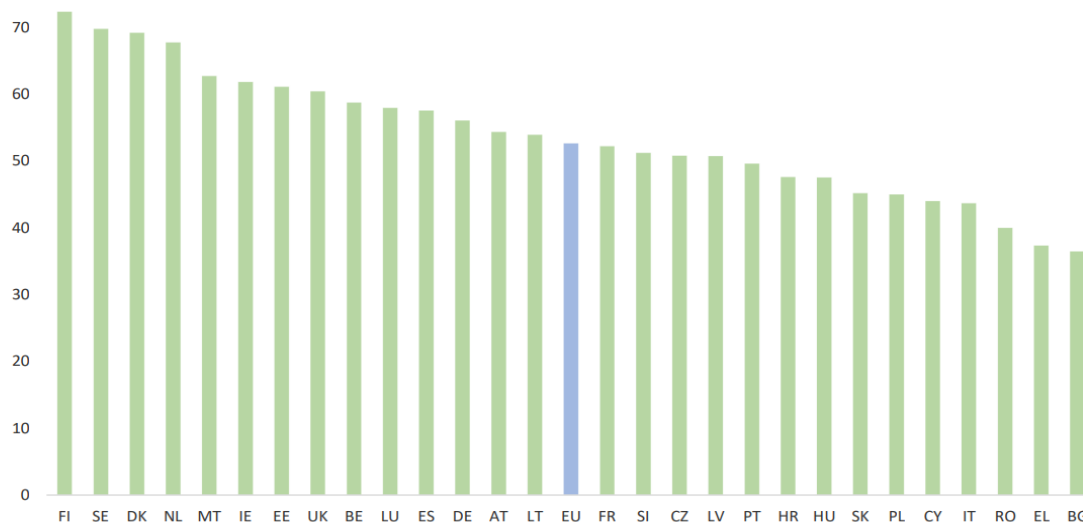

Figure 3. DESI 2020
Source: *European Court of Auditors based on the DESI Index.*

Impact of digitalization on industry competitiveness.
Studies have shown that digitalization in industry makes it possible to reduce the organizational and management cycle, thereby creating an effective planning system based on the analysis of big data, which will lead to the improvement of the competitiveness of an industrial enterprise. Digitalization in industry implies a completely new concept, i.e., a holistic change in the organization and management of industrial production. Digitalization allows real-time information support for decision-making, thereby accelerating the cycle of development of current and strategic initiatives.

In the context of Tajikistan, an important area for the implementation of digital technologies is the processing industry, which can become the main driver of national industry and the primary area in promoting exports. As the experience of industrially advanced countries shows, digitalization lies at the heart of the system of factors ensuring the competitiveness of the processing industry. New trends in the development of the processing industry require a new approach to the organization and management of production, in particular based on the expansion of interactions between manufacturers and consumers through various communication and marketing technologies, which are based on the use of state-of-the-art digital platforms.

The role of digitalization in maintaining and improving the local and global competitiveness of industry is also important. New trends in ensuring the competitiveness of industry, which are dependent on the use of digital technologies, imply a global modernization of the industrial sector. In this regard, in the author's opinion, digitalization in the processing industry of Tajikistan can become the basis for improving its competitiveness, since it makes it possible to:
- create an effective business foresight system, since digital technologies that allow processing big data offer real-time control of business processes and the elaboration of various scenarios of development;
- accurately identify customer needs, including personalized products and services, since modern technological platforms make this possible;

- create the necessary ecosystem with conditions promoting effective interaction between participants, in particular for the manufacture of new and even extremely complex products;
- use artificial intelligence, or a combination of different types of artificial intelligence, to forecast the scale of business.

Industrial digitalization in Tajikistan: Problems and solutions

Tajikistan has adopted the Concept of the Digital Economy in the Republic of Tajikistan (hereinafter – the Concept), which, in particular, provides for the digitalization of key areas of economic activity, as well as key industrial sectors such as energy and mining. In this context, a fair question arises as to why exactly the extractive industry, and not the processing one, was chosen as the target of this legislation. Global practice shows that the processing industry is the leader in the implementation of digital platforms. Hence, it follows that the main institutional document, which in essence should determine the promising directions for the introduction of digital technologies in industry, de facto excludes their use in the processing industry.

In conditions when the global economy is achieving rapid progress and time is the most valuable form of capital, the implementation of this Concept is extended until 2040, i.e., divided into three stages: the first stage until 2025, the second stage until 2030, and the third stage until 2040. This once again indicates that the development and determination of the time frame for the implementation of this Concept is not scientifically substantiated and does not fit into the general trends of development of the global economy. It is also worth noting that only two paragraphs are devoted to industrial digitalization as a key area of the national economy. They mainly refer to the digitalization of the extraction industry with the prospect of using autonomous machinery and the introduction of a decision-making system mainly based on the analysis of big data.

According to this Concept, it is also planned to introduce sensor technologies, detectors and advanced analytical tools that allow visualizing data, conducting scenario modeling and making management decisions based on them. In addition, it is planned to launch pilot projects on the creation of model digital factories in the processing and extraction industries, where Industry 4.0 technologies will be implemented.

The analysis of the text of the Concept shows that it does not cover the full range of promising areas of industrial digitalization and active use of digital platforms to improve the competitiveness of industrial enterprises. Based on this, in the author's opinion, the following problems exist today on the path towards ensuring industrial digitalization, creating the necessary ecosystem and increasing in the role of digital technologies in ensuring the competitiveness of the industry of Tajikistan:

- the underdevelopment of IT infrastructure and the industrial Internet, as well as the lack of systems for analyzing big data;
- the imperfection of institutional support and the system of state regulation and support for the introduction and implementation of digital technologies in industry and other sectors of the economy, especially in terms of linking technologies and innovations to industrial production;
- the dependence on foreign technologies in Tajikistan, since the country does not produce technological equipment and software (dependence is mainly on Chinese technologies and software for industry, and all major codes and developments are foreign);
- the fact that small and medium-sized businesses do not have enough financial resources and state support in the acquisition and use of new technological platforms, as well as strategic corporate innovations, which, among other things, create a digital ecosystem;
- the existing personnel training system for digitalization of the economy and development of the digital ecosystem does not meet the requirements, and reforms in this field are fragmentary and fall short of expectations in solving the problems of staffing for the transition to a digital economy;

- the problems that exist regarding financial support and the high cost of digital start-ups, which are associated with a lack of financial resources and budget funding;
- at the level of industrial enterprises, the low digital maturity of current processes, the low level of automation, the lack of competencies and the low level of IT literacy among employees;
- the low level of development of automated process control systems, as well as information security risks, a decrease in the number of jobs and a temporary deterioration in production manageability.

Along with the above problems, one can add issues related to technological competencies, the business environment, investment policy, the quality of the business environment and the level of its development, as well as issues of a structural and component nature. This requires a balanced approach to identifying and solving problems that hinder the development of digitalization processes in the industry and the entire economy of Tajikistan based on the application of the project approach in particular.

To solve the problems that hinder the introduction of digital technologies in industry, it is necessary to develop sectoral digitalization programs and create conditions for the formation of a completely new digital economy ecosystem. In this context, attention should be paid to the following points:
- the development of an industrial policy, which will determine the directions and prospects for the introduction of digital platforms in industrial production;
- the creation of a state system for supporting and encouraging private information systems, including on the basis of determining the conditions, standards and trends for industrial digitalization;
- the creation of an ecosystem for the development of digital technologies, in particular through the expansion of cooperation between market participants, strengthening the relationship between science and production, developers and manufacturing enterprises, as well as the formation of a new system for commercialization of research and development and intellectual deliverables;
- the promotion and encouragement the use of Internet technologies for the management of production processes, supply and distribution activities, marketing and communication, as well as management decision-making;
- the creation of conditions for the development of technologies for collecting, analyzing and using big data, which can solve numerous problems, in particular in the sphere of organization and management of industrial production;
- the preparation of recommendations for the creation of systems generating modern software, which allows collecting, analyzing, building algorithms and using very large volumes of data;
- the cultivation of the practice of automation and robotization of industrial production, i.e., combining measures and mechanisms for industrial digitalization, which, through interaction, allow creating an effective system of autonomous functioning;
- the optimization of using cutting-edge technologies, which allows determining the priorities and directions for high-priority digitalization in the industrial production system;
- the development of predictive analytics, which is aimed at monitoring the efficiency and smooth functioning of technological platforms;
- the training of personnel in the sphere of the digital economy possessing relevant competencies in the field of software development, artificial intelligence and technology platforms, as well as the implementation of special industrial software already existing on the global market.

Conclusion

Therefore, the implementation of digital technologies in industry contributes to the improvement of the competitiveness of industrial enterprises both at the product and industry levels. Moreover, the use of digital technologies has a positive impact on all production processes, including such important indicators as labor productivity and transaction costs. The introduction of digital platforms also allows an enterprise to enter the international market and integrate into global digital platforms to promote its products and improve technological processes. It is clear that digital technologies will create a sustainable competitive advantage for industrial enterprises and products.

Tajikistan still has to overcome numerous institutional, investment and technological challenges in order to achieve a full transition to digital platforms. However, there are prerequisites and conditions for this. Developed countries have elaborated certain algorithms and templates for the transition to the digital economy, which allow certain problems to be solved faster and more efficiently.

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