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TRANSFORMATION OF INDUSTRY: DIGITALIZATION AND INTEGRATION OF MANUFACTURING SYSTEMS

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Annotation: The article examines the key aspects of industrial digital transformation and its impact on integrated production. Integrated production in the context of digitalization not only improves economic performance, but also contributes to sustainable development, minimizing the negative impact on the environment. Enterprises that actively implement digital technologies will have a significant competitive advantage in the future.
Keywords: industrial digital transformation, integrated manufacturing, Internet of Things (IoT), artificial intelligence (AI), optimization of production processes, improvement of product quality, reduction of time to market, corporate culture, personnel training, digital initiatives, sustainable development, economic indicators, competitive advantage, digitalization in production.

In the context of the digital economy, characterized by increased competition and the emergence of new opportunities, as well as tools for optimizing business processes, more and more industrial companies are launching digital transformation projects. The main task is to analyze and systematize the potential advantages, costs, and risks associated with digital transformation, with a focus on an informational approach.

Additional objectives of this research include justifying the need for in-depth study of digital transformation processes in enterprises and comparing digitalization costs with other types of investment expenditures. The main research methods are systematization of analysis, both of scientific and practical works, as well as comparison and synthesis of data. Summarizing existing opinions on the potential benefits of implementing digital projects, three key groups of advantages can be identified.

As a result of the research, a growing interest from the scientific community in the issues of digital transformation was noted, including the situation in Uzbekistan. Key cost items for the digitalization of domestic companies, including industrial holdings, were also identified, along with their connection to investment costs.

The findings showed that infrastructure costs occupy a predominant place in the overall digitalization expenditures. Additionally, key risks associated with the implementation of digital transformation projects were identified, emphasizing the importance of controlling expenses and the need to develop risk mitigation measures in advance. This research holds practical value both for industrial enterprises and for the scientific community.

The development strategy of New Uzbekistan for 2022-2026 covers seven priority areas for further reforms, which include government administration, the rule of law, economic development, social policy, spiritual enlightenment, security, as well as pragmatic and active foreign policy. In turn, these seven priority areas encompass one hundred strategic goals that must be achieved by 2026.

Industrial transformation is a key element of the global digital transformation of organizations. The application of a proactive and coordinated approach to the implementation of digital

technologies for the phased modernization of an enterprise's operational activities allows for the rethinking of production processes at factories, plants, mines, and other manufacturing sectors.

Key Features of Industrial Transformation:

Industrial transformation is an essential component of digital transformation and encompasses, among other things, the industrial Internet of Things (IIoT). The primary focus of industrial transformation is on the manufacturing processes of discrete, continuous, and batch production. As a result, the operational activities of factories, plants, and mines are directly influenced by this transformation.

Industrial transformation contributes to the implementation of the concept of continuous improvements in production.

One of the key tasks of industrial transformation is the coordination, management, and dissemination of solutions and best practices to remote production facilities. Manufacturing systems are geographically and organizationally distributed structures, often including sites located hundreds or even thousands of kilometers apart. Differences in the production cultures of these sites create challenges for process standardization. In this regard, one of the main tasks of industrial transformation is not only to find the optimal solution for a specific business problem but also to ensure its adaptation and replication, taking into account the unique characteristics of remote production locations.

Industrial transformation covers both assets and processes, as well as the products of an enterprise:

a) Initiatives related to assets focus on opportunities to increase productivity and efficiency in the use of core manufacturing equipment;

b) Product-related initiatives aim to improve the quality of produced goods, reduce the level of defects or non-conforming products, and shorten the production cycle time;

c) Initiatives focused on operational activities include measures to improve interdepartmental interaction between production shops, stages, and divisions to enhance efficiency both in the manufacturing process and in providing services to the company's clients.

The presence of a digital transformation concept or roadmap alone cannot be considered a competitive advantage. Achieving the set goals and addressing challenges in the fields of digital and industrial transformation requires the appropriate resources and tools.

A key factor for further optimization of manufacturing processes is improving the interaction between information systems and personnel within the context of the overall digital transformation of the enterprise.

The national economy of our country, being at the stage of digital transformation across all areas of human activity, including socio-economic relations and the institutional structure of society, as well as the transition to digital platforms integrated with the global Internet network, faces risks inherent in the processes of globalization. The resource-based orientation of the economy has led to reckless and active activities, resulting in the loss of key competencies in industries responsible for integrating technological and logistical chains of domestic enterprises into international networks, including those in Europe, the USA, China, and other countries. This has complicated the satisfaction of domestic demand for goods and services.

In the context of import substitution, it is necessary to conduct a scientifically grounded analysis of the current situation and develop strategies to reduce Uzbekistan's industrial dependence on foreign technologies, goods, and services. It is important to identify changes in the digitalization processes of domestic industrial enterprises caused by changes in political and economic conditions, as well as to assess the effectiveness of design and technological preparation at machine-building enterprises and the presence of innovative components under current conditions.

One of the key features of a modern digital enterprise is its integration, which implies the creation of a corporate ecosystem. This ecosystem not only unites internal automated systems but also two other essential components: business processes and human resources.

In-depth integration of processes, employees, and information systems contributes to increased efficiency both of each element individually and of the entire production chain as a whole, thanks to the following aspects:

- Digital management of work processes;
- Standardization of production operations based on common corporate practices, considering the unique features of different production sites and divisions;
- Collaborative activities of employees and automated systems from various departments;
- Modular development, creation of a unified user interface, and the possibility of remote deployment of applications.

A key component for achieving mutual integration is the Business Process Management System (BPMS) in the manufacturing environment. It provides the opportunity to digitally display existing business processes within the enterprise or industry best practices, and it also facilitates horizontal integration between departments at the same level and vertical integration across different levels of personnel.

Digital transformation in Uzbekistan began ten years ago. To support digital changes in the country, 19 special economic zones and over 400 small industrial zones were established, with 10 trillion UZS allocated for the development of their infrastructure. To ensure the industry has the necessary resources, geological exploration efforts have been tripled, leading to the discovery of over 600 new deposits.

Uzbekistan holds leading positions in reserves of minerals such as gold, uranium, gas, copper, potassium, phosphates, and several others. Our country is one of the largest producers of gold, uranium, and gas in the world. As part of the investment program for 2023, projects totaling over $3.5 billion were implemented in Uzbekistan. Key investment partners in Uzbekistan's mining sector include the Canadian company B2Gold, Turkish companies MTA and Calik Holding, which are involved in gold mining, and Japanese JOGMEC and French Orano Mining, specializing in uranium.

Let’s examine the current directions of digitalization in the mining and metallurgical complex using the example of Almalyk Mining and Metallurgical Complex (AMMC), which holds a leading position in gold mining in Uzbekistan and is the largest copper producer in Central Asia. In 2022, the complex developed a five-year digital transformation strategy. By implementing numerous projects annually, the enterprise is gradually automating both technological and managerial processes. By 2023, data on mineral resources was digitized, electronic document management and electronic journals were introduced, and BI dashboards were created for key business processes. The transport management and control system saved 16.8 thousand tons of diesel fuel in one year, equivalent to 151 billion UZS. The implementation of the "PI System" (Plant Information System) at the copper processing plant doubled the decision-making speed and increased production efficiency by 5%.

Since the start of large-scale reforms in 2024, Uzbekistan has achieved significant progress in transforming its economy and digitalization, which has accelerated economic growth. The adopted measures have improved the competitiveness of the national economy, contributed to the liberalization of prices, increased transparency, and reduced barriers to attracting foreign investments.

Uzbekistan ranked 60th in the Global Digitalization Index 2024, scoring 32.7 points out of a possible 120. This index evaluates the level of digitalization in different countries and demonstrates the correlation between the use of digital technologies and gross domestic product

(GDP). Uzbekistan is classified as an emerging country, showing an initial level of maturity in information and communication technologies (ICT) and the economy. Among neighboring countries, Kazakhstan ranks 58th, while other Central Asian countries are not included in this index. The index covers countries that account for 93% of global GDP and 80% of the world's population, providing a broad perspective on global progress in digital transformation.

It should also be emphasized that modern management, global projects, and the adaptation of leading enterprises to current conditions play a key role in enhancing the stability and efficiency of the country's economy. The Presidential Decree "On Measures to Increase Uranium Mining and Processing Volumes, as well as the Transformation of the State Enterprise 'Navoiuran' for the Period from 2022 to 2030" outlines the stages of transformation for the state enterprise "Navoiuran" and the specific tasks that need to be addressed.

The main goal of the transformation is to turn the enterprise into a competitive organization through the comprehensive implementation of digital technologies and platform solutions. This aims at reducing the cost of production, improving operational efficiency, and ensuring stable operations.

The state enterprise "Navoiuran" is actively working on developing a modern corporate governance system, implementing cutting-edge global technologies, and building a competitive workforce. In this context, the aforementioned Presidential decree serves as a foundational document for the company's specialists and partners.

Strategically and effectively executed transformation processes elevate the enterprise's development to a new level within the international business environment. Transformation is not only a contemporary necessity but also a key stage that contributes to enhancing competitiveness and meeting consumer needs.

A key aspect of the future state enterprise "Navoiuran" will be improving the quality of the produced products as well as enhancing analytical capabilities. The implementation of modern technologies and the development of innovative solutions will create a comfortable and flexible working environment, opening new opportunities for engineering and technical personnel. The main goal is to form a modern corporate governance system and further expand the enterprise's export capabilities.

Undoubtedly, digital transformation holds significant potential for modernizing society and integrating the national economy into global processes. In this context, as part of the ongoing reforms and the Development Strategy of New Uzbekistan for the next five years, special attention is being given to the digitalization of key sectors and the creation of a true information society in the country.

Initiatives such as the "Digital Uzbekistan – 2030" Strategy and the "Development Strategy of New Uzbekistan for 2022-2026" have been launched, aimed at implementing digital transformation in the economy, industry, and society as a whole. Expanded digitalization and transformation should become key priorities for developing countries, including Uzbekistan. Over the past ten years, the country has achieved significant successes in this area. In addition to continued cooperation with South Korea, Russia, Estonia, and China, it is important to attract more technologically advanced countries like Germany, the United Kingdom, the United States, and Singapore into the IT sector, which will diversify international partnerships. Investments in the digital ecosystem and IT infrastructure will further modernize the country's economy and accelerate inclusive growth in all sectors.

Conclusions to the article:

Industrial digital transformation is becoming a key factor in enhancing the competitiveness and resilience of enterprises in a rapidly changing economic environment. The integration of digital technologies into production processes significantly improves efficiency and reduces costs.

Digital transformation allows for the optimization of manufacturing processes, improves product quality, and shortens time to market. This is achieved through more accurate data monitoring and analysis, enabling informed decision-making.

Integrated production within the context of digital transformation also opens up opportunities for more sustainable resource usage and minimizes negative environmental impact, in line with contemporary requirements for sustainable development.

The prospects for further development of integrated production in the context of digitalization appear promising. It is expected that companies that actively implement digital technologies will have significant advantages in the market and will be able to respond more quickly to changes in consumer demands.

Overall, industrial digital transformation and integrated production are interconnected processes that can significantly enhance the efficiency and resilience of enterprises in the modern world.

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