BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg

DIGITAL CONTROL OF PRODUCTION PROCESSES BASED ON ARTIFICIAL INTELLIGENCE: OPPORTUNITIES FOR UZBEKISTAN INDUSTRY

Maxmudova Shoira Muxiddinovna
Senior Lecturer, Higher School of Business
and Entrepreneurship under the
Cabinet of Ministers of the Republic of Uzbekistan
email:maxmudova2020@gmail.com

https://doi.org/10.5281/zenodo.20567623

Abstract

This article analyzes the role and importance of artificial intelligence technologies in digital management of production processes. Also, within the framework of the Industry 4.0 concept, the impact of artificial intelligence, big data (Big Data), Industrial Internet (IIoT) and smart manufacturing (Smart Manufacturing) technologies on the activities of industrial enterprises is studied. The current state, problems and prospects of implementing digital management systems in industrial enterprises of Uzbekistan are highlighted. The study substantiates that managing production processes based on artificial intelligence is an important factor in increasing the efficiency of enterprises, reducing costs and strengthening competitiveness.

Keywords: artificial intelligence, digital management, Industry 4.0, Smart Manufacturing, industrial enterprises, digital transformation, production efficiency, Uzbekistan.

Introduction

The digital transformation processes taking place in the world economy are making fundamental changes to the management systems of industrial enterprises. Digital technologies, especially artificial intelligence (AI), are becoming an important tool for automating, optimizing and effectively managing production processes. Today, increased global competition, the need for rational use of resources, and increased requirements for product quality require enterprises to introduce modern management technologies.

Within the framework of the Industry 4.0 concept, production systems are integrating with digital technologies and moving to a smart manufacturing model. This model creates the opportunity to control production processes in real time through the use of artificial intelligence, big data, cloud computing, robotics, and industrial internet technologies. As a result, production efficiency increases, operating costs decrease, and enterprises become more adaptable to market demands.

The share of the industrial sector in the economy of Uzbekistan is increasing year by year. As a result of the economic reforms being implemented in the country, the policy of industrial diversification, and investment projects aimed at expanding production capacities, industry is becoming one of the leading sectors of the national economy. In particular, the increase in production volumes in the metallurgical, chemical, textile, building materials, electrical and mechanical engineering industries serves to strengthen the country's economic potential. At the same time, the digital transformation processes taking place in the world economy require industrial enterprises to introduce modern management technologies and develop production systems on an innovative basis.

Today, increased competition in global markets, rapid changes in consumer demands, and increased requirements for product quality and cost create the need to apply new approaches to the activities of enterprises. Therefore, the widespread introduction of digital technologies in industrial enterprises and the development of management systems based on artificial intelligence are one of the urgent tasks. Digital technologies allow for the automation of production processes, real-time data collection and analysis, monitoring of equipment performance, and rapid adoption of management decisions. As a result, the operational efficiency of enterprises increases, production costs decrease, and resource utilization improves.

The introduction of artificial intelligence technologies into industrial enterprises will bring the quality of production management to a new level. AI algorithms allow processing large amounts of data, identifying production failures in advance, forecasting supply and demand, and formulating optimal management decisions. This approach will help enterprises quickly adapt to market requirements, improve product quality, and strengthen their competitiveness. Artificial intelligence can also be used to effectively use production capacities, optimize energy consumption, and reduce maintenance costs.

As part of Uzbekistan's strategy for transition to a digital economy, the introduction of Industry 4.0 technologies, the development of Smart Manufacturing systems, and the improvement of artificial intelligence-based management mechanisms are becoming increasingly important in industrial enterprises. This is necessary not only to increase production efficiency, but also to expand export potential, develop the production of high-value-added products, and ensure sustainable growth of the national economy. Therefore, accelerating digital transformation in industrial enterprises, creating a modern technological infrastructure and training qualified personnel remain one of the priority areas of the country's industrial policy. As a result, Uzbek industry will have the opportunity to become a more competitive and innovative sector in the global economic space.

The role of artificial intelligence in managing production processes

Artificial intelligence is a set of technologies that allow computer systems to perform the functions of analysis, learning, forecasting and decision-making inherent in human mental activity. AI technologies are used in industrial enterprises in the following areas:

- automation of production processes;
- monitoring of equipment status;
- predicting failures;
- automation of quality control;
- optimization of energy consumption;
- management of logistics and supply chains;
- improvement of production planning.

Artificial intelligence systems analyze large amounts of data collected through sensors and determine the optimal parameters of production processes. As a result, errors related to the human factor are reduced and the accuracy of management decisions is increased.

Smart Manufacturing and Industry 4.0 technologies

Smart Manufacturing is a modern production model based on real-time control, monitoring and optimization of production processes. This model is a key component of the Industry 4.0 concept, which serves to increase production efficiency through the integration of digital technologies and cyber-physical systems. Unlike traditional production methods, Smart Manufacturing relies on data-driven management principles and ensures interconnected and intelligent operation of production systems.

The Industry 4.0 concept is recognized as the fourth stage of industrial development, in which artificial intelligence, the industrial Internet, big data, cloud computing, robotics and other advanced technologies are used together. These technologies allow for the automation of production processes, improvement of management decisions and increased flexibility of enterprises to market requirements.

Artificial Intelligence (AI)

Artificial intelligence is one of the central elements of the Smart Manufacturing system. AI technologies allow analyzing large amounts of data, identifying hidden patterns, predicting production processes, and making automatic decisions. With the help of artificial intelligence, the technical condition of equipment is monitored, failures are detected in advance, and maintenance processes are optimized. Also, the efficiency of production capacity utilization is increased based on AI, and energy and resource consumption are reduced.

Industrial Internet of Things (IIoT)

The Industrial Internet is a technology that connects production equipment, sensors, robots, and control systems into a single digital network. With the help of IIoT, data is collected in real time from all production facilities of the enterprise and transmitted to a centralized management system. This allows for continuous monitoring of the operating status of equipment, rapid identification of problems in production processes, and making operational management decisions. As a result, the continuity of production processes is ensured and the efficiency of the enterprise increases.

Big Data

Millions of data are generated in Smart Manufacturing systems every day. Storage, processing and analysis of this data is carried out using Big Data technologies. Big Data technologies allow assessing the efficiency of production processes, forecasting market demands, analyzing customer behavior and improving strategic planning. Based on Big Data, enterprises will be able to make accurate and informed management decisions based on data.

Cloud Computing

Cloud technologies provide centralized storage, processing and use of production data. These technologies reduce the need for additional technical infrastructure for storing large amounts of data and allow enterprises to access data remotely. Cloud platforms accelerate the exchange of information between different departments and branches, increasing the efficiency of management. In addition, cloud technologies help reduce production costs and accelerate the digital transformation of the enterprise.

Robotics and automation systems

Robotics is one of the most important components of the Smart Manufacturing model. Modern industrial robots perform complex and repetitive operations with high accuracy and speed. Robotized production lines reduce human error, increase product quality, and significantly improve labor productivity. In particular, in industries such as automotive, metallurgy, electronics, and chemical, the use of robotics is becoming an important factor in increasing production efficiency.

Cyber-Physical Systems

The basis of the Industry 4.0 concept is cyber-physical systems. These systems are based on the mutual integration of physical equipment and digital control tools. With the help of cyber-physical systems, production facilities can independently analyze their state, exchange information, and automatically make certain management decisions. This increases the flexibility of production and moves enterprises to an intelligent management model.

Advantages of Smart Manufacturing technologies

The integrated use of these technologies not only increases production efficiency, but also strengthens the competitiveness of enterprises. In particular, production costs are reduced, product quality is improved, the efficiency of energy and raw material resources is increased, and production processes are managed more efficiently. In addition, enterprises have the opportunity to quickly adapt to market requirements, fulfill individual orders, and produce innovative products. Thus, Smart Manufacturing and Industry 4.0 technologies are one of the main factors ensuring the digital transformation of modern industrial enterprises, making production processes more efficient, flexible, and competitive. The widespread introduction of these technologies in Uzbek industrial enterprises is of great importance for the innovative development of the national economy and increasing its competitiveness in international markets.

Opportunities for introducing artificial intelligence in the industry of Uzbekistan

Large-scale reforms are being implemented in Uzbekistan to digitize various sectors of the economy. A number of programs and strategies are being implemented in the country to develop the digital economy, introduce modern information and communication technologies in industrial enterprises, and automate production processes. The role of artificial intelligence technologies in these processes is increasingly increasing. Artificial intelligence is ushering in a new stage of production process management, enabling enterprises to make quick and accurate decisions based on data. The introduction of artificial intelligence technologies in industrial enterprises provides a number of economic, technological, and organizational advantages.

First, artificial intelligence allows for a significant increase in production efficiency. Modern AI algorithms constantly monitor the operating status of equipment, analyze their technical indicators, and predict possible failures in advance. Predictive Maintenance systems reduce unexpected equipment failures, prevent production interruptions, and increase production capacity utilization. As a result, enterprises will be able to increase production volumes and increase labor productivity.

Secondly, artificial intelligence helps reduce operating costs. Increasing the efficiency of energy resources, raw materials and materials in production processes is one of the important factors ensuring the profitability of the enterprise. AI systems analyze production data, optimize energy consumption, identify excessive losses in resource consumption and help organize production processes in the most optimal mode. This leads to a decrease in the cost of production, reduction of expenses and increase in the profit of the enterprise.

Third, artificial intelligence allows you to improve product quality. Modern computer vision technologies and machine learning algorithms allow you to automatically control products on production lines. Such systems detect product defects faster and more accurately than the human factor, helping to identify products that do not meet quality standards at an early stage of the production process. As a result, the share of defective products decreases, production quality improves, and the level of satisfaction of consumer needs increases.

Fourth, artificial intelligence plays a significant role in improving the efficiency of logistics and supply chains. AI technologies allow you to forecast market demand, determine the need for raw materials and materials in advance, and optimize cooperation between supply chain participants. Forecasting models developed based on artificial intelligence help enterprises effectively manage warehouse stocks, reduce transportation costs, and ensure timely delivery of products. This ensures the continuity of logistics processes and increases overall operational efficiency.

Fifth, artificial intelligence significantly enhances the competitiveness of enterprises. High-tech management systems expand the possibilities of flexible organization of production processes,

rapid response to changes in market demands, and production of products based on individual orders. Also, management decisions made on the basis of AI technologies improve the quality of strategic planning and serve the innovative development of enterprises. This creates the basis for the successful operation of local industrial enterprises not only in the domestic market, but also in international markets.

In addition, the introduction of artificial intelligence technologies also helps to ensure environmental sustainability. Through the efficient use of energy and resources, reduction of waste, and ecological optimization of production processes, enterprises will be able to operate in accordance with the principles of the "green economy". Therefore, the widespread use of artificial intelligence technologies in industrial enterprises is one of the important conditions for the modernization, innovative development, and adaptation of Uzbekistan's industry to the requirements of the digital economy. As a result, production efficiency, product quality, and competitiveness of enterprises will increase, contributing to the sustainable development of the country's economy.

Problems in Uzbek industrial enterprises

Despite this, there are a number of problems in the implementation of artificial intelligence technologies:

- insufficient development of digital infrastructure;
- lack of qualified IT specialists and data analysts;
- incomplete formation of digital transformation strategies in enterprises;
- limited financing mechanisms for innovative projects;
- high initial costs of artificial intelligence technologies.

Solving these problems requires cooperation between the state, scientific institutions and business entities.

Proposals and recommendations

It is advisable to implement a number of comprehensive measures to develop digital management systems based on artificial intelligence at industrial enterprises in Uzbekistan. First of all, it is necessary to develop national programs for the introduction of artificial intelligence technologies at industrial enterprises and implement them gradually. Such programs should be developed taking into account the technological characteristics of industrial sectors, accelerate digital transformation processes at enterprises, and encourage the use of modern technologies at all stages of production. At the same time, it is advisable for the state to provide tax incentives, subsidies, and other economic incentive mechanisms to enterprises implementing artificial intelligence technologies.

Expanding the activities of technoparks and innovation centers is also one of the important factors in forming an industrial ecosystem based on artificial intelligence. Technoparks serve as a platform for effective cooperation between research institutions, higher education institutions, and industrial enterprises. They expand the possibilities of transforming innovative ideas into practical products and technologies, supporting startup projects, and implementing new technologies in production. As a result, the innovative potential of industrial enterprises increases, and the processes of developing and implementing new digital solutions are accelerated.

It is also of particular importance to encourage the introduction of modern information systems such as ERP (Enterprise Resource Planning), MES (Manufacturing Execution System), and SCM (Supply Chain Management) in enterprises. While ERP systems serve to manage enterprise resources on a single platform, MES systems allow for real-time monitoring and control of production processes. SCM systems, in turn, help to effectively manage the supply chain, reduce

logistics costs, and optimize the movement of resources. The integration of these systems with artificial intelligence technologies forms a data-based management model in enterprises and significantly improves the quality of decision-making.

The issue of training qualified specialists in artificial intelligence is also of strategic importance. In the digital economy, training highly qualified personnel in the fields of data analytics, machine learning, artificial intelligence algorithms, robotics and cybersecurity is an important condition for industrial development. To this end, it is necessary to introduce modern curricula in higher education institutions, develop cooperation with international universities, expand the dual education system and organize advanced training programs tailored to the needs of enterprises. This will serve to form the human capital necessary for the effective implementation of artificial intelligence technologies in industrial enterprises.

Improving the mechanisms for commercializing scientific research and experimental design developments (R&D) is also one of the important areas of innovative development. Since many scientific developments are not put into practice, their economic effectiveness is not sufficiently demonstrated. Therefore, it is necessary to introduce scientific results into the activities of industrial enterprises, simplify patenting processes, develop mechanisms for launching innovative products on the market and expand venture financing systems. This will expand the opportunities for effective use of local scientific potential and the creation of new technologies.

One of the important tasks is also the development of mechanisms for financing innovative projects based on public-private partnerships. International experience shows that public-private sector cooperation plays an important role in the implementation of large-scale technological and innovative projects. Such cooperation allows reducing investment risks, effectively mobilizing financial resources, and attracting advanced technologies. In Uzbekistan, supporting projects aimed at developing artificial intelligence, smart manufacturing, and digital management systems based on public-private partnerships will accelerate the technological modernization of industrial enterprises.

Umuman olganda, mazkur chora-tadbirlarning izchil amalga oshirilishi O‘zbekiston sanoat korxonalarida sun’iy intellekt asosida raqamli boshqaruv tizimlarining keng joriy etilishiga, ishlab chiqarish samaradorligining oshishiga, resurslardan oqilona foydalanishga va korxonalarning xalqaro bozorlardagi raqobatbardoshligini kuchaytirishga xizmat qiladi. Natijada mamlakat sanoatining innovatsion rivojlanishi ta’minlanib, raqamli iqtisodiyot sharoitida barqaror iqtisodiy o‘sish uchun mustahkam asos yaratiladi.

Conclusion

In conclusion, digital control of production processes based on artificial intelligence is one of the most promising and strategic directions of modern industrial development. The integration of digital technologies and artificial intelligence into production systems is taking the quality of management of enterprises to a new level, allowing them to organize production processes more efficiently, flexibly and innovatively. In particular, the application of advanced technologies such as artificial intelligence, the Industrial Internet of Things (IIoT), big data (Big Data), cloud technologies and robotics within the framework of the Industry 4.0 concept allows enterprises to make data-based management decisions, rationally use resources and quickly adapt to market demands.

The results of the study show that the introduction of artificial intelligence technologies helps to increase the operational efficiency of enterprises, reduce production costs, increase the reliability of equipment and improve product quality. Also, by automating production processes, errors related to the human factor are reduced, the number of production interruptions is reduced and the

overall profitability of enterprises increases. Artificial intelligence-based forecasting and analysis systems increase the quality of strategic planning, allowing enterprises to anticipate changes in market conditions and act accordingly. The widespread use of artificial intelligence technologies in Uzbek industrial enterprises is of great importance in accelerating the country's innovative development, improving the technological level of production, and increasing competitiveness in international markets. At the same time, the introduction of artificial intelligence will expand the opportunities for expanding the production of high-value-added products, increasing export potential, and creating new jobs. This will contribute to the long-term sustainable development of industrial enterprises and the structural modernization of the country's economy. In order to develop digital management systems based on artificial intelligence in the future, it is important to form a modern digital infrastructure in industrial enterprises, support research and innovation activities, train qualified specialists, and widely introduce international experience. It is also possible to expand the scope of application of artificial intelligence technologies in industrial sectors by strengthening cooperation between the state, business and scientific institutions. In general, digital control of production processes based on artificial intelligence is an important factor in accelerating the digital transformation of Uzbek industry, increasing production efficiency, enhancing investment attractiveness and ensuring sustainable growth of the national economy. Therefore, the consistent introduction of these technologies into the activities of industrial enterprises and increasing their practical effectiveness is of strategic importance for the long-term economic development of the country.

References:

1. Schwab K. *The Fourth Industrial Revolution*. Geneva: World Economic Forum, 2016.
2. Lee J., Bagheri B., Kao H.A. A Cyber-Physical Systems Architecture for Industry 4.0-Based Manufacturing Systems // Manufacturing Letters. – 2015. – Vol. 3. – pp. 18–23.
3. Kagermann H., Wahlster W., Helbig J. *Recommendations for Implementing the Strategic Initiative INDUSTRIE 4.0*. Germany, 2013.
4. Porter M., Heppelmann J. How Smart, Connected Products Are Transforming Competition // Harvard Business Review. – 2014. – Vol. 92(11). – pp. 64–88.
5. Brynjolfsson E., McAfee A. *The Second Machine Age*. New York: W.W. Norton & Company, 2014.
6. O‘zbekiston Respublikasi Prezidentining raqamli iqtisodiyot va sun’iy intellektni rivojlantirishga oid farmon va qarorlari.
7. OECD. *Artificial Intelligence in Society*. Paris: OECD Publishing, 2019.
8. World Economic Forum. *Shaping the Future of Advanced Manufacturing and Production*. Geneva, 2023.