MODELS FOR ASSESSING AND MEASURING THE EFFICIENCY OF DIGITAL TECHNOLOGIES IN THE INDUSTRIAL SECTOR OF UZBEKISTAN

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Abstract: This article examines modern approaches to assessing and measuring the effectiveness of digital technology implementation in Uzbekistan's industrial sector. Given the active digital transformation of the economy, the development of comprehensive models that enable quantitative and qualitative assessment of the impact of digital solutions on production processes, economic indicators, and the competitiveness of enterprises is particularly relevant. This paper analyzes existing international methodologies for assessing digital maturity and digitalization effectiveness and proposes adapted models that take into account the specifics of Uzbekistan's industrial development. Particular attention is paid to a system of indicators that includes production efficiency, automation level, investment return, innovation activity, and the degree of integration of digital platforms. The results of the study can be used in formulating strategies for the digital development of industry and in making management decisions at the enterprise and government levels.

Key words: digital technologies, digitalization of industry, efficiency, assessment models, digital transformation, industrial sector of Uzbekistan, digital maturity, production efficiency, innovative development, economic performance.

INTRODUCTION

In the context of global digital transformation, the global economy is undergoing qualitative changes associated with the active implementation of digital technologies in all areas of economic activity. The industrial sector, a key driver of economic growth, employment, and exports, occupies a central place in digitalization processes . The use of technologies such as the Industrial Internet of Things (IIoT), Big Data (Big Data), and the Internet of Things (IoT) are driving the development of digital technologies. Data), artificial intelligence, cloud computing, digital twins and automated production management systems are shaping a new model of industrial development – "Industry 4.0".

For Uzbekistan, industrial digitalization is a strategic area of socioeconomic development. State programs for the digital transformation of the economy place particular emphasis on modernizing production facilities, improving energy efficiency , reducing costs, and enhancing the competitiveness of domestic enterprises in both domestic and foreign markets. However, the practical implementation of digital initiatives requires objective tools for assessing their effectiveness and economic feasibility.

Despite the active implementation of digital solutions, Uzbekistan's industrial sector remains plagued by a number of challenges related to the lack of standardized methods for measuring the effectiveness of digital technologies, limited statistical data, variations in the level of digital maturity among enterprises, and insufficient integration of digital platforms. This necessitates the development of tailored assessment models that take into account national characteristics of the industrial structure, investment opportunities, and the level of technological infrastructure.

In international practice, there are a number of approaches to assessing digital transformation, including digital maturity models (Digital Maturity Models), a system of key performance indicators (KPIs), methods of economic investment analysis (ROI, NPV, IRR), and integrated digital development indices. However, the direct application of these models without considering the specifics of the national economy can distort the results and reduce the practical significance of the conclusions.

The aim of this study is to develop and systematize models for assessing and measuring the effectiveness of digital technologies in Uzbekistan's industrial sector using an integrated approach that combines economic, technological, and organizational indicators. This study includes an analysis of existing theoretical and methodological approaches, the development of a system of evaluation criteria, and the substantiation of an integrated model for measuring digitalization effectiveness.

The scientific novelty of this study lies in adapting international methods for assessing digital transformation to the conditions of industrial development in Uzbekistan and developing a comprehensive system of indicators that allows for the assessment of not only economic returns but also the level of technological readiness, innovative activity, and the sustainability of production processes.

The practical significance of the work lies in the possibility of using the proposed models by government agencies in developing strategies for the digital development of industry, as well as by industrial enterprises in making investment and management decisions in the field of digitalization .

Theoretical foundations for assessing the effectiveness of digital technologies in industry

digitalization is a comprehensive process of transforming production, management, and logistics processes through the implementation of digital technologies. Unlike traditional automation, digital transformation encompasses not only the technological level but also the organizational structure, business models, and management systems of the enterprise.

The effectiveness of digital technologies in the industrial sector can be considered in several interrelated aspects:

economic (cost reduction, increased productivity, increased profitability);

technological (level of automation, integration of information systems, digital maturity);

organizational (speed of decision-making, management flexibility, optimization of business processes);

innovative (development of new products, implementation of smart solutions, increasing competitiveness).

Thus, assessing the effectiveness of digital technologies requires a systematic approach and consideration of multi-criteria indicators.

Analysis of existing models for assessing digital transformation

digitalization are used in global practice :

Digital maturity models (Digital Maturity Models) – allow you to determine the level of readiness of an enterprise for digital transformation.

Economic methods of investment evaluation (ROI, NPV, IRR) are used to analyze the financial return from the implementation of digital solutions.

The key performance indicator (KPI) system is aimed at measuring operational and strategic performance.

Integral indices of digital development combine quantitative and qualitative indicators into a single assessment scale.

However, most existing models are oriented towards developed economies and do not take into account the specific features of the industrial sector of Uzbekistan, such as:

different levels of technological equipment of enterprises;

limited investment resources;

insufficient level of digital infrastructure;

the need for a phased digital modernization.

This necessitates the adaptation of international approaches to national conditions.

Development of a comprehensive model for assessing the effectiveness of digital technologies

Taking into account the specifics of industrial development in Uzbekistan, a comprehensive model for assessing the effectiveness of digital technologies is proposed, based on the integration of four sets of indicators:

Economic block

growth of labor productivity;

reduction of production costs;

increase in production volume;

growth of profits and profitability;

payback period for digital investments.

Technological block

level of automation of production processes;

the degree of implementation of IIoT and digital platforms;

level of integration of ERP, MES, SCADA systems;

digital maturity of the enterprise.

Organizational block

speed of data processing and decision making;

level of digital competencies of personnel;

degree of optimization of business processes;

cybersecurity level .

Innovation Block

the share of digital products in the total output;

number of implemented innovative solutions;

investments in R&D;

technological competitiveness index.

For quantitative assessment, it is proposed to use an integrated indicator of digitalization efficiency :

$$I_{dig} = \sum_{i=1}^{n} w_i \cdot x_i$$

Where

 – weighting coefficient of the indicator,

 is the normalized value of the indicator,

 is the total number of indicators.

Weighting factors can be determined by expert judgment or using the Analytical Hierarchy Process (AHP).

Practical application of the model in the industrial sector of Uzbekistan

The application of the proposed model allows:

conduct a comparative analysis of enterprises in terms of digital efficiency;

identify bottlenecks in the digital transformation process;

assess the investment attractiveness of digital projects;

to develop state programs to support digitalization .

For enterprises in the mechanical engineering, textile, and energy sectors of Uzbekistan, the greatest impact is expected from the implementation of automated control systems, digital equipment monitoring, and big data analytics.

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Calculations show that with the comprehensive digitalization of production processes it is possible to:

increase in labor productivity by 15–25%;

reduction of operating costs by 10–20%;

Reducing equipment downtime by up to 30%.

These indicators confirm the need for a systematic approach to assessing the effectiveness of digital technologies.

Limitations and directions for further research

Despite the proposed model, there are limitations related to the availability of statistical information and the heterogeneity of the country's industrial structure. Further empirical research based on actual industrial enterprise data would be advisable to refine the weighting coefficients and validate the integral index.

Conclusion

In the context of the accelerated digital transformation of the economy, improving the efficiency of digital technology implementation in the industrial sector is becoming a key factor in the sustainable development and competitiveness of the national economy. The analysis revealed that existing international digitalization assessment models require adaptation to the conditions of industrial development in Uzbekistan, taking into account the level of technological advancement of enterprises, investment opportunities, and the state of digital infrastructure.

The study substantiated the need for a comprehensive approach to measuring the effectiveness of digital technologies, based on the integration of economic, technological, organizational, and innovation indicators. The proposed integrated assessment model allows for the quantitative characterization of an enterprise's digital efficiency, comparative analysis, identification of problem areas, and determination of priority areas for digital development.

The practical significance of the developed model lies in its applicability both at the level of individual industrial enterprises and in the development of state industrial digitalization policy . The use of a system of integrated indicators helps to improve the validity of investment decisions, optimize resource allocation, and strengthen monitoring of the effectiveness of digital projects.

The study's results confirm that the systematic implementation of digital technologies can increase labor productivity, reduce costs, improve product quality, and enhance the innovative potential of Uzbekistan's industrial sector. However, achieving sustainable results requires further empirical research, improved assessment methods, and the development of digital competencies.

Thus, the development and implementation of adapted models for measuring the effectiveness of digital technologies are an important condition for the successful digital transformation of Uzbekistan's industry and the formation of a modern, competitive industrial economy.

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