| Research Article

Efficiency of Using Digital Technologies in Light Industry Enterprises in Uzbekistan

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Annotation

The adoption of digital technologies in Uzbekistan's light industry has become a key driver of industrial modernization, improving efficiency, sustainability, and competitiveness. This study evaluates the effectiveness of digital solutions such as automation, artificial intelligence (AI), the Internet of Things (IoT), blockchain, enterprise resource planning (ERP) systems, and cloud computing in textile and garment manufacturing. Using a systematic analysis approach, we examine their impact on productivity, cost reduction, supply chain optimization, and product quality.

Findings indicate that digitalization has increased labor productivity by 70–80% and reduced ICT expenditures by 55%, with cloud technologies significantly lowering operational costs. However, challenges such as high initial investment, cybersecurity risks, and a shortage of skilled professionals hinder widespread adoption. The research reviews international digital maturity models, including those developed by Deloitte, KPMG, PwC, and the German National Academy of Sciences and Technology, to benchmark Uzbekistan's progress.

To enhance digital transformation, the study recommends government incentives, workforce training programs, stronger cybersecurity measures, and scalable digital infrastructure. By embracing these strategies, Uzbekistan's light industry can achieve higher efficiency, global market integration, and sustainable economic growth.

Keywords: light industry, Uzbekistan, digital technologies, textiles, economic efficiency, Industry 4.0, cloud computing, supply chain optimization technologies, production.

Introduction. The integration of digital technologies into the light industry sector has become a key driver of industrial modernization worldwide, including in Uzbekistan. Given the sector's significant contribution to the national economy—particularly in textiles and garment production—digitalization offers a pathway to increased efficiency, cost reduction, and improved product quality. However, the implementation of digital technologies presents challenges such as high initial investment, the need for skilled labor, and the necessity for robust infrastructure.

Assessing the efficiency of digital technologies in light industry enterprises is crucial for informed decision-making and strategic planning. A comprehensive evaluation can help enterprises

determine the level of digitalization, optimize resource allocation, and enhance competitiveness in both domestic and global markets. This study aims to analyze the effectiveness of digital technologies in Uzbekistan's light industry, exploring the key benefits, challenges, and international methodologies used to measure digital transformation.

Given the complexity and duration of the implementation of digital technologies in the activities of enterprises and for the timely adoption of correct management decisions, there is a need for a comprehensive assessment of the effectiveness of the use of digital technologies in the activities of enterprises. In this case, the assessment of effectiveness can be used both as a means of determining the level of digitalization and as a factor analysis of the digitalization process.

Literature review. In the coming years, economic growth will be associated with the full automation of processes, that is, with increased labor productivity and the radical introduction of new business models and technologies, such as digital platforms, digital ecosystems, and Industry 4.0 [5]. Computer information systems, digital and network technologies, due to the high quality, speed, and reliability of transmission, storage, and processing of digital signals, as well as other features, increase labor productivity, competitiveness, develop innovation, and ensure timely decision-making in production processes. [4]. The principles of the Internet of Things are widely used in industry, peripheral computing systems are being introduced into production processes, and special software is being developed that allows monitoring parameters in real time and making quick management decisions [6].

Research methodology. This study employs a systematic analysis approach to assess the efficiency of digital technologies in Uzbekistan's light industry enterprises. The following research methods were used:

➢ System Analysis Method – To identify key areas where digital technologies are implemented and assess their impact on production processes, logistics, and management.

➢ Comparative Analysis – Evaluating international best practices in digital transformation, including models developed by global consulting firms such as Deloitte, KPMG, PwC, and the German National Academy of Sciences and Technology.

➢ Quantitative Assessment – Measuring key performance indicators (KPIs) such as labor productivity, cost savings, and revenue growth before and after digital technology adoption.

➢ Case Study Approach – Examining specific Uzbek enterprises that have integrated digital solutions to understand real-world applications and challenges.

This methodological approach ensures a comprehensive evaluation of digitalization efficiency, providing both theoretical insights and practical recommendations for businesses and policymakers.

Discussion and results. Our research shows that there are currently several approaches to determining efficiency:

➢ efficiency as the ratio of the magnitude of the achieved effect and the amount of actual costs. With this approach, the activity that yields the greatest output per unit of output is characterized by the greatest efficiency. Ideally, the effect should be positive;

➢ efficiency as the level of achieving the set goals (indicators);

➢ efficiency as a criterion for realizing potential in the macroenvironment. To improve the result, it is necessary to use the resources of the microenvironment of the system being assessed to the maximum. Among the approaches considered to defining the concept and essence of the efficiency category, this provision represents the most detailed and complete understanding.

Efficiency in the implementation of digital technologies is defined primarily as the ratio of the results obtained and the costs of digitalization, i.e. the methods are based on a comparison of the results obtained and costs. The main problem of assessing the economic efficiency of digitalization is the optimal distribution of limited resources between the production and economic processes of the enterprise in conditions of uncertainty. Accordingly, modern methods of assessing efficiency should take into account the possibility of adjusting management decisions depending on changes in the level of risk in the implementation of digitalization processes.

Digital technologies are the main factor of global economic growth, and the world experience of using digital technologies creates the necessary conditions for the development of systems for analyzing the effectiveness of their implementation. In the course of our research, foreign methods for assessing the effectiveness of digital technologies in the activities of light industry enterprises were studied, which are presented in Table 1.

In Germany, the founders of the Industry 4.0 concept, the Industry 4.0 index was developed based on research by the German National Academy of Sciences and Technology, which allows determining the stage of the enterprise's digital transformation process. When determining the Industry 4.0 index, the main areas of digital transformation for all areas of the enterprise's activity (production, marketing, logistics, etc.) are assessed taking into account the available material and intangible resources, information systems, organizational structure and stages of implementation.

Based on this concept, the world's largest consulting and auditing companies have developed their own assessment models. The digital maturity model developed by Deloitte defines five main areas for assessing the prospects for digital development: strategy, technology, production, enterprise structure, and culture. Particular attention is paid to the enterprise strategy, including the prospects for the development and implementation of innovations, on the basis of which the business model and production and technological processes are formed.

➢ The digital capabilities assessment model was developed by KPMG and is based on a set of indicators distributed across five key areas of enterprise activity: strategy, management, digital capabilities, key digital transformation processes, as well as technological and resource flexibility.

The assessment results are presented in matrix form, and the industry average numerical assessment of capabilities is also included for comparison.

Table 1. Methodological approaches to assessing the economic efficiency of implementing digital technologies

Names	Producer	Purpose
Digitalization Index	Boston Consulting, Group, USA	It is used to assess the level of digital competencies development in comparison with existing competitors, industry averages, digital leaders and other groups.
Digital Maturity Model	Deloitte in partnership with the Massachusetts Institute of Technology	It defines the prospects for digital development in 5 dimensions: strategy, technology, production, organizational structure and culture. The organization's strategy and prospects for the development and implementation of innovations, on the basis of which the production and technological processes and the organization's business model are built, are assessed.
Industry 4.0	German National	This allows you to determine the stage of

Index	Academy of Science and Technology	development of the enterprise's digital transformation. The main areas of digital transformation for all areas of the organization's activity (production, marketing, logistics, etc.) are determined and assessed according to the following criteria: information, connectivity, visibility, transparency, predictability, self-correction.
Digital Capability Assessment Model	KPMG (Netherlands)	It is based on a set of indicators for 5 main areas of the organization's activity: strategy, management, digital capabilities, key digital transformation processes, technological and resource flexibility. The assessment results are presented in the form of a circular matrix.
Digital Champions	PwC (UK)	Identifies sources of digital priorities and assesses the internal potential of the organization's digital transformation: the presence of skills and competencies in the field of the digital economy; digital transformation of provided processes and services, implementation of digital technologies and platforms for clients
Business Digitalization Model	Institute for Statistical Studies and Economics of Knowledge, Higher School of Economics, National Research University	The assessment includes 3 indicators: broadband connection to the Internet information and communication network; use of RFID technologies for labeling and tracking products, contactless payment when purchasing goods, works, services; use of ERP systems for resource planning and automation of business processes of organizations; e-commerce.

➢ The audit company PwC has developed the concept of "Digital Champions" to identify sources of digital priorities (clients, production, technologies, interaction with employees) and assess the internal potential of the digital transformation of the organization in the following areas:

➢ skills and qualifications in the field of digital economy;

➢ digital transformation of provided processes and services, implementation of digital technologies and platforms for clients.

Our study shows that among the CIS countries, Russia also conducts research on the implementation of digital technologies in the activities of enterprises, and various methods for assessing the level of digitalization are being developed. For example, in order to study the degree of use of digital technologies by business entities and the level of their adaptation to the digitalization of the economy, an assessment was made of the business digitalization model developed by the Institute of Statistical Research and Knowledge Economy of the National Bank. The university's research is based on the following indicators:

✓ Broadband connection to the Internet and information and communication network;

✓ Use of technologies based on RFID and contactless signal exchange. Marking and tracking of products, use of contactless payment, biometric identification, etc. when purchasing goods,

works, services;

✓ Use of ERP systems, resource planning and automation of business processes of organizations;

✓ e-commerce platform.

The above methods for assessing the digitalization of enterprises determine the level of digital transformation of enterprises and the level of their implementation in business processes, that is, they assess the effectiveness of the implementation of digital technologies in the activities of the enterprise.

Thus, approaches to the implementation of digital technologies and the level of their use in different countries of the world vary depending, among other things, on economic development, as well as technological trends in a particular country. Digitalization tools are interconnected, the level of their application is determined by the number and quality of connections with other tools and mechanisms of digital transformation of the industry. At the same time, the transition to digitalization of light industry as a strategic goal exists in most developed countries, which is associated with modern global social, economic, technological and other trends.

In particular, the introduction of cloud computing technologies into the activities of light industry enterprises leads to the achievement of high efficiency in the digitalization of the enterprise.

Cloud computing is a data processing technology in which computer resources and capabilities are provided to the user as an Internet service.

Cloud is a new technology for using server resources that helps to use all available computing power and RAM by dividing them into different independent tasks.

Cloud computing technologies help light industry enterprises reduce capital expenditures, minimize security risks, increase the stability of IT services, and provide the ability to quickly expand IT resources. One of the important advantages of the cloud is the ability to easily regulate the amount of resources used and pay only for those resources that are necessary to solve the problem, without excessive fees.

Graph 1.Efficiency gains from digital technologies in light industry enterprises
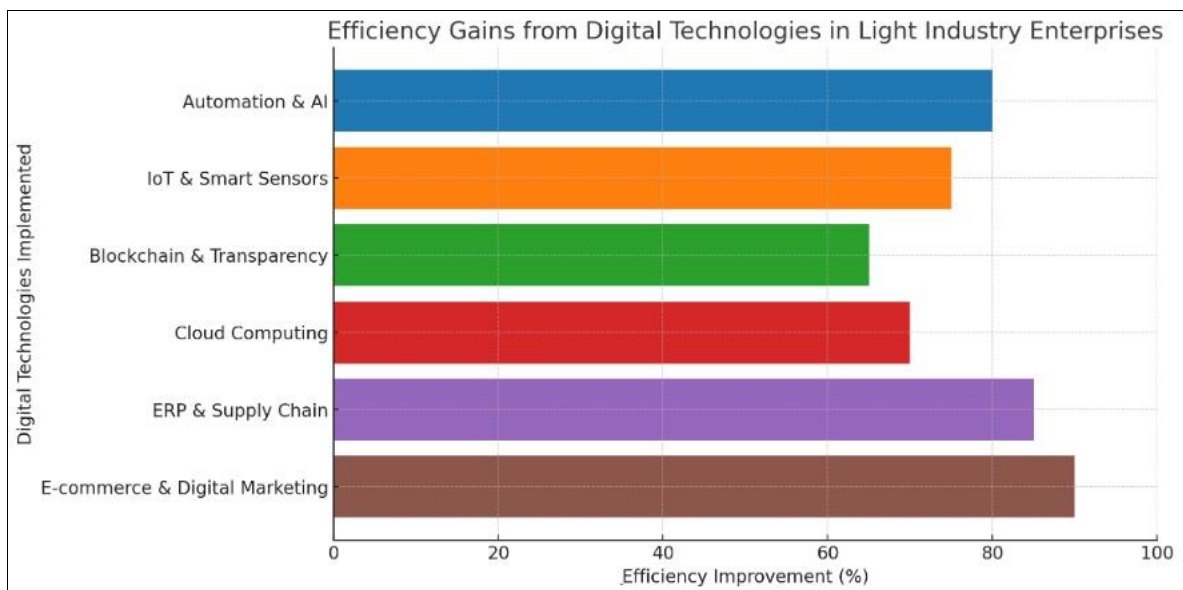
Here is a bar chart illustrating the efficiency improvements (%) achieved through different digital technologies in Uzbekistan's light industry enterprises. Key Insights from the Graph:

- E-commerce & Digital Marketing and ERP & Supply Chain show the highest efficiency gains (90% and 85%, respectively), indicating their critical role in optimizing production and sales.
- Automation & AI and IoT & Smart Sensors significantly improve productivity, reducing costs and errors.
- Blockchain Technology contributes to transparency and trust in supply chains, enhancing compliance with international standards.
- Cloud Computing provides flexible and cost-effective IT infrastructure, improving operational stability.

Optimizing internal business processes without additional costs is important for business leaders. This is one of the reasons for turning to cloud services and computing.

The move to cloud computing provides significant cost efficiencies in the following areas:

1. Deploying ICT infrastructure in the cloud can save 30% to 70% on total cost of ownership.

2. Reduce capital expenditure on equipment purchases by up to 70%.

3. Increase equipment operation and maintenance resources by up to 70% monthly.

4. Save up to 50% on monthly data center (DC) resources (electricity, cooling, space).

5. Reduce equipment pre-booking costs by 50-70% with monthly availability.

6. Reduce licensing costs by 30% each month.

7. Reduce new service deployment time by up to 90%.

Using cloud technologies in business leads to the following performance indicators:

1. Acceleration of implementation of new technologies.

2. Reduction of costs for acquisition of IT infrastructure.

3. Increased efficiency of the company's activity due to use of best practices.

4. Reduce expenses on software by renting only what you need.

5. Reduction of costs due to standardization of the used software.

6. Reduction of risk of data loss.

7. Reduction of expenses on IT personnel.

The main advantages of implementing cloud technologies are:

1. Availability and mobility. Access to cloud computing systems is possible from any place where there is an Internet connection. Company employees will be able to access their workplace from any remote point on the planet using any mobile device: laptop, tablet, netbook, smartphone.

2. Reduction of capital and operating costs. Cloud technologies allow you to reduce the daily costs of an enterprise for maintaining ICT infrastructure.

3. Operational control. Technologies allow an enterprise to fully automatically control the configuration of online services, as well as take the necessary measures in the event of the slightest malfunction, thereby ensuring their stable and trouble-free operation.

4. Scalability. Cloud computing allows you to almost instantly increase or decrease the scale depending on the unique needs of your business, paying only for the resources you use.

5. Security. Cloud technologies provide high security by combining computing resources, minimizing the "human factor" and strictly accounting for access to the service. In our study, the

indicator of total costs for the use of digital technologies in enterprises was determined by the following formula:

$BQK = DE + IC_1 + IC_2$ (1)

Here are:

DE – direct costs

$IC_{1,2}$ – indirect costs of the first and second groups respectively.

Here are:

$DE = DE_1 + DE_2 + DE_3 + DE_4 + DE_5 + DE_6 + DE_7$ (2)

Here are:

DE_1 – capital expenditures;

DE_2 – system management costs;

DE_3 – hardware and software technical support costs;

DE_4 – outsourcing costs;

DE_5 – travel expenses;

DE_6 – communication service costs;

DE_7 – other expenses.

The costs of implementing digital technologies in enterprises can be viewed not as expenses, but as investments in business.

Annual savings due to the reduction of manual labor for processing information when implementing digital technologies are calculated using the following formula:

$T = AX_1 - AAX_2$ (3)

$$AX_1 = \frac{z^1_i}{Q} * (1 + \alpha)(1 + \beta) * 12 \qquad (4)$$

where T is the amount of annual savings resulting from the reduction of manual labor in information processing:

AX_1 – annual operating costs when using manual labor to process information:

$AAX_2 = MV_1 + YX_2 + SX_3$ (5)

Z^1_i – basic monthly salary of the i-th employee;

Q – average number of working days in a month, days;

α - additional expense coefficient;

β - additional salary coefficient (contributions to social security, various funds, etc.).

AAX_2 – annual costs of using automated information processing:

MV_1 – annual machine time spent on solving the problem;

YX_2 – annual costs for filling out documents, analyzing and correcting data (manual operations);

SX_3 — annual costs for staff training, familiarization and equipment setup.

Our research shows that after the introduction of digital technologies in the activities of light industry enterprises, especially the use of cloud technologies in data processing, the productivity of the company's employees increased by 70-80%, and financial income increased by 10%. During our study, we calculated the costs of digital technologies at the enterprise and found that ICT costs at the enterprise decreased by 55%. Before improving the information systems in the company, 1 billion 764 million were spent on ICT. more than sums were spent, and in 2023, after improvement, the costs will amount to 970 million sums.

Our research shows that the implementation of cloud technologies allows not only to completely avoid the costs associated with the acquisition and further use of equipment, but also to save on the salaries of employees who are primarily responsible for the operation of the equipment. The use of cloud technologies for existing systems allows you to get rid of periodic costs associated with equipment maintenance.

The world's most innovative companies even consider cloud technologies as a means of revolutionizing entire industries. Cloud technologies are of great importance for solving information problems of large companies, enterprises and organizations, since transferring a powerful database to the cloud or actively using a virtual server or remote specialized software is more important than purchasing and storing physical devices.

Our research shows that the main areas that allow achieving high efficiency in the implementation of digital technologies in the activities of light industry enterprises are the following: improving product quality; determining demand and supply of new products to the market; logistics; post-development support; optimization of equipment operation; ensuring high efficiency and safety.

The main effect of the introduction of digital technologies in light industry enterprises should be reflected in the adoption of management decisions. Because the adoption of a further strategy for the enterprise's activities, improving the quality of products for consumers, and mastering new types of products are inextricably linked with the timely adoption of management decisions.

In the course of our research, a digital business model of the enterprise was developed and proposed for the effective implementation of digital technologies in light industry enterprises (Fig. 1). As can be seen from this model, as a result of collecting, integrating and analyzing data using digital technologies at the enterprise, it will be possible to effectively organize a number of tasks at the enterprise and create additional value.

Conclusion. Thus, digitalization in the light industry can improve automation, sustainability, customization, and supply chain management, while addressing challenges such as high initial investment, dependence on skilled labor, and global competition. By seizing the opportunities provided by digital technologies and overcoming the threats, light industry enterprises can achieve higher efficiency in the evolving digital environment.

The integration of digital technologies in Uzbekistan's light industry has demonstrated significant potential for improving efficiency, reducing costs, and increasing global competitiveness. Our study highlights that automation, AI, IoT, blockchain, ERP systems, and cloud computing are transforming production processes, supply chain management, and decision-making. These technologies enable enterprises to optimize resources, enhance product quality, and improve overall business performance.

The adoption of automation, AI, and cloud computing has led to an estimated 70–80% increase in workforce productivity.

Digital transformation reduces ICT expenditures, with cloud technologies cutting operational costs by 55% and improving resource allocation.

The use of digital platforms (ERP, blockchain, and e-commerce) enables enterprises to access global markets, improve transparency, and strengthen brand positioning.

Smart sensors and IoT applications optimize material use, minimize waste, and contribute to environmentally friendly production.

Despite these benefits, challenges such as high initial investment costs, lack of digital skills, and cybersecurity risks remain. To maximize the potential of digitalization, the following strategies should be implemented:

➢ **Government and Private Sector Collaboration** – Increased investment in digital infrastructure and technology adoption incentives.

➢ **Education and Workforce Development** – Training programs to equip employees with digital skills.

➢ **Cybersecurity and Data Protection** – Strengthening policies to safeguard enterprise data and ensure digital trust.

➢ **Scalability and Innovation** – Encouraging enterprises to embrace emerging technologies such as 3D printing and AI-driven predictive analytics to stay competitive.

The future of Uzbekistan's light industry lies in its ability to adapt, innovate, and integrate digital technologies effectively. Enterprises that strategically embrace digitalization will not only increase efficiency and profitability but also enhance sustainability and global market reach. As the government continues to push for industrial modernization through initiatives like "Digital Uzbekistan 2030," the role of digital technologies in light industry will become even more crucial.

By leveraging global best practices and localized strategies, Uzbekistan can establish itself as a regional leader in digitally advanced light industry production, paving the way for sustainable economic growth.

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