

**THE IMPORTANCE OF THE APPLICATION OF RESOURCE-EFFECTIVE
"GREEN" INNOVATIVE TECHNOLOGIES IN TEXTILE INDUSTRY ENTERPRISES
IN REDUCING PRODUCTION COSTS**

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Abstract. The article examines the issues of economic efficiency achieved in the reduction of production costs of the use of digital technologies in the organization of resource-saving production in textile industry enterprises.

Keywords. Textile industry, sustainable development, resource saving, innovative technologies, economic efficiency.

INTRODUCTION

It is necessary to continue the policy of structural changes and accelerated development of modern industries and production sectors based on high technologies, aimed at ensuring the competitiveness of Uzbekistan in the world market and strengthening its position. In solving these problems, there are urgent tasks in the production of competitive types of products by establishing a balanced use of production potential based on the rational use of all available resources, and in this process, the issue of using modern methods and innovative technologies in managing the potential of existing resources is of great importance in ensuring the sustainable development of textile enterprises.

However, today there are serious objective obstacles to reducing the cost of Uzbek textile products. Firstly, the remoteness of the Republic of Uzbekistan from seaports ("double landlocked") sharply increases transport and logistics costs. Secondly, instability in the supply of energy resources (electricity and gas) leads to disruption of the production rhythm and additional technological losses. Thirdly, the dependence on imports of dyes and chemicals makes the cost of production extremely sensitive to exchange rates.

Due to the impossibility of changing the above external factors in the short term, the only effective way to reduce costs is to use modern methods of managing the use of existing resource potential, preventing environmental pollution as a result of the use of internal resources, and preventing excessive consumption of material resources. Therefore, this article examines the importance of using resource-saving "green" innovative technologies in reducing production costs

at enterprises of the textile industry of the Republic of Uzbekistan, and develops relevant conclusions and proposals for effective management of resource potential.

LITERATURE REVIEW

Today, the use of innovative technologies based on the principles of a "green" economy is proving highly effective in the sustainable development of industrial enterprises. Therefore, the United Nations Environment Programme (UNEP) defines a green economy as an economic activity that "significantly reduces environmental risks and degradation, while improving human well-being and social justice". The United Nations Environment Programme, or UNEP, is a programme within the UN system that helps coordinate environmental protection at the system-wide level [1]. As foreign scholars N. Stern (2025) have noted: "a green economy is not only a means of solving environmental problems, but also a strategic approach to ensuring long-term economic growth. Innovative technologies, including digital solutions, serve to overcome the contradiction between economic growth and environmental protection" [2].

Another foreign scholar, J. Rifkin (2011), argues in his works that the combination of digital transformation and environmental sustainability can pave the way for a "third industrial revolution." According to his theory, information technologies and renewable energy sources will lead to a new stage of the economy [3].

We will first try to reveal the essence of the term "resource" while searching for opportunities to improve the efficiency of resource management in industrial enterprises. Extensive research work has been carried out by researchers to reveal the essence of this economic term. At the initial stage, the study of the concept of "resource potential" includes a more precise definition of the terms that make it up. "Resource" comes from the word "resource". According to S.I. Ojegov's "Annotated Dictionary of the Russian Language" (Ojegov S.I., 2023), it means: "reserves, sources of something, natural resources, economic resources and labor resources" [4].

Among the Uzbek scientists, R.A. Isaev studied the issues of improving organizational and economic mechanisms for implementing strategies for sustainable development of the textile industry [5].

It would also be appropriate to study the understanding and interpretation of the concept of resource potential by various authors.

M.V. Melnik and E.B. Gerasimova (Bromovich M., 2016), in turn, consider that "resource potential is a set of resources (labor and production) that ensure the continuity and efficiency of the organization's activities" [6].

A.G. Fonotov (*Fonotov A.G., 2025*) defines resource potential as “the volume of resources in comparison with national economic needs, taking into account the potential for expansion and replenishment of these resources in the long term, and its connection with the characteristics of resource sources.” This includes natural, material, financial and information resources, as well as the population [7].

RESEARCH METHODOLOGY. The research was based on the research results of foreign and local researchers on the subject and used methods such as statistical, selective observation, comparison, and expert evaluation.

ANALYSIS AND RESULTS

The study highlights the possibilities of minimizing operating costs by accurately controlling raw material and energy consumption and predicting technological waste using ERP systems, artificial intelligence (AI), and the Internet of Things (IoT).

The issue of alternative production costs within the framework of the concept of "Industry 4.0" in the global economy has been studied by many foreign scientists, in particular, K. Schwab, M. Porter. In their opinion, each link in the digital transformation chain serves to reduce additional costs in the process from the supply of raw materials to the sale of finished products [8,9].

To assess the effectiveness of digital technologies, it is first necessary to understand how the cost of production is formed at Uzbek textile enterprises. Analyses show that the main part of the costs in the production of yarn and fabric - on average 60-70% - falls on raw materials (cotton fiber, chemical fiber). Energy costs account for 10-15%, and labor and other operating costs account for the rest. According to statistics, for the production of 1 ton of fabric, an average of 1500-3000 liters of water, 1500-1800 kW/h of electricity, 100-250 kg of chemicals, 1.6-1.8 tons of cotton fiber are consumed, and 10-15% of waste is generated [10]. This makes it urgent to minimize waste and recycle it.

Therefore, the most important resource for reducing costs is the elimination of raw material waste and increasing energy efficiency. In our research, we studied the impact of the use of resource-efficient digitalization technologies on the cost of product production in industrial enterprises, in particular, in the textile industry, in increasing the level of resource utilization (Table 1).

Table 1

Results of the impact of the use of digital technologies on the cost of production¹

¹Author's development.

Digital technology	Scope	Economic effect (cost impact)
CAD/CAM systems	Planning and design	Reduces raw material waste by 10-15%
ERP systems	Warehouse and Finance	Saves up to 20% on working capital
IoT and Smart Sensors	Energy and Equipment	Reduces electricity consumption by 15-18%
AI (Artificial Intelligence)	Quality control	Eliminates waste by identifying 90% of defective products and eliminating costs

Results of the analysis of the data in Table 1:

A) Alternativeization of reserves through ERP systems:

In many cases, warehouse reserves (raw materials and finished products) are not adequately controlled in local enterprises. This leads to an increase in "frozen capital". Modern ERP (Enterprise Resource Planning) systems (for example, SAP, 1C:ERP) combine production, finance and logistics into a single chain.

B) "Smart" sensors (IoT) and energy efficiency. A promising direction of digitization in the management of production resources is the Internet of Things (IoT), or a system that connects digital devices into a common network that exchanges information without human intervention. According to Cisco estimates, "IoT technologies will generate assets worth about \$ 8.0 trillion in the next decade, of which \$ 1.9 trillion will fall on the logistics network" [11].

Textile machinery (spinning, weaving, dyeing) consumes a lot of electricity. Within the framework of the Internet of Things (IoT) technology, "smart meters" and sensors are installed on each device. They determine when the equipment is idle [12].

C) Artificial Intelligence (AI) and Quality Control:

Computer Vision systems detect even the smallest defect in the fabric (spot, thread break) in milliseconds and stop the machine.

D) CAD/CAM systems – The key to saving raw materials:

In sewing workshops, automated design systems (CAD) place patterns on the fabric surface in such a way that waste (cuts) is minimized [12].

In the course of the research, the effectiveness of the use of innovative technologies in the search for sustainable development opportunities based on the principles of the "green" economy at textile industry enterprises was studied using the analysis of the correlation of factors.

First, at the first stage, the correlation between the "Green Energy" and energy consumption indicators was studied. In the climatic conditions of Uzbekistan, there are an average of 300 sunny days per year. Textile factories usually consist of large hangars, the roof of which is an ideal area for installing solar panels.

We propose to calculate the efficiency of reducing the cost of production using the following formula:

$$E_{cost} = \frac{(W_{grid} \times T_{grid}) + (W_{solar} \times T_{solar})}{Q} \tag{1}$$

Here:

- Ecost — Energy costs per unit of product;
- Wgrid — The amount of electricity received from the grid (kW);
- Tgrid) — State electricity tariff (sum/kW);
- Wsolar — Energy received from solar panels (kW);
- Tsolar — Cost of solar energy (almost 0 sum, only depreciation);
- Q — Volume of produced product.

If an enterprise covers 40% of its needs with solar panels, the total energy costs will be reduced by an average of 35-40% (because free solar energy is used instead of the most expensive daytime tariff). The results of the comparative analysis of the obtained reporting data are presented in Table 1. In this case, the energy costs of the traditional technologies used in the production of 1 kg of product (yarn) in textile industry enterprises and the proposed (Digital + Green) technologies were compared (Table 1).

Table 1

Economic efficiency of a digital energy management system

Indicators	Traditional method	Digital + Green Method	Difference (+/-)
Energy consumption (per 1 kg of product)	3,5 kW/h	2,8 kWh	- 20 % (due to IoT)
Electricity source	100% State Grid	60% Grid / 40% Solar	Diversification

Average energy price (per 1 kWh)	1000 soums	600 soums (mixed)	- 40 %
Energy consumption per 1 kg of product	3500 soums	1680 soums	The cost has decreased by 1820 soums
Annual CO2 emissions	500 tons	300 tons	Environmental efficiency

In the second stage of the analysis, the relationship between the indicator "share of resource-saving "green" innovative technologies" and the indicator "reduction in production costs" in textile industry enterprises was studied using the method of correlation-regression analysis. The results obtained show that the limits of increasing the share of resource-saving "green" innovative technologies ($27\% \leq ETT \leq 41\%$) and reducing production costs ($GDP \leq 9.8\%$) were justified in improving the mechanisms for sustainable development of textile industry enterprises.

CONCLUSION/RECOMMENDATIONS

Based on the results of the research, the following conclusions and proposals were made to ensure the sustainable development of textile industry enterprises of the Republic of Uzbekistan in the future through the effective use of resource-saving technologies based on digital transformation and reduce costs:

- As a result of resource substitution through ERP systems, the demand for raw materials is accurately forecasted, which reduces excess inventory by 20-30 percent. This frees up the company's working capital and ensures increased production activity;

- The use of "smart" sensors (IoT) and solar energy to ensure energy efficiency will reduce energy costs by 12-15 percent;

- The introduction of artificial intelligence (AI) and a quality control system into production activities will eliminate the production of "defective" products and save processing costs;

- the use of CAD/CAM systems in the main production will allow reducing raw material waste by 10-15 percent compared to manual labor;

- the introduction of cost-effective technologies based on the principles of "green economy" at textile enterprises;

- the development of an effective quality management system at textile enterprises and its implementation in practice to establish the production of competitive product types;

- increasing export potential by applying the "GSP+" system to textile industry practice.

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