

International Congress on Economics, Management and Business Studies
Hosted Online from New York, USA
Date: 23rd November, 2026
Website: https://econferencia.com

APPLYING INNOVATIVE TECHNOLOGIES IN THE TEXTILE INDUSTRY TO IMPROVE PRODUCT QUALITY AND ENSURE PRODUCTION EFFICIENCY

Yusupov Saidvali Shukrullayevich
Doctor of Economic Sciences (DSc), Acting Professor
Department of International Tourism Management, Faculty of Tourism
Alfraganus University, Tashkent, Uzbekistan

Abstract
The paper analyses how automation, digital monitoring, artificial-intelligence-based quality control and eco-efficient technologies affect product quality and production efficiency in the textile industry, and develops practical recommendations for textile enterprises.

Keywords: textile industry, innovative technologies, product quality, production efficiency, digitalisation, automation, artificial intelligence, quality control, competitiveness, export potential.

Annotatsiya
Tezisda to‘qimachilik sanoatida avtomatlashtirish, raqamli monitoring, sun’iy intellekt asosidagi sifat nazorati va ekologik toza texnologiyalarni joriy etishning mahsulot sifati va ishlab chiqarish samaradorligiga ta’siri tahlil qilingan hamda korxonalar uchun amaliy takliflar ishlab chiqilgan.

Аннотация
В тезисе проанализировано влияние автоматизации, цифрового мониторинга, контроля качества на основе искусственного интеллекта и

экологичных технологий на качество продукции и эффективность производства в текстильной промышленности, разработаны практические предложения для предприятий.

Kalit so‘zlar: to‘qimachilik sanoati, innovatsion texnologiyalar, mahsulot sifati, ishlab chiqarish samaradorligi, raqamlashtirish, avtomatlashtirish, sun’iy intellekt, sifat nazorati, raqobatbardoshlik, eksport salohiyati.

Ключевые слова: текстильная промышленность, инновационные технологии, качество продукции, эффективность производства, цифровизация, автоматизация, искусственный интеллект, контроль качества, конкурентоспособность, экспортный потенциал.

INTRODUCTION

The textile industry remains one of the most labour-intensive and export-oriented sectors of the global manufacturing economy. In recent years, competition in international markets has shifted from price-based rivalry towards competition based on quality, speed of delivery, traceability and environmental performance. Under these conditions, the ability of an enterprise to introduce and absorb innovative technologies becomes a decisive factor of its long-term competitiveness. As M. Porter emphasises, the competitive advantage of nations and industries is created not by inherited factors of production but by the capacity of firms to innovate and upgrade continuously [1].

For Uzbekistan, the textile sector has a special strategic role: the country has moved from exporting raw cotton towards deep processing of fibre into yarn, fabrics and finished garments. Recent research shows that the growth of production and exports in the industry is closely linked to investment in fixed

capital and the modernisation of technological equipment [3]. At the same time, a considerable share of enterprises still faces problems of uneven product quality, high energy and water intensity, and insufficient digital integration of production processes. The purpose of this paper is to substantiate the role of innovative technologies in improving product quality and production efficiency in textile enterprises and to propose practical measures for their effective implementation.

MAIN PART

The modern technological transformation of the textile industry is part of the broader process described by K. Schwab as the Fourth Industrial Revolution, in which physical, digital and biological systems are increasingly integrated [2]. For textile manufacturing this means a transition from isolated machines to connected production systems, in which data on raw materials, machine parameters and product characteristics are collected and analysed in real time. Four groups of innovative technologies are of particular importance for the industry: (1) automated and high-speed spinning, weaving and knitting equipment; (2) Internet of Things (IoT) sensors integrated with manufacturing execution (MES) and enterprise resource planning (ERP) systems; (3) machine-vision and artificial-intelligence systems for automatic defect detection; and (4) resource-saving technologies of dyeing and finishing. Their main characteristics and expected effects are summarised in Table 1.



Table 1. Key innovative technologies in the textile industry and their effects on quality and efficiency

Technology	Stage of value chain	Impact on product quality	Impact on production efficiency
Automated spinning, weaving and knitting equipment	Yarn and fabric production	Stable yarn linear density and fabric structure; fewer manual errors	Higher machine speed and productivity per worker; lower labour costs
IoT sensors with MES/ERP integration	Entire production cycle	Real-time control of technological parameters; product traceability	Predictive maintenance, less unplanned downtime, better capacity planning
AI-based machine-vision inspection	Fabric inspection, garment finishing	Earlier and more objective detection of defects; consistent grading	Less rework and waste; reduced inspection time
Waterless / low-impact dyeing and finishing	Dyeing, printing, finishing	Uniform shade and colour fastness; compliance with eco-labels	Lower consumption of water, energy and chemicals; lower treatment costs
Digital product development (CAD/3D sampling)	Design and pre-production	Accurate fit and pattern; fewer design-related defects	Shorter sampling cycle and time-to-market

Source: compiled by the author on the basis of [1], [2], [4].

As Table 1 shows, the effects of innovative technologies are two-sided: practically every technology simultaneously improves product quality and reduces costs. This contradicts the traditional view that higher quality necessarily requires higher production costs. When technological parameters are controlled digitally, the variability of the process decreases, and therefore the share of defective products, rework and raw material losses falls at the same time. In this sense, quality and efficiency should be managed not as competing objectives but as two results of a single process of technological modernisation.

The mechanism through which innovative technologies influence the final results of a textile enterprise is presented in Figure 1. Individual technologies by themselves do not guarantee results; they create value only when they are combined into a digitally controlled production system with standardised parameters, real-time monitoring and predictive maintenance.

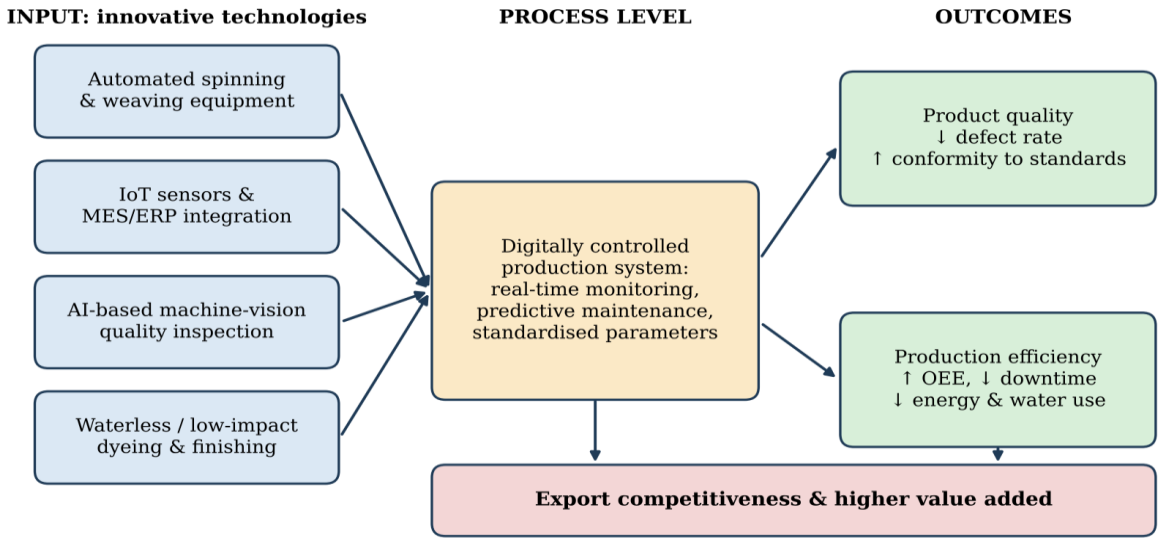


Figure 1. Model of the impact of innovative technologies on product quality and production efficiency in a textile enterprise

Source: developed by the author.

The model in Figure 1 highlights three levels. At the input level, the enterprise acquires equipment and digital solutions. At the process level, these solutions are integrated into a single production system in which decisions are based on data rather than on the subjective judgement of operators. At the outcome level, the enterprise obtains measurable improvements in quality (defect rate, conformity to international standards) and in efficiency (overall equipment effectiveness,

downtime, resource consumption), which together raise export competitiveness and the share of value added.

The experience of Uzbek textile enterprises confirms that the effectiveness of modernisation depends largely on the management system. G. Umarova notes that the strategic development of the industry requires not only the attraction of investment but also the improvement of management mechanisms at the level of the industry association and individual enterprises [4]. In practice, the main barriers to innovation include the high cost of imported equipment, a shortage of engineers and operators with digital competences, weak integration of separate information systems, and the limited use of production data for managerial decisions. Similar conclusions are drawn by A. Urinov, who links the further development of the industry to the deepening of processing and the renewal of the technological base [3].

Consequently, the introduction of innovative technologies should be organised as a staged process: first, digital accounting and monitoring of key processes; second, automation of quality control at critical points (yarn, grey fabric, dyed fabric, finished product); third, integration of all data into a unified MES/ERP environment; and fourth, the use of analytics and artificial intelligence for forecasting defects, equipment failures and demand. Such a sequence allows enterprises to obtain quick results at low cost and to finance subsequent stages from the savings achieved.

To evaluate the results of modernisation objectively, enterprises should rely on a balanced system of indicators rather than on the volume of investment alone. For quality, the most informative indicators are the defect rate at each technological stage, the share of first-grade products and the number of customer claims; for efficiency, they are overall equipment effectiveness (the product of availability, performance and quality rate), labour productivity and the specific consumption

of energy, water and raw materials per unit of output. Regular comparison of these indicators before and after the introduction of each technology makes it possible to identify the projects with the highest return and to adjust the modernisation programme in time.

CONCLUSION AND RECOMMENDATIONS

The study leads to the conclusion that innovative technologies are the key instrument for simultaneously improving product quality and production efficiency in the textile industry. Their effect is systemic: the greatest results are achieved when automation, digital monitoring, intelligent quality control and resource-saving technologies are combined in a single managed production system [1; 2]. On this basis, the following recommendations are proposed:

1) to develop at each enterprise a phased programme of digital modernisation with clear indicators of quality (defect rate, share of first-grade products) and efficiency (overall equipment effectiveness, specific consumption of energy and water);

2) to introduce machine-vision systems of automatic quality control at the critical stages of the technological chain, primarily in fabric inspection;

3) to integrate production data into unified MES/ERP systems and use them for predictive maintenance and production planning;

4) to expand the use of waterless and low-impact dyeing and finishing technologies in order to meet the environmental requirements of export markets;

5) to establish joint training programmes of enterprises, universities and technology suppliers to prepare personnel with digital and engineering competences [3; 4].

The implementation of these measures will help textile enterprises to reduce costs, improve the stability of product quality, strengthen their position in

international markets and increase the share of high value-added products in exports.

REFERENCES

1. Porter M.E. The Competitive Advantage of Nations. – New York: Free Press, 1990.
2. Schwab K. The Fourth Industrial Revolution. – Geneva: World Economic Forum, 2016.
3. Urinov A.A. Trends in the Activities of Enterprises of the Textile Industry of the Republic of Uzbekistan // Central Asian Journal of Innovations on Tourism Management and Finance. – 2023. – Vol. 4, No. 9. – P. 75–82.
4. Umarova G. Analysis of the strategic development of the textile industry and its management // Economics and Innovative Technologies. – 2023. – Vol. 11, No. 3. – DOI: 10.55439/EIT/vol11_iss3/i12.
5. Yusupov S.Sh. (2020). O‘zbekiston to‘qimachilik sanoati raqobatbardoshligini oshirishning innovatsion strategiyalari [Innovative strategies for increasing the competitiveness of the textile industry of Uzbekistan]: Monograph. Tashkent: Lesson Press. 218 p.
6. Yusupov S.Sh. (2019). Innovatsion to‘qimachilik korporatsiyalarini maqsadli raqobat mavqeiga erishish strategiyalari [Strategies of innovative textile corporations for achieving a target competitive position]. Moliya va bank ishi, (5), 192–199.
7. Yusupov S.Sh. (2023). Innovatsion to‘qimachilik korporatsiyalarini boshqarishda strategik ko‘ra bilishlikning nazariy yondashuvlari [Theoretical approaches to strategic foresight in managing innovative textile corporations]. O‘zbekiston bojxona axborotnomasi, (2), 33–40.



8. Yusupov S.Sh. (2024). O‘zbekiston innovatsion to‘qimachilik korporatsiyalarini tashkil etishning asosiy jihatlari [Main aspects of organising innovative textile corporations of Uzbekistan]. Mutafakkir, (29), 36–44.
9. Yusupov S.Sh. (2024). O‘zbekiston to‘qimachilik sanoati raqobatbardoshligini oshirishning innovatsion strategiyalari [Innovative strategies for increasing the competitiveness of the textile industry of Uzbekistan]. Marketing: ilmiy, amaliy va ommabop jurnali, (7), 47–55.
10. Yusupov S.Sh. (2025). The empirical study of textile research and industrial development. Mutafakkir, (31), 74–77.