EFFECTIVENESS OF DIGITAL TECHNOLOGIES IN THE DEVELOPMENT OF THE "GREEN" ECONOMY: QUALITY CONTROL IN THE TEXTILE INDUSTRY

Nabieva Kamola Furkatovna
Doctoral Student, Department of Management
Tashkent Institute of Textile and Light Industry
k.nabiyeva@ttyesi.uz
+998997901255

Annotatsiya. *Maqolada "yashil" iqtisodiyotning asosiy yo'nalishlaridan biri bo'lgan to'qimachilik sanoatida sifat nazoratini oshirishda raqamli texnologiyalarning roli yoritilgan. Matoda sifat, xavfsizlik va ekologiklikni tartibga soluvchi xalqaro standartlar va me'yorlar tahlil qilinadi. Ishlab chiqarish jarayonlariga raqamli yechimlarni integratsiya qilishning afzalliklari, barqaror rivojlanish, chiqindilarni kamaytirish va korxonalarning ekologik ko'rsatkichlarini yaxshilashga xizmat qiluvchi omillar sifatida ko'rsatilgan.*

Kalit so'zlar: *raqamli texnologiyalar, "yashil" iqtisodiyot, sifat nazorati, to'qimachilik sanoati, ISO standartlari, barqaror rivojlanish, IoT, bulutli hisoblash.*

Аннотация. *В статье рассматривается роль цифровых технологий в повышении эффективности контроля качества в текстильной промышленности как одного из ключевых направлений «зелёной» экономики. Описаны международные стандарты и нормы, регулирующие качество, безопасность и экологичность текстильной продукции. Выделены преимущества интеграции цифровых решений в производственные процессы, способствующие устойчивому развитию,*

снижению отходов и улучшению экологических показателей предприятий.

Ключевые слова: *цифровые технологии, «зелёная» экономика, контроль качества, текстильная промышленность, стандарты ISO, устойчивое развитие, IoT, облачные вычисления.*

Abstract. *The article examines the role of digital technologies in improving quality control efficiency in the textile industry as one of the key areas of the "green" economy. It describes international standards and regulations governing the quality, safety, and environmental sustainability of textile products. The advantages of integrating digital solutions into production processes are highlighted as factors contributing to sustainable development, waste reduction, and improved environmental performance of enterprises.*

Keywords: *digital technologies, green economy, quality control, textile industry, ISO standards, sustainable development, IoT, cloud computing.*

The development of the "green" economy requires the implementation of innovative approaches to production, including in the textile sector, which is one of the most resource-intensive and environmentally sensitive industries. A key priority is to improve product quality while simultaneously reducing the negative environmental impact.

In this context, digital quality control technologies play a crucial role, ensuring transparency, precision, and sustainability throughout production processes.

Quality standards form the foundation for product safety, design, and performance characteristics. They regulate parameters such as dimensional stability, fabric thickness, colorfastness, and finishing methods.

The International Organization for Standardization (ISO) defines the core principles of quality management systems and sets requirements for environmental responsibility and production safety.

Key regulatory documents include:

• CPSC (USA) — regulates product safety, including flammability and lead content;

• REACH (EU) — governs the use of chemicals in textile products;

• EU General Product Safety Directive — ensures consumer protection from potentially hazardous goods.

In the field of sustainable production, several ecological standards are widely applied:

• GOTS (Global Organic Textile Standard) — covers the full production cycle of organic textiles;

• OEKO-TEX® Standard 100 — guarantees the absence of harmful substances in fabrics and accessories.

Clear and reliable product labeling (composition, care, origin, size) is also an essential element of quality control and corporate environmental responsibility.

Several countries are actively developing sustainable textile production, introducing environmental initiatives such as waste recycling, the use of organic materials, and energy-efficient technologies. Their experience serves as a model for building a more ethical and eco-friendly textile industry.

The list of international certifications implemented by textile enterprises in Uzbekistan demonstrates the industry's readiness to operate in global markets, improve productivity, and enhance performance. International experience in standardization and certification has proven highly effective in achieving export competitiveness (Figure 1).

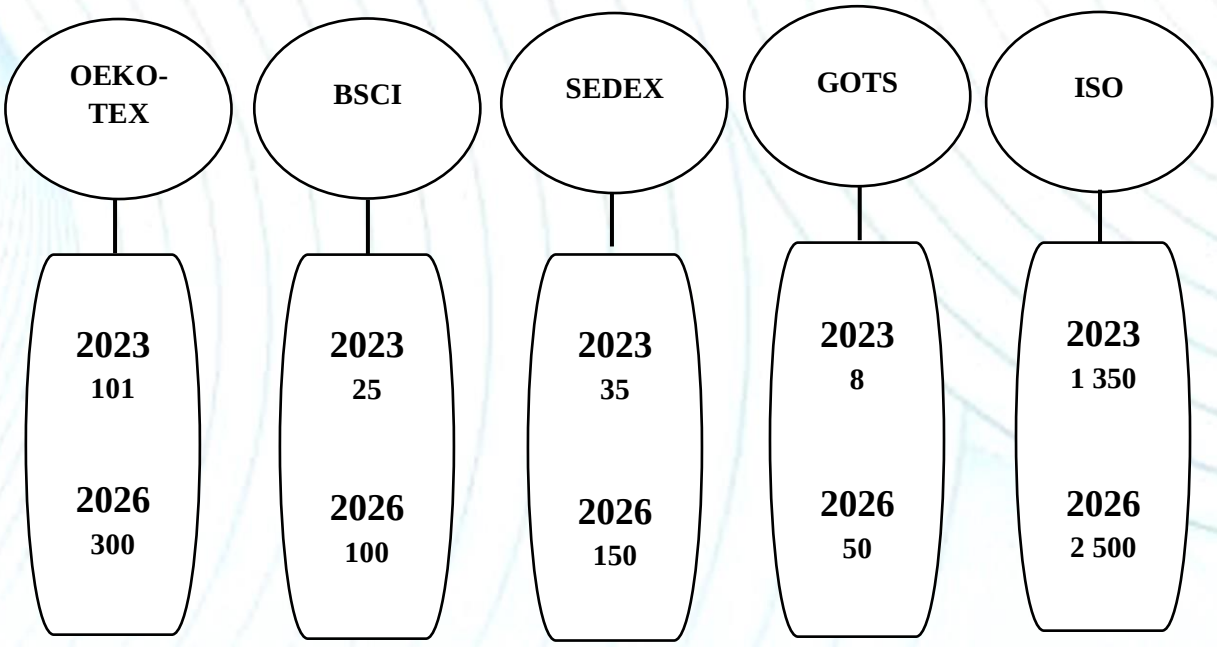


Figure 1. List of international certificates implemented in textile enterprises of Uzbekistan.

The role of digital technologies in garment quality control is particularly significant, as they integrate traditional production methods with modern tools for analysis, automation, and sustainable management.

Digitalization of quality control processes ensures high accuracy, objectivity, and speed of performance evaluation at all stages—from model design to final inspection of finished garments.

Technologies such as 3D scanning, artificial intelligence, machine vision, and the Internet of Things (IoT) substantially reduce human error, enhance standardization, and minimize production waste.

For example, 3D bodies scanners enable the creation of virtual patterns tailored to individual customer measurements, minimizing fabric waste and ensuring a perfect fit.

Modern technologies allow automation of key processes:

• 3D body scanners provide accurate measurements for custom tailoring while minimizing material waste;

• Spectrophotometers precisely measure color shades and ensure palette consistency across production batches;

• Automated sewing machines maintain stable seam quality, reduce errors, and increase productivity.

Data analytics helps identify and prevent potential quality issues through:

• analysis of material durability;

• evaluation of equipment and operator efficiency;

• integration of consumer feedback to refine quality standards.

Such systems enhance production sustainability and reduce defect rates, directly improving environmental performance.

Automated sewing systems and robotic lines ensure consistent quality, particularly in mass production. These systems can autonomously monitor thread tension, seam evenness, and stitch density, instantly responding to deviations from set parameters.

Cloud technologies centralize quality control data, allowing companies to monitor performance in real time regardless of location. This contributes to:

• standardization of production processes;

• faster decision-making;

• reduced duplication and energy consumption.

The Internet of Things (IoT) creates an interconnected ecosystem in which equipment and software interact automatically:

• sewing machines signal parameter deviations;

• cutting machines adapt to fabric properties;

• sensors and trackers monitor product movement throughout the supply chain.

This digital integration forms a closed feedback loop, minimizing human error and improving production sustainability.

Furthermore, the implementation of data analytics and cloud platforms allows centralized collection and analysis of information on material quality,

production performance, and consumer feedback. This not only increases internal audit efficiency but also supports continuous quality improvement and supply chain transparency.

Conclusion

The digitalization of quality control processes in the textile industry represents an essential step toward the transition to a "green" economy, improving product quality and promoting more efficient use of resources. The adoption of advanced technologies—such as 3D scanning, IoT, cloud computing, and data analytics—opens new horizons for enhancing production efficiency and sustainability.

Digital transformation not only improves performance indicators but also contributes significantly to the sustainable development of the textile sector. Reduced waste and optimized resources use lower environmental impact, decreasing pollution levels and minimizing water and energy consumption, thereby reducing the carbon footprint.

Thus, digital technologies become not merely tools for improving quality but strategic drivers of sustainability and competitiveness in the textile industry. By investing in digitalization, companies can enhance financial performance while contributing to the creation of a more sustainable and responsible textile sector.

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