

Digital Technologies Driving Circular Economy Adoption in the Textile Industry: A Systematic Literature Review



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Abstract

The textile industry has undergone a dramatic change in recent times because organizations are incorporating digital technology solutions for addressing issues related to sustainability and fast-tracking the journey toward a circular economy. These include Digital Product Passports (DPP), blockchain, Radio Frequency Identification (RFID), the Internet of Things (IoT), Artificial Intelligence (AI), and Industry 4.0 technologies, among others. The current research intends to conduct a systematic review of the literature on the topic of digital transformation and sustainability in the textile industry.

A Systematic Literature Review (SLR) was conducted following the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. In all, 55 peer-reviewed journals from 2020 to 2026 have been reviewed based on a structured selection process and analyzed using the thematic analysis approach. Six themes have been identified in the literature, which are as follows: Digital Product Passport, Digital Traceability Technologies, Industry 4.0 & Artificial Intelligence, Circular Economy Practices and Circular Supply Chains, Sustainability and Environmental, Social & Governance (ESG), and Barriers, Challenges and Future Research Directions.

The results show that digital technology greatly improves the traceability of products, efficiency, and resource recycling, facilitating sustainability along the supply chain. Yet, issues such as costly digital technology implementation, inadequate digital infrastructure, the absence of standardization in digital data structures, and organizational readiness hinder digital technologies' broader application. This research fills a gap in the literature in that it identifies a consolidated thematic framework explaining the role of digital technologies in transforming the industry sustainably. The results provide insights useful for academic studies, industry professionals, and policymakers working on sustainable textile ecosystems powered by digital technology.

Keywords: Digital Product Passport, Digital Transformation, Textile Industry, Circular Economy, Sustainability, Industry 4.0, Systematic Literature Review.

Introduction

The textile and apparel industries are amongst the most important manufacturing industries of the world that play an extremely vital role in economic development, international business, job creation and industrial development. One of the largest value chains of the world, the textile industry helps create substantial income for both developed and developing nations in its capacity as a generator of innovations and creating millions of jobs in the field of fibre manufacturing, textile production, clothing production, retailing and distribution of goods. Fast-paced development of fashion markets and rising demands of consumers has played a vital role in accelerating the process of production and consumption. (Rahman et al., 2025; Lavate et al., 2025; Mohite et al., 2025)

Even though it plays a critical role in the economy, the textile industry is becoming increasingly complicated due to globalization, fragmented value chains and

shifting customer demand. The phenomenon of fast fashion has substantially raised production amounts while simultaneously lowering usage periods of products, leading to unprecedented consumption of resources and wastage creation. The textile industry thus faces increasing pressure from government bodies, international organizations, consumers and other stakeholders to move to sustainable modes of production and consumption. There is a need to come up with innovative ways of doing business that can strike a balance between competitiveness and environmental considerations. This makes sustainability a key strategic concern in the textile industry. (Herrador & Imanishi, 2025; Sharma et al., 2025; Chourasiya & Malviya, 2025)

Although the textiles industry functions as an important engine for the growth of economies all over the world, at the same time it has been known to be one of the most environmentally aggressive industries

across the globe. It makes heavy use of natural resources such as water, energy, chemicals and raw materials during different phases of the product life cycle, ranging from fibre cultivation to textile manufacturing and garment making, through distribution, consumption and disposal phases. (Das & Dwivedi, 2024; Tedesco & Montacchini, 2020; Rahman et al., 2025)

The environmental impact of the textile industry is not confined to its manufacturing operations alone. The high amount of textile waste is produced each year owing to overproduction, short product lifecycle and growing consumer demands for affordable fashion products that change frequently. Moreover, inefficiencies in waste management and the widespread adoption of the "take-make-dispose" production system also add to landfill waste, greenhouse gas emission and wastage of valuable resources. These problems have caused concern across the globe about sustainable production and consumption, leading to the search for an alternative solution that can help mitigate environmental issues while remaining economically competitive. Thus, transforming the textile industry into a sustainable and efficient one has become a matter of urgency towards the goal of sustainability and climate change at the global level. (Islam et al., 2026; Saha et al., 2026; Osman et al., 2026)

Increasing concerns about the environmental impact of the textile industry have led to the exploration of sustainable production and consumption systems, with the circular economy (CE) being identified as one of the best options. This is because unlike the conventional linear economy model that operates on a "take-make-dispose" approach, the circular economy model focuses on extending the lifecycle of products through methods like reduced resource use, reuse, repair of damaged goods, remanufacture, and recycling of materials. The idea behind the circular economy approach is to keep the value of products and materials in the economy as much as possible. (Carvalho et al., 2025; Civera et al., 2025; Kumar et al., 2022)

As far as the textiles industry is concerned, implementation of circular economy approach calls for shifting from quantity-based production to value-based manufacturing that focuses on creating durable products, material recovery, and closing supply chains. This kind of change will involve the cooperation of several entities such as producers, providers of raw materials, retail companies, customers, recyclers, and policy-makers. Circular business models, like for instance, textile recycling, regeneration of fibres into new fibres, resale of clothing, rental solutions, repairing, and take back programs have been gaining more popularity as viable ways of combating textile waste and saving natural resources. Nevertheless, implementation of circular economy in the industry is difficult because of such barriers as fragmentation of the supply chain, lack of transparency, shortage of information exchange and underdeveloped

technology infrastructure. Therefore, there is a necessity of developing digital solutions that can help to deal with these problems. (Pathak et al., 2026; Chandra et al., 2026; Nguyen et al., 2026)

In the development of a circular economy model in the textile industry, apart from having sustainable models of business, the role of technology also comes into play. The effective adoption of digital technologies, which can help in increasing transparency, traceability, and better decision-making through the collection and analysis of data, is needed to make the implementation of circular economy in the textiles sector possible. With the growing globalization of textile supply chains, it has become important for all stakeholders to have digital tools that can help them monitor materials and products. (Amjad & Joshi, 2025; de Oliveira Neto et al., 2025; Hu et al., 2026)

Among the many digital innovations that have emerged, the Digital Product Passport (DPP) has become one of the most interesting innovations in terms of transforming the product lifecycle management process. Thanks to digital information regarding composition, origin, production processes, sustainability, repairability, and end-of-life options of products, decision makers can make better choices during the product lifecycle. Additionally, such innovations like blockchain technology provide higher security and transparency of supply chain data, while RFID, QR code, IoT and AI technologies help to track products and manage inventory in real time, perform predictive analysis, and optimize resources. Overall, all the mentioned technologies help to promote the circular economy approach by improving information exchange, reverse logistics, materials recovery and consumer confidence. However, even though there are many technological innovations, current literature is very scattered and examines different innovations independently from each other without paying attention to the contribution of digital technologies in the adoption of circular economy approach in the textile industry. (Abreu et al., 2025; Carvalho et al., 2026; Becchi et al., 2026; Ugale & Brewster, 2025)

Research Design

This research will use a Systematic Literature Review (SLR) framework to conduct an extensive analysis of the current state of knowledge regarding the role of digital technology in facilitating circular economy within the textile industry. Different from narrative literature review, the SLR methodology uses a rigorous and replicable framework in conducting a thorough investigation of relevant academic literature through identification, selection, appraisal and synthesis of the literature.

In order to make the review process more transparent and rigorous, the present study adheres following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines, PRISMA includes an international set of recommendations on how to perform and report systematic reviews in

accordance with a well-defined procedure consisting of four stages such as identification, screening, eligibility assessment and inclusion. Thus, by following PRISMA 2020, the present review assures that the literature search process is systematic and reproducible.

This review was formulated with the aim of compiling the latest literature on digital technologies such as Digital Product Passports, blockchain technology, RFID, Internet of Things (IoT), Artificial Intelligence (AI), among other digital technologies that help in implementing circular economy in the textiles industry. In addition, the current literature review also intends to identify the research trends, assess the existing knowledge, and offer research gaps for the future.

Database Selection

Literature search was carried out for this systematic review using Scopus as the database, because it provides extensive coverage of high-quality peer-reviewed literature (Page et al., 2021). Scopus was chosen for its reputation as one of the world's largest multidisciplinary databases, comprising a huge number of peer-reviewed publications from reputable journals in various disciplines, such as business, management, sustainability, environment, engineering and information technology. In view of the multidisciplinary nature of this research paper, Scopus can be considered a good source to conduct a literature search for relevant academic papers.

Justification for choosing Scopus was provided by the stringent indexing criteria, complete citation details and superior search capabilities of the database, which allow the use of Boolean operators, combination of keywords and filters to retrieve relevant literature. Furthermore, Scopus indexes high-quality, internationally visible journals, thereby making it a suitable database for carrying out a systematic literature review.

Based on the aims of the current literature review, the use of Scopus provided consistency in the search process while reducing overlap in databases and duplication of results across several sources. Thus, it

was deemed adequate enough to source the literature necessary for analysing digital technologies enabling the circular economy in the textile industry.

Search Strategy

The literature review for this topic was done by conducting a comprehensive search in the Scopus database for studies concerning digital technologies supporting the implementation of the circular economy model in the textile industry. The search string used was created using various terms associated with the main themes of the research, which included circular economy, textile industry, digital product passport, blockchain, radio frequency identification (RFID), Internet of Things (IoT), artificial intelligence (AI), Industry 4.0, traceability and sustainability. Boolean operators (AND, OR) were used in the search string.

The search included only peer-reviewed articles found in Scopus indexed journals. Other filtering options were employed to assure the appropriateness and validity of the selected papers, such as limiting the search by English language and subject fields, specifically business, management, environment, engineering, sustainability and technology. The search results were downloaded in CSV format.

There were initially 170 records obtained through the search. After removing duplicates and screening according to established inclusion criteria, there were 55 papers included in the thematic analysis discussed in this literature review.

Eligibility Criteria

In order to make sure that the systematic review was relevant, high in quality and consistent, predetermined eligibility criteria were created prior to conducting the screening. The studies found through the search were assessed taking into account their relevance to the research goals, publishing features and methodological appropriateness. Only those studies that fully complied with all inclusion criteria and did not comply with any exclusion criteria were selected for further analysis. The eligibility criteria used in this research are shown in Table 1.

Table 1. Eligibility Criteria

Inclusion Criteria	Exclusion Criteria
Peer-reviewed journal articles indexed in Scopus	Conference papers, book chapters, editorials, notes, and review summaries
Studies published in the English language	Publications in languages other than English
Studies focusing on the textile, apparel, or fashion industry	Studies unrelated to the textile, apparel, or fashion sector
Studies addressing circular economy, sustainability, digital technologies, or supply chain traceability	Studies not aligned with the objectives of the review
Full-text articles available for review	Articles with inaccessible full text
Studies published between 2020 and 2026	Publications outside the selected time period

Study Selection Process

The study selection procedure was done according to

the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) protocol. First, an

exhaustive search from the Scopus database was conducted and produced 170 documents. The results obtained were exported into CSV files and any duplicate documents were removed.

After excluding 28 duplicated articles, 142 unique papers were left for the selection process. Titles and abstracts of these papers were reviewed for relevance to the research topic. Papers not addressing any of the following topics were excluded from further consideration: use of digital technology, application of circular economic model and issues related to the

textile and fashion industry. The rest of the papers went through the full-text review.

After the application of the inclusion and exclusion criteria, 55 peer-reviewed journal articles were identified as being relevant and were included in the systematic literature review. These articles served as the foundation for the next stage of data extraction and analysis. The process of selecting the studies is presented in the PRISMA 2020 flow diagram (Figure 1).

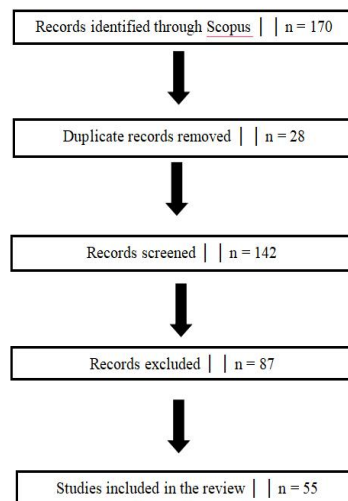


Figure 1. PRISMA 2020 flow diagram illustrating the study selection process

Data Extraction

A methodical extraction of information was done in order to make sure that there was consistency when conducting the review of the chosen studies. Information from all 55 academic articles was carefully collected using Microsoft Excel spread sheet. The information extracted from the selected studies comprised of the author(s), publication year, the journal, title of the article, Digital Object Identifier (DOI) and thematic categorization. Extra information related to the research focus, the digital tool used, circular economy application, and contributions made by the study was also collected.

It was possible to organize the literature review using the structured approach used for extracting data into similar categories. The extracted dataset formed the basis for identifying recurring themes, emerging trends, and gaps in knowledge within the extant literature on the digital technologies that facilitate the circular economy in the textile industry.

Data Analysis

The selected articles have been analyzed through a thematic analysis approach in order to find common concepts, research trends and patterns associated with the use of digital technologies that can help promote a circular economy in the textile industry.

After extracting data from the selected articles, each of the 55 articles was analyzed based on their research goals, methods, technology, and findings. The articles that share similar research emphasis have been classified into broad themes for analysis.

Firstly, the studies were classified according to the focal areas of the studies. Secondly, these classifications were further sorted out into six major themes, which are: (i) Digital Product Passport (DPP), (ii) Digital Traceability Technologies (Blockchain, RFID, IoT, and QR Codes), (iii) Industry 4.0, Artificial Intelligence, and Digital Transformation, (iv) Circular Economy and Circular Supply Chains, (v) Sustainability, ESG and Sustainable Business Practices, and (vi) Challenges and Future Research Direction. The thematic sorting helped to identify the dominant research trends, technologies, strategies and knowledge gaps in the literature. The thematic analysis approach offered an organized method of comparison of results in relation to each other and in terms of the connection between digital technology, circular economy concepts, and sustainable development efforts within the fashion industry. This synthesis of the evidence on the six themes serves as the foundation for the Results and Discussion chapter through thematic analysis (Braun & Clarke, 2006).

Table 2. Thematic classification framework adopted for the analysis of the included studies

Theme	Description
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Digital Product Passport (DPP)	Studies focusing on the implementation, adoption, traceability, transparency, and regulatory compliance of Digital Product Passports in the textile industry.
Digital Traceability Technologies (Blockchain, RFID, IoT & QR Codes)	Studies examining digital technologies that enhance product identification, tracking, authentication, and supply chain traceability.
Industry 4.0, Artificial Intelligence & Digital Transformation	Studies investigating Industry 4.0 technologies, artificial intelligence, machine learning, automation, and digital transformation in textile manufacturing and supply chains.
Circular Economy Practices & Circular Supply Chains	Studies addressing recycling, reuse, remanufacturing, upcycling, circular business models, textile waste management, and circular supply chain practices.
Sustainability, ESG & Sustainable Business Practices	Studies focusing on environmental sustainability, ESG, cleaner production, green innovation, sustainable manufacturing and sustainable business performance.
Barriers, Challenges & Future Research Directions	Studies identifying implementation barriers, adoption challenges, policy issues, enabling factors, and future research opportunities related to digital technologies and circular economy practices.

Overview of Included Studies

The number of studies included in the final systematic literature review is 55 journal articles that have been published between 2020 and 2026 based on the PRISMA-based screening process. The current studies reflect the state-of-the-art of the scientific research of digital technologies that facilitate circular economy activities and sustainability within the framework of the textile industry. The selected studies are related to different technological developments such as Digital Product Passports (DPP), blockchain, RFID, IoT, AI and Industry 4.0 applications.

Table 3 and Figure 2 show the annual publication rate of the selected articles. It becomes evident that there was a remarkable boost in the number of publications over the last two years of the research period. Only a few studies have been found in 2020 through 2024, while the number of publications has risen considerably in 2025 and peaked in 2026. It can be said that there is increasing attention being paid to the application of digital technologies for increasing traceability, transparency, efficiency, and circularity of the textiles industry.

The distribution of themes among the studies under review is illustrated in Table 4 and Figure 3 below. It can be seen from the analysis that Sustainability, ESG and Sustainable Business Practices, and Circular

Economy Practices and Circular Supply Chains are the leading themes of research, meaning that researchers have paid attention to enhancing environmental performance and resource efficiency in the textile industry as well as to development of sustainable business models. Another important theme includes studies related to Industry 4.0, Artificial Intelligence and Digital Transformation.

A fair amount of literature also discusses Digital Traceability Technologies such as blockchain technology, RFID, IoT and QR-codes which help to increase product traceability and transparency within textile value chain. However, in contrast, DPP is one of the recent fields of study because of its growing relevance in helping to ensure transparency within the product lifecycle. Moreover, a few studies reveal implementation challenges, organisational challenges, and opportunities for further research indicating that even though digital transformation has made a lot of progress, its implementation still remains constrained. In general, the results show that the existing literature has shifted from conventional approaches to sustainability to circular economy enabled through technologies. The following sections will analyze the different research themes in detail, discussing the key findings, technologies and gaps in research observed in the reviewed papers. (Page et al., 2021)

Table 3. Publication Year Distribution

Year	Number of Studies
2020	1
2021	0
2022	2
2023	0
2024	1
2025	21
2026	30
Total	55

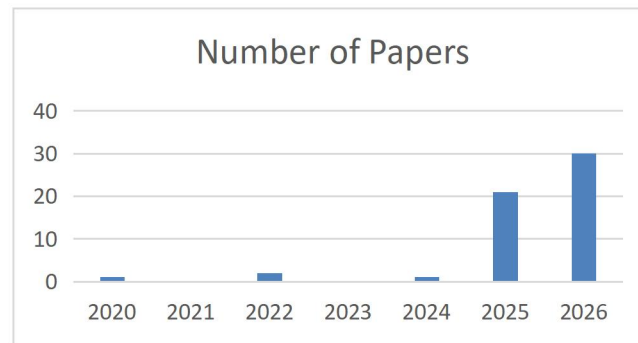


Figure 2. Publication trend of the selected studies (2020–2026)

Table 4. Distribution of Studies by Research Theme

Theme	Number of Studies
Sustainability, ESG & Sustainable Business Practices	15
Circular Economy Practices & Circular Supply Chains	14
Industry 4.0, Artificial Intelligence & Digital Transformation	9
Digital Traceability Technologies	7
Barriers, Challenges & Future Research Directions	7
Digital Product Passport (DPP)	3
Total	55

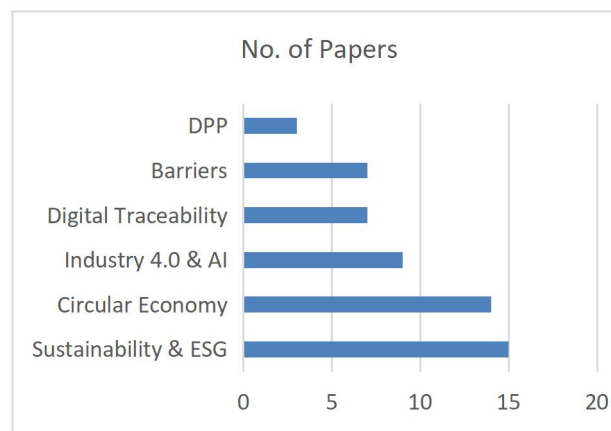


Figure 3. Distribution of the selected studies across the identified research themes

Digital Product Passport (DPP)

The development of Digital Product Passports (DPPs) can be considered one of the most important digital solutions designed to enhance the level of transparency, traceability, and circularity in the textile industry. As follows from the findings of reviewed literature sources, DPPs make it possible to store and share information about the entire life cycle of products, such as their composition, production process, impact on the environment, and end-of-life management (Abreu et al., 2025; Carvalho et al., 2025; Carvalho et al., 2026).

The literature confirms that DPPs support circular economy strategies by supporting the ability to repair, reuse, remanufacture, and recycle products. Improved traceability ensures that stakeholders know about the material content, resulting in improved resource

recovery and minimized waste from textiles. Moreover, DPPs ensure regulatory compliance and transparency in the supply chain through recording of sustainability information across the lifespan of the product. Studies among consumers also reveal that DPPs help in building trust, and promote sustainable behavior (Abreu et al., 2025; Boonpanya et al., 2026; Becchi et al., 2026).

However, the following drawbacks have been identified in the studies reviewed above, which include cost of adopting the system, data standardization, interoperability amongst the supply chain participants, and lack of digital maturity amongst others, especially for small and medium enterprises. This calls for the need for cooperation in developing industrial standards that can facilitate adoption of DPP in the industry. Future research on

the same ought to cover large scale implementation and integration with other related technologies like blockchain and RFID, as well as effectiveness of DPP in new textile producing economies (Carvalho et al., 2025; Carvalho et al., 2026; Becchi et al., 2026).

Digital Traceability Technologies (Blockchain, RFID, IoT and QR Codes)

There is an increasing use of digital traceability technology to enhance transparency and accountability within the textile supply chain. From the reviewed studies, it is clear that technology like blockchain, Radio Frequency Identification (RFID), Internet of Things (IoT) and QR codes enable the tracing of textile products through the entire product lifecycle. Such technologies allow better information exchange, reduce information asymmetry, and increase authenticity of the products, thus contributing towards circular economy. From among the technologies mentioned above, blockchain technology has been receiving significant consideration due to its capability to create a tamper-proof record of product information. Through data exchange in a trustable way among supply chain members, blockchain makes data manipulation impossible and facilitates sustainability certification. Likewise, RFID and IoT technologies offer efficient inventory management, automated data collection, and real-time data monitoring. Moreover, through QR codes, the consumers and recyclers can access relevant product information (Ugale & Brewster, 2025; Abreu et al., 2025; Carvalho et al., 2026).

While promising, the reviewed studies also reveal certain problems related to digital traceability technologies, such as the cost of implementation, issues with interoperability, cybersecurity problems, and the absence of unified data standards among supply chains. The problem is especially relevant for small and medium-sized textile companies that cannot afford to use these technologies because of their high cost and complex technical nature. Thus, the future studies need to concentrate on the development of cost-efficient digital traceability technologies (Ugale & Brewster, 2025; Boonpanya et al., 2026; Dake & Ahuja, 2026).

Industry 4.0, Artificial Intelligence and Digital Transformation

Integration of technologies from the field of Industry 4.0 has greatly facilitated the process of digital transformation within the textile industry. The studies under consideration have shown that manufacturers can become more efficient in operations, more effective in using resources and more successful in sustainability improvement with the help of new technologies like artificial intelligence (AI), machine learning, robotic vision, smart sensors, digital manufacturing and decision support systems (Rahman et al., 2025; Osman et al., 2026; Hu et al., 2026).

There is a range of implementations of the concept of Industry 4.0 within textile production. The use of AI

and machine learning allows improving production precision, performing quality inspection, yarn classification, forecasting the demand and optimizing processes through predictive maintenance. Digital manufacturing helps to optimize production processes and reduce material losses, energy consumption and environmental footprint (Kumar et al., 2026; Al-Dmour et al., 2026; Chourasiya & Malviya, 2025).

Moreover, the digital transformation contributes to the enhancement of the circular economy practices through increased resource efficiency and improved coordination among all supply chain functions. According to the review of literature, the use of Industry 4.0 technology combined with traceability methods such as Blockchain, RFID, and Digital Product Passports increases visibility and promotes sustainable production and consumption. Nonetheless, factors such as expensive investments, insufficient digital infrastructure, lack of skilled labour force and organisational reluctance are some of the issues preventing the adoption of Industry 4.0 technologies, especially among SMEs. Further investigation into scalable digital transformation strategies and the sustainability advantages associated with the application of Industry 4.0 technologies is thus recommended (Amjad & Joshi, 2025; de Oliveira Neto et al., 2025; Saha et al., 2026).

Circular Economy Practices and Circular Supply Chains

The concept of circular economy (CE) is a prominent topic studied in the textile field. It reflects the growing importance of using resources efficiently and creating a sustainable value. The articles show that the practices of CE are applied to the textile industry with the aim of reducing the negative impact on the environment and maximizing the utilization of materials. The most important CE practices in the field are as follows: recycling, upcycling, remanufacturing, extending product life cycle, circular business models, reverse logistics, and sustainable supply chain management (Carvalho et al., 2025; Islam et al., 2026; Das & Dwivedi, 2024).

It is evident from the literature that switching from the linear "take-make-dispose" to the circular production process is able to reduce waste generation and enhance the productivity of resources used. Designing products with regard to their durability, reuse possibility, reparability and recyclability helps to keep them in productive use for longer periods of time. Moreover, the application of circular supply chain practices helps to recover materials efficiently, manage waste effectively, and collaborate between producers, retailers, consumers, and organizations engaged in recycling (Chourasiya & Malviya, 2025; Saha et al., 2026; Kumar et al., 2022).

A number of researchers emphasize that digital technologies are one of the factors which facilitate circular economy development. For instance, Digital Product Passports, blockchain, RFID and Industry 4.0

technologies contribute to tracing products and materials, as well as exchanging information, thus enhancing recycling and closed-loop supply chains. Nevertheless, despite technological progress, there are many obstacles which hinder circular economy transition, such as lack of infrastructure, fragmented supply chains, consumers' low awareness, financial issues and lack of supportive policies. It is especially true for developing countries where the textile industry consists of numerous small- and medium-sized companies (Abreu et al., 2025; Ugale & Brewster, 2025; Dake & Ahuja, 2026).

In general, the studies considered reveal that efficient circular economy development presupposes a combination of the efforts of all parties involved – stakeholders of the industry, policymakers, and technology suppliers (Nguyen et al., 2026; Al-Dmour et al., 2026; Civera et al., 2025). Further research should concentrate on studying the effectiveness of circular business models, developing supportive policies, and investigating scalable approaches to integration of digital technologies and circular supply chain management (Islam et al., 2026; Chourasiya & Malviya, 2025; Saha et al., 2026).

Sustainability, ESG and Sustainable Business Practices

There is an increasing realization of the importance of sustainability within the textile industry owing to environmental challenges, stakeholder pressure and regulation. From the reviewed literature, there is clear indication that the notion of sustainable operations does not only involve environmental protection but also involves environmental social and governance (ESG) criteria that are critical for organizational performance. Sustainability initiatives enable textile organizations to increase efficiency, corporate reputation and competitiveness while at the same time contributing to global sustainable development (Kumar et al., 2022; Civera et al., 2025; Rahman et al., 2025).

From the literature review, various sustainability practices within the textile value chain have been identified including cleaner production, energy efficient manufacturing processes, sustainable sourcing, waste reduction practices, supplier selection based on sustainability, and green innovations. These initiatives lead to reduction of resources used, emissions and pollution as well as improvement of the quality of products. Moreover, digital tools such as Artificial Intelligence, blockchain technology, RFID and Industry 4.0 have increasingly been identified as facilitators of sustainable manufacturing (Hu et al., 2026; Osman et al., 2026; Amjad & Joshi, 2025).

Other research works highlight the role of ESG incorporation as a way to enhance the sustainability performance of organizations. Good governance systems, stakeholder involvement, and sustainability reporting increase the level of responsibility and provide the means for making informed decisions in the textile value chain. The literature reviewed above

identifies several constraints including insufficient financial resources, poor technological capacity, lack of standardization in terms of sustainability, and different regulations preventing the use of an integrated sustainability strategy especially by small and medium enterprises (Al-Dmour et al., 2026; Kumar et al., 2022; Saha et al., 2026).

All the findings from this literature review demonstrate that the path to sustainability in the textile industry is a holistic one which should include technological advancement, sustainable management, stakeholder engagement, and public policies. Future research should be directed at developing standardized ESG performance metrics, examining the impact of digital sustainability approaches, and developing ways to help textile firms achieve sustainable development (Rahman et al., 2025; Chourasiya & Malviya, 2025; Kumar et al., 2022).

Barriers, Challenges and Future Research Directions

However, despite an increasing application of digital solutions and the principles of the circular economy in the textile industry, a number of limitations in the implementation of these initiatives have been identified in the reviewed literature. First of all, these include a number of barriers such as the relatively high cost of implementation, underdeveloped digital infrastructure, non-integrated supply chains, the low level of interoperability of existing digital systems, and a lack of standardized data. It should be noted that these barriers are especially significant among SMEs due to their financial and technological limitations (Dake & Ahuja, 2026; Carvalho et al., 2026; Becchi et al., 2026).

Apart from that, there is also a number of organizational and regulatory factors that are considered to be obstacles to the digital transformation of the textile industry. These are resistance to organizational changes, a lack of skills required for the successful use of digital solutions, problems related to the protection of information and its security, and a lack of cooperation between supply chain actors. In addition, inconsistent sustainability regulations and policy gaps can be considered to be obstacles to implementing digital solutions (Al-Dmour et al., 2026; Nguyen et al., 2026; Osman et al., 2026). Several possible directions for future research may be identified from the literature review. First of all, more empirical analysis is required in order to test the effectiveness of Digital Product Passports, blockchain technology, Artificial Intelligence, and Industry 4.0 for improving sustainability and circularity in textile supply chains. Comparative research between developed and developing countries with the focus on the major textile producers like India may offer important insights into this issue. It is also crucial to examine how a combination of different digital technologies may contribute to enhancing supply chain transparency, resource efficiency, and circularity performance (Hu et al., 2026; Rahman et al.,

2025; Saha et al., 2026).

Interpretation of the Findings

Indeed, results of the conducted systematic review of scientific literature prove that the textiles sector is experiencing the process of significant transformation due to the emergence of the intersection of digital technologies and concepts of the circular economy. Digital technologies such as Digital Product Passports (DPP), blockchain, RFID, IoT, AI and other Industry 4.0 technologies function not as separate inventions but as an integral part of an entire digital ecosystem (Abreu et al., 2025; Carvalho et al., 2025; Ugale & Brewster, 2025).

It becomes clear that the usage of digital technologies is not only a means of operational efficiency enhancement and increase of the productivity but also the means for enabling sustainable transformations in the field of the business. Digital traceability technologies help to create transparency throughout the entire lifecycle of the product since it allows obtaining relevant information concerning product origin, materials used, and production methods (Becchi et al., 2026; Boonpanya et al., 2026; Chourasiya & Malviya, 2025).

Furthermore, it appears that the circular economy model increasingly depends on the use of digital technologies. Product reuse, repairs, remanufacturing, and recycling can be effectively performed in case there is adequate product data available, which is possible with the help of digital integration. Hence, digitalization and circular economy should be regarded as mutually supporting approaches, rather than two different organizational strategies. Those organizations that managed to successfully integrate both the digitalization and the circular economy models are likely to be more efficient and sustainable in their activities (Dake & Ahuja, 2026; Al-Dmour et al., 2026; Kumar et al., 2022). However, despite the mentioned improvements, the review also notes a number of challenges that limit the implementation of the circular economy models. Financial issues, technological complexity, the lack of an integrated supply chain, inconsistent data standards, and inadequate digitalization – especially among small- and medium-sized enterprises-remain important obstacles. Such conclusions indicate that technological progress is not enough for the achievement of sustainability. Coordinated action by all the relevant parties is required to overcome the identified challenges.

On balance, the review reveals that the future competitiveness of the textile sector will be contingent upon the successful integration of technological innovations with sustainable and circular business principles. The overall evidence suggests that the need for a comprehensive and collective effort is critical for creating resilient and environmentally friendly textile supply chains (Rahman et al., 2025; Saha et al., 2026; Islam et al., 2026).

Theoretical Implications

This systematic review makes an important contribution to the existing body of knowledge concerning digital transformation and sustainability in the textile sector by bringing together disjointed studies within a unified thematic framework. While past research has mostly been concerned with individual technologies or specific instances of sustainability, the current review reveals that Digital Product Passports, blockchain, RFID, IoT, Artificial Intelligence, Industry 4.0, and circular economy practices are better considered as interrelated parts of a digital sustainability ecosystem.

The thematic synthesis adds to the extant literature through the uncovering of the associations between technology innovation, circular economy deployment, and business practices aimed at achieving ESG goals. Digital transformation is not merely a new technology but also an essential factor in enabling sustainable business practices and circular supply chain management. At the same time, the analysis allows for summarizing the current state of implementation challenges and research gaps as the starting point for further empirical studies. Hence, this research provides conceptual grounds for the further exploration of digital solutions as a part of moving towards sustainability in the textile sector (Chourasiya & Malviya, 2025; Kumar et al., 2022; Saha et al., 2026; Al-Dmour et al., 2026).

Practical Implications

The results of this systematic literature review can be seen to hold some practical implications for the industry stakeholders including the textile manufacturers, policymakers and technology providers within the textile industry. The findings suggest that the manufacturers should take measures to integrate advanced digital technologies such as DPP, Blockchain, RFID, IoT, and Artificial Intelligence in their operations in order to enhance product traceability and resource management. This can enable them to increase the transparency in the supply chain processes and develop sustainable practices (Becchi et al., 2026; Dake & Ahuja, 2026; Carvalho et al., 2026). For the policymakers and regulatory agencies, the results of this review indicate that it is necessary to devise standards and policies to encourage the use of digital traceability systems and sustainable practices. Financial support and development of digital infrastructure is especially needed by small and medium-sized enterprises (SMEs) due to the resource constraints. Harmonisation of the regulations regarding product information and sustainability reporting will be beneficial for the international trade.

The results could be used by technology companies and supply chain partners to create interoperable digital platforms to allow for seamless data sharing within the textile value chain. Also, raising the awareness of consumers about traceability and

sustainability of products will result in responsible purchase decisions, leading to the growth of circular textile products. Altogether, these implications of the research prove that the digital transformation process must be carried out collaboratively (Saha et al., 2026; Al-Dmour et al., 2026; Islam et al., 2026).

Future Research Directions

The conclusions drawn from the above review present several areas for further investigation that are likely to contribute to knowledge development and application in this area. Firstly, it appears that the effectiveness of Digital Product Passports and their scalability requires more empirical research that would explore the impact of implementing such systems in terms of increasing the level of traceability, circularity and sustainability in the textile production chain. It is also important to explore how such passports can be integrated into digital systems involving blockchain, RFID, IoT and Artificial Intelligence (Carvalho et al., 2025; Abreu et al., 2025; Dake & Ahuja, 2026).

Secondly, comparative research in the sphere of digital transformation in the developed and developing economies is needed to identify differences between these regions in relation to the technology adoption process, readiness for regulation and implementation of circular economy principles. Of special importance seems to be the identification of the challenges faced by emerging textile producing nations like India, which experience rapid growth in the sphere of digital transformation. The focus on SMEs is particularly important in this regard (Rahman et al., 2025; Hu et al., 2026; Osman et al., 2026).

Finally, future research must formulate a standardized framework and set of performance metrics for examining the impact of digitalization on the environment, economy, and society in the textile industry. Future longitudinal research that evaluates organizational outcomes over time and cross-disciplinary research involving sustainability, supply chain management, information systems, and policy studies will offer better insights into the role of digital innovation in achieving a sustainable and circular textile industry (Kumar et al., 2022; Saha et al., 2026; Chourasiya & Malviya, 2025).

Conclusion

This systematic literature review presents an overview of the current state of research regarding the use of digital technologies for sustainability and circular economy in the textile industry. Following the PRISMA approach, 55 peer-reviewed journal articles published during the period from 2020 to 2026 have been identified and analyzed systematically. Thematic analysis of the literature yielded six main research areas: Digital Product Passport (DPP), Digital Traceability Technologies, Industry 4.0 and Artificial Intelligence, Circular Economy Practices and Circular Supply Chains, Sustainability and ESG, and Barriers, Challenges and Future Research Directions (Abreu et

al., 2025; Carvalho et al., 2025; Ugale & Brewster, 2025).

Thus, the study shows how digital technologies are viewed as enablers of supply chain transparency and resource efficiency in the textile industry. Technologies like DPP, blockchain, RFID, IoT and Artificial Intelligence make products more traceable, improve decision-making processes and help implement circular economy measures. On the other hand, this systematic review highlights a number of challenges that include high implementation costs, fragmentation of digital infrastructure, absence of standardized data frameworks, and organizational obstacles, especially for SMEs. Therefore, it seems impossible to achieve sustainable transformation by means of technology innovation only (Becchi et al., 2026; Kumar et al., 2022; Chourasiya & Malviya, 2025).

The review provides valuable contributions to existing literature through the development of an integrated thematic synthesis of recent studies and showcasing how digital technologies, collectively, contribute to the sustainability and circularity of the textile supply chain. Thematic framework presented in the paper will act as a solid platform for further studies while helping researchers understand the interconnections between digital technologies, sustainability, and circular economy concepts (Rahman et al., 2025; Saha et al., 2026; Al-Dmour et al., 2026).

There are some limitations associated with this study. It considered only peer-reviewed journal articles published during the years of 2020-2026 and focused only on the papers retrieved from the selected academic database. Hence, conference papers, book chapters, grey literature and other sources that are not in scope of the chosen criteria were not included in the analysis. Further research should widen the base of evidence through using multiple databases, performing empirical analysis in various geographic locations and considering the long-run impact of integrated digital technologies on the sustainability and circularity of the textile industry globally.

Overall, these results underscore the importance of the effective combination of digital innovation, sustainability practices, and collaboration among stakeholders for the future success of the textile sector. It is important to enhance the effectiveness of this combination in order to create sustainable textile supply chains that can foster sustainable development in the future (Islam et al., 2026; Dake & Ahuja, 2026; Carvalho et al., 2026).

References

1. Abreu, H., Pereira, V., & Barata, J. (2025). Blockchain-based digital product passport: Design principles and demonstration. *International Journal of Production Research*, 63(16), 5863–5882.
<https://doi.org/10.1080/00207543.2025.2464161>

2. Ugale, P., & Brewster, M. (2025). Unlocking circularity in textiles through a RAIN-enabled automated framework. *IEEE Journal of Radio Frequency Identification*, 9, 1–10. <https://doi.org/10.1109/JRFID.2025.3636554>
3. Boonpanya, O., Mitomo, H., & Otsuka, T. (2026). Consumer evaluation of digital product passport information: Evidence from a conjoint analysis in Japan. *Telecommunications Policy*, 50, Article 103249. <https://doi.org/10.1016/j.telpol.2026.103249>
4. Carvalho, C., Silva, C. J., Silva, T. L., & Abreu, M. J. (2026). Enhancing traceability and circularity in the textile sector: Leveraging digital product passports (DPP) for sustainable innovation. In *Springer Proceedings in Materials* (pp. 267–276). Springer. https://doi.org/10.1007/978-3-032-20865-1_26
5. Becchi, B., Cascavilla, A., D'Adamo, I., & Grosso, C. (2026). Digital product passports for cleaner production: Economic evidence from producers and consumers in the fashion industry. *Journal of Cleaner Production*, 564, Article 147792. <https://doi.org/10.1016/j.jclepro.2026.147792>
6. Abreu, M. J., Carvalho, C., & Silva, C. J. (2024). Implementation of the digital product passport (DPP) in the textile industry. In *Fiber Society 2024 Fall Meeting and Technical Conference: Come to Where the Future of Fibers Is*.
7. Dake, P. G., & Ahuja, V. (2026). Smart-circularity assessment for digital product passports in the textile-exporting countries of the Global South. *Procedia CIRP*, 142, 1548–1553. <https://doi.org/10.1016/j.procir.2026.05.174>
8. Carvalho, C., Silva, C. J., & Abreu, M. J. (2025). Circular economy: Literature review on the implementation of the digital product passport (DPP) in the textile industry. *Sustainability*, 17(5), Article 1802. <https://doi.org/10.3390/su17051802>
9. Shaker, S. A., & Elshazly, S. E. E. (2026). Circular advantage in global textile waste trade: Geographic vs. nongeographic distances in a fragmented world. *Journal of Shipping and Trade*, 11, Article 29. <https://doi.org/10.1186/s41072-026-00229-3>
10. Saha, K., Gupta, N., Yoruk, D. E., & Kumar, V. (2026). Sustainability-oriented innovation and circular economy transitions: Evidence from the UK textile and clothing industry. *Business Strategy and the Environment*. Advance online publication. <https://doi.org/10.1002/bse.70518>
11. Arango, R. M., Ledesma, K. L., & Leguia, J. M. (2025). Proposal to increase efficiency in the weaving area of a textile SME using SMED 4.0, E-Kanban and TPM (Pillar VI). *Congreso Internacional de Innovación y Tendencias en Ingeniería (CONIITI)*. <https://doi.org/10.1109/CONIITI68560.2025.11366207>
12. Krishna, R. K., & Palaniswamy, N. (2025). Framework for implementing energy efficiency strategies in textile SMEs to achieve sustainability and business growth. *Industria Textila*. <https://doi.org/10.35530/IT.076.03.2024160>
13. Lavate, S., Mandot, A., & Periyasamy, A. P. (2025). Strategies for achieving sustainable development in the Indian textile industry. *Journal of the Textile Association*. <https://doi.org/10.63665/jta.v86i4.6>
14. Rahman, A., Ahmad, M. F., Ansari, M. K., Husain, T., & Noor, H. (2025). Growth, environmental sustainability and inclusivity in the textile industry: A systematic literature review. *International Research Journal of Multidisciplinary Scope*. <https://doi.org/10.47857/irjms.2025.v06i04.06853>
15. Chaturvedi, D. K., & Chanana, B. (2025). The role of circular fashion in cultural sustainability: Upcycling Saura and Toda art forms. *Journal of the Textile Association*. <https://doi.org/10.63665/jta.v86i2.15>
16. Mohite, D., & Venkatesh, S. (2025). Sustainable fashion through recycling and circular economy: A review. *Journal of the Textile Association*. <https://doi.org/10.63665/jta.v86i01.05>
17. Herrador, D., Gómez, J., & García, M. (2025). Blockchain technology adoption for circular supply chains in the textile industry. *Kybernetes*. <https://doi.org/10.1108/K-08-2023-1449>
18. Gurusamy, S., Kumar, R., & Prakash, V. (2025). Industry 4.0 technologies for sustainable textile manufacturing: A systematic review. *International Journal of Clothing Science and Technology*. <https://doi.org/10.1108/IJCST-03-2024-0070>
19. Shreenidhi, S., & Narayanan, R. (2025). Digital transformation and smart textile manufacturing: Emerging technologies and applications. *Journal of the Textile Association*. <https://doi.org/10.63665/jta.v86i4.14>
20. Das, B., & Dwivedi, S. (2024). Post-consumer textile waste management practices and challenges in India: A systematic literature review. *International Journal of Environmental Science and Technology*. <https://doi.org/10.1007/s13762-024-06010-y>
21. Herrador, M., & Imanishi, M. (2025). Unlocking the circular economy potential in the textiles and fashion industries of Japan: Opportunities for European businesses. *Journal of Cleaner Production*. <https://doi.org/10.1016/j.jclepro.2024.144491>
22. Civera, C., Santoro, G., & Chiaudano, V. (2025). Do not stop the loop: Driving circular textiles with technology and stakeholder engagement. *Business Strategy and the Environment*. <https://doi.org/10.1002/bse.4250>
23. Kuo, P.-C., Chien, C.-F., & Chiu, M.-C. (2025). Company-level circularity indicator for small and medium enterprises: An empirical study in the textile industry. *Engineering Economist*. <https://doi.org/10.1080/0013791X.2025.2594977>
24. Sithi, S. S., Ara, M. A., Dhruvo, A. T., Rony, A. H., & Shabur, M. A. (2025). Sustainable supplier selection in the textile industry using triple bottom

- line and SWARA-TOPSIS approaches. *Discover Sustainability*. <https://doi.org/10.1007/s43621-025-01206-9>
25. Naranjo, I., de la Torre, R., & Boza, A. (2025). Sustainable decision-making in SMEs of the textile industry: Integrating methodologies, practices, and barriers. *Business Strategy and the Environment*. <https://doi.org/10.1002/bse.4295>
 26. Boonpanya, O., Mitomo, H., & Otsuka, T. (2026). Consumer evaluation of digital product passport information: Evidence from a conjoint analysis in Japan. *Telecommunications Policy*. <https://doi.org/10.1016/j.telpol.2026.103249>
 27. Carvalho, C., Silva, C. J., Silva, T. L., & Abreu, M. J. (2026). Enhancing traceability and circularity in the textile sector: Leveraging digital product passports (DPP) for sustainable innovation. *Springer Proceedings in Materials*. https://doi.org/10.1007/978-3-032-20865-1_26
 28. Becchi, B., Cascavilla, A., D'Adamo, I., & Grosso, C. (2026). Digital product passports for cleaner production: Economic evidence from producers and consumers in the fashion industry. *Journal of Cleaner Production*. <https://doi.org/10.1016/j.jclepro.2026.147792>
 29. Shaker, S. A., & Elshazly, S. E. E. (2026). Circular advantage in global textile waste trade: Geographic vs. nongeographic distances in a fragmented world. *Journal of Shipping and Trade*. <https://doi.org/10.1186/s41072-026-00229-3>
 30. Saha, K., Gupta, N., Yoruk, D. E., & Kumar, V. (2026). Sustainability-oriented innovation and circular economy transitions: Evidence from the UK textile and clothing industry. *Business Strategy and the Environment*. <https://doi.org/10.1002/bse.70518>
 31. Al-Dmour, R., Al-Dmour, H., Al-Dmour, Y., & Al-Dmour, A. (2026). Digitally circular: Unlocking sustainability performance through sequential transformation and green innovation in the fashion and textile industry. *Discover Sustainability*. <https://doi.org/10.1007/s43621-026-03562-6>
 32. Pathak, P., Sharma, R., & Singh, A. (2026). Digital transformation and circular economy adoption in textile supply chains. *Circular Economy and Sustainability*. <https://doi.org/10.1007/s44274-026-00766-5>
 33. Islam, M. R., Akash, B. M. A., Hossain, M. B., Hasan, S. M. K., & Banu, A. (2026). Upcycling versus recycling in fast fashion: A systematic-critical review of circular economy solutions. *Waste Management & Research*. <https://doi.org/10.1177/0734242X261418398>
 34. Aakanksha, Choudhary, S., Kumar, S., & Singh, S. (2026). Circular material innovations in textiles: Designing for recycling and reusability in the Indian context. *Macromolecular Symposia*. <https://doi.org/10.1002/masy.70166>
 35. Osman, M., Rahman, M., & Hasan, M. (2026). Industry 4.0 technologies for sustainable textile manufacturing: A review. *Smart Sustainable Human and Artificial Organizations*. <https://doi.org/10.1016/j.ssaho.2026.102734>
 36. Hu, Y., Zhang, X., & Li, J. (2026). Artificial intelligence and digital transformation for sustainable textile production. *Energy, Ecology and Environment*. <https://doi.org/10.1007/s43615-026-00737-1>
 37. Saha, K., Gupta, N., Yoruk, D. E., & Kumar, V. (2026). Digital innovation for sustainability transitions in textile supply chains. *Business Strategy and the Environment*. <https://doi.org/10.1002/bse.70822>
 38. Nguyen, T., Pham, H., & Tran, Q. (2026). Circular economy implementation in the textile sector: Challenges and opportunities. *Journal of Material Cycles and Waste Management*. <https://doi.org/10.1007/s10163-026-02563-x>
 39. S, G., Sundareswari, V. M., S.K, S., R, D. & D, M. (2026). Beyond Compliance: Mapping Csr Contributions To Sustainable Development Goals Among Leading Indian Pharmaceutical Companies. *Advances in Consumer Research*, 3(6), 400-404.
 40. Carvalho, C., Silva, C. J., & Abreu, M. J. (2026). Digital product passports and circularity in textile systems. In *Springer Proceedings in Materials*. https://doi.org/10.1007/978-3-032-06703-6_28
 41. Amjad, M., Joshi, S., & Khan, A. (2026). Legal and policy perspectives on digital transformation for sustainable textile supply chains. *Journal of Industry, Competition and Trade*. <https://doi.org/10.1007/s10751-026-02409-w>