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The Integration of Artificial Intelligence in Apparel Fashion Industry: A Bibliometric Analysis

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ABSTRACT

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This research paper is an exploration on the use of artificial intelligence in the apparel textile industry. The keywords which were used to retrieve relevant documents included Textile, Fashion industry, Apparel and Artificial intelligence, relevant documents were downloaded from authentic online databases, which included Web of Science, and Scopus. The bibliometric analysis of peer-reviewed articles was conducted on 234 articles. Data merging, summarization, and visualization of a network were done with the help of tools like, Biblioshiny and VOSviewer. The results show great and increasing academic interest in this field. The number of authors for 234 articles was 732, which is an indicator of active research cooperation. China, Spain and Hong Kong are the top in terms of publication output and citation impact. Donghua University is the most fruitful institution having 127 publications in the data. The co-occurrence analysis keyword reveals that the most common and most closely related term is that of Artificial intelligence. Analysis of the sources reveals that the journal which has issued the most articles related to the topic is the Textile research journal (14), next are the International journal of clothing science and technology and journal of the textile institute. There are also high levels of international cooperation as evidenced in the area of network visualization. A critical analysis of the top ten most pertinent articles shows that artificial intelligence has evolved into an operational support solution to a strategic facilitator that improves creativity, decision-making, efficiency, and sustainability throughout the textile and fashion value chain. It is on

this basis that a conceptual framework is suggested to direct future research. The research adds to the already existing debates about sustainable practices in the fashion industry and a basis to push the digital innovation forward to satisfy the increasing need in sustainable and customized products.

Keywords: Apparel, artificial intelligence, bibliometric, fashion industry, textile

INTRODUCTION

The societal, environmental and economic transformation in the industrial sector has changed the way of operation in various industries. The paradigm shift from industry 4.0 to 5.0 has brought massive changes over the adoption of advance information and communication technology in the business operation. According to the European Commission's report (European Commission, 2021), there has been a notable evolution in the foundational principles and strategies guiding industrial development, transitioning from the Industry 4.0 framework to Industry 5.0. Since its emergence around 2011, Industry 4.0 has primarily focused on leveraging digital technologies to facilitate flexible production systems and improve the effectiveness of industrial and operational processes (Ghobakhloo et al., 2022). In comparison, Industry 5.0 extends the foundations of Industry 4.0 by prioritizing research and innovation to promote industries that are sustainable, resilient, and centered on human needs. Consequently, modern operations and supply chain management (OSCM) practices are increasingly shaped by artificial intelligence (AI), supported by technologies that prioritize social and environmental values alongside sophisticated digital advancements and AI implementations. Traditional manufacturing systems under Industry 4.0 have evolved into smart factories through the incorporation of key technologies, such as the Industrial Internet of Things (IIoT) and big data analytics, aimed at enhancing process performance, product quality, manageability, and visibility (Nguyen et al., 2019).

The global apparel sector stands as one of the most prominent consumer-oriented industries. However, its inherent volatility demands exceptionally short lead times, placing sustained pressure on retailers to adopt cutting-edge technologies, particularly artificial intelligence (AI), to minimize production costs and deliver optimized solutions across design, manufacturing, and retailing processes. Within contemporary organizations, AI exerts a substantial impact on both economic performance and cognitive advancement, making it indispensable for leading enterprises. Approximately 80% of senior executives regard AI as the most transformative and disruptive technology warranting significant investment

(Wamba-Taguimdje et al., 2020). By harnessing sophisticated computational methods for instance, machine learning, neural networks, and cognitive computing AI enables the effective processing of vast, intricate, and diverse datasets, thereby fundamentally reshaping industrial manufacturing practices. AI has profoundly transformed the textile and apparel (T&A) industry by supporting a broad spectrum of functions. These include computer-aided design systems, personalized fashion recommendation engines based on sensory and preference data, smart tracking mechanisms, automated quality assurance in textiles, trend forecasting, informed decision-making in supply chain operations, and advanced e-marketing strategies leveraging social networks (Ayesha, 2025; Jhanji, 2017; Sun, 2025; Wang et al., 2025; Zhang et al., 2025). The textile manufacturing sector plays a pivotal role in the world economy, accounting for 38% of activity in the Asia-Pacific region, 26% in Europe, and 22% in North America (Gazzola & Grechi, 2025). Advanced AI applications have been effectively deployed to establish sustainable digital supply chains (Yadav et al., 2024) and have proven valuable across multiple stages, including apparel design, pattern development, sales forecasting, production planning, and supply chain optimization (Xiao, 2025). Artificial intelligence and big data are no longer some behind-the-scenes players in the realm of fashion, they were, in fact, the technologies that will keep changing the way fashion itself is being designed, produced, promoted, and consumed. They are disrupting very old industry conventions by designing production and stock management forecasts through algorithms as well as by hyper-personalized marketing and analytics-based sustainable programs (Xiao, 2025). These AI-driven capabilities have been instrumental in modernizing the textile manufacturing landscape. Industry 4.0 is transforming the fashion and textile industry and high-tech manufacturing industries with AI. Machine learning, computer vision, predictive analytics and generative design are transforming the way we create things, enabling us to create things more quickly, more accurately and creatively. In the textile industry, AI is used to know when machines are required to be repaired, identify defects immediately, save money, make patterns, and make smart fabrics. All these enhance the quality of their products and cut costs of operations and environmental impact (Biswas, 2025). H&M and Burberry are some of the biggest brands using AI to demonstrate the true advantages to its supply chain, inventory management, and customer experience (Biswas, 2025). The planet can also benefit through AI as it is used to pick improved materials, save energy, and contribute to a circular economy. People require new training, good morals, and prudent utilization of them to receive these benefits. Ultimately, the most effective outcomes

are achieved when technology development is matched with humanistic and sustainable thought-process.

The integration of sophisticated machinery and refined processes has markedly enhanced operational efficiency, leading to substantial improvements in overall industrial performance. The rapid growth of e-commerce has shifted consumer behavior, with increasing numbers browsing and purchasing clothing and fashion items online. In response, retailers are continually refining digital shopping experiences through AI applications. Beyond retailing, manufacturers, designers, and merchants are employing AI in areas such as conceptual design, pattern recognition, fabric finishing, packaging, and demand prediction.

Given the apparel sector's critical contribution to retail and the intensifying competition among online platforms, retailers are actively exploring AI integration in design, production, and supply chain management to elevate customer satisfaction and operational effectiveness.

In the context of this evolving paradigm, the present study seeks to provide a thorough and organized overview of the development of scholarly research on the conceptual dimensions of digital transformations within the fashion sector, with a specific focus on the apparel textile industry, viewed through the lens of Industry 5.0. Concentrating particularly on the incorporation of artificial intelligence (AI) in the apparel and textile sectors, the authors conducted a bibliometric analysis of 234 peer-reviewed articles sourced from reputable databases such as Web of Science and Scopus. The analytical methods employed in processing the bibliometric data allowed for the identification of the most impactful publications on this subject, thereby facilitating several key objectives: highlighting deficiencies in the existing systematic organization and examination of diverse digital tool applications in the sector; establishing a robust foundational framework to support the advancement of Industry 5.0 in the fashion domain; and clarifying its capacity to extend industrial models beyond Industry 4.0, with implications for future scholarly inquiry and practical implementation.

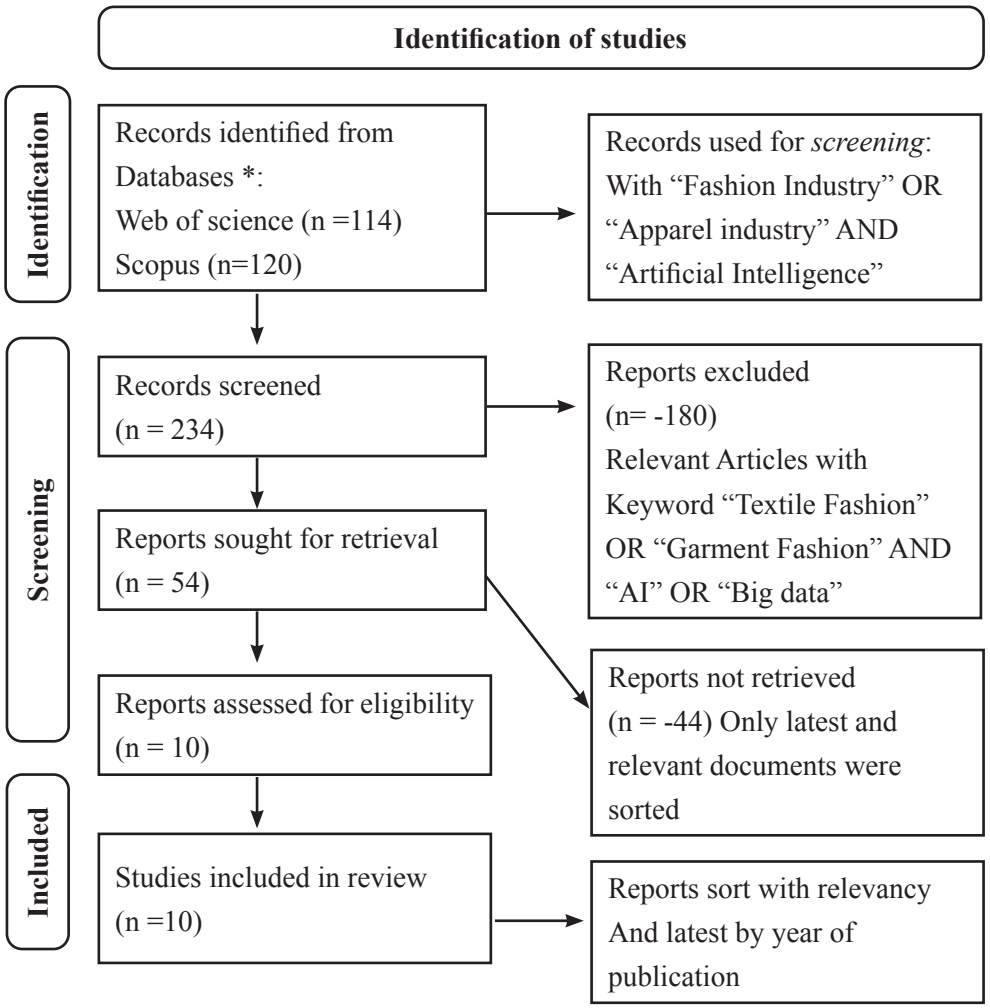
METHODOLOGY

The study employs a bibliometric review to collectively analyze all the scholarly literatures in a specific research domain since over 32-year period from 1992 to 2025 (Dec 5th). The dataset consists of 120 academic documents collected from Scopus and remaining 114 from Web of Science (WoS). The objective is to gain valuable insights into the evolution of the research domain and identify influential works, citations, countries, associations and authors of contributing major publications, prolific authors and emerging research trends in the field

of fashion industry. The initial stage or process is to accumulate the reliable and authentic data from the data source. Data preprocessing is conducted to ensure the data integrity and consistency. Here data were filtered for the further analysis process. For this different activities were followed like removing the duplicated data, addressing missing data and

Figure 1

PRISMA Model



The study selection process was conducted in accordance with PRISMA guidelines to ensure methodological transparency and systematic rigor. A total of 234 records were identified through database searches, including 114 articles from Web of Science and 120

from Scopus. The search strategy incorporated the terms "Fashion Industry" OR "Apparel Industry" combined with "Artificial Intelligence" to capture relevant literature within the defined scope. During the initial screening of titles and abstracts, 180 records were excluded due to their limited relevance to the research focus, particularly those emphasizing textile fashion, garment fashion, artificial intelligence in unrelated contexts, or broad applications of big data without specific alignment to the study objectives. Following this stage, 54 reports were retrieved for further consideration. Of these, 44 were excluded after applying additional criteria that prioritized the most recent and contextually relevant publications, with documents sorted according to relevance and year of publication. Subsequently, 10 full-text articles were assessed for eligibility and met all predefined inclusion criteria. These 10 studies were ultimately included in the final review and formed the basis of the qualitative synthesis.

RESULTS

Figure 2

Scholarly publications produced between 1992 and 2026.

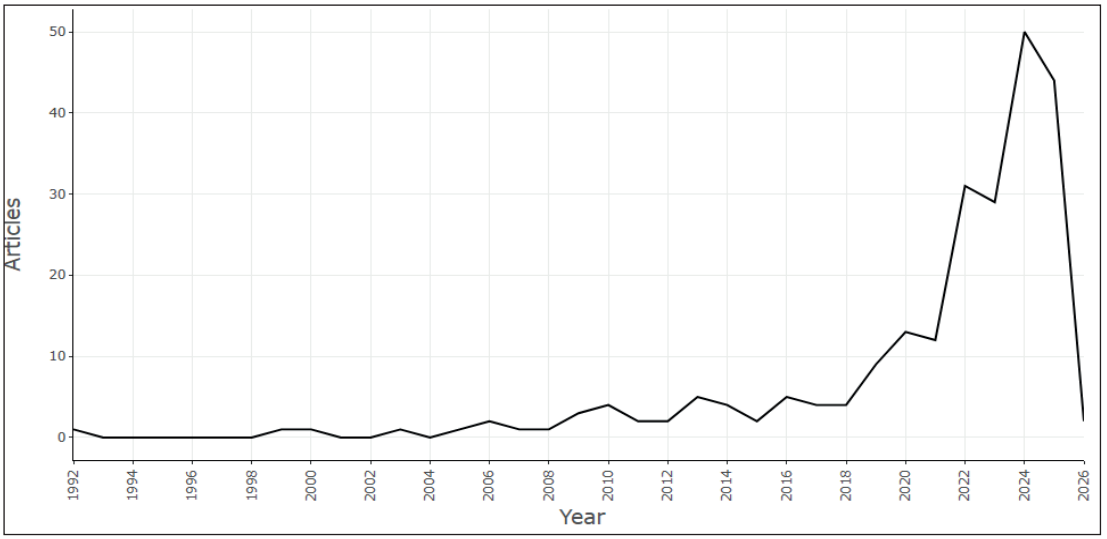
This study offers an in-depth bibliometric assessment of scholarly publications produced between 1992 and 2026. The dataset comprises 234 publications contributed by 732 authors, providing a broad basis for examining trends in authorship, collaboration, and thematic development within the field. The analysis highlights a strong culture of collaboration, reflected in an average of 4.27 authors per publication, although a small number of studies (six documents) were produced by individual authors, indicating the continued presence of independent scholarly contributions.

The intellectual diversity of the field is evident from the use of 871 unique author-defined keywords and the dissemination of research across 123 different publication sources. The literature appears relatively recent, with an average publication age of just over four years, suggesting a dynamic and continually advancing research domain. This is further supported by an annual growth rate of 2.06 percent, indicating steady expansion in scholarly output. In terms of academic influence, the documents demonstrate moderate to strong visibility, achieving an average of 12.67 citations per publication. A summary of these descriptive bibliometric indicators is presented in Figure 2.

Figure 3 presents the trend in annual scientific publications related to artificial intelligence in the textile and fashion industry. The results indicate that research activity in this area began at a very low level in 1992, with only one published article. In the following years, the publication output remained nil till 1999. After that publication output remained irregular and limited, showing slow but steady growth until approximately 2015. A noticeable change occurred after 2019, when the number of studies increased rapidly. This upward trend continued strongly and reached its highest point in 2024, with a total of 50 published articles. Overall, the findings clearly demonstrate a growing research focus on the application of artificial intelligence in the textile and fashion sector, highlighting its increasing importance in recent academic studies.

Figure 3

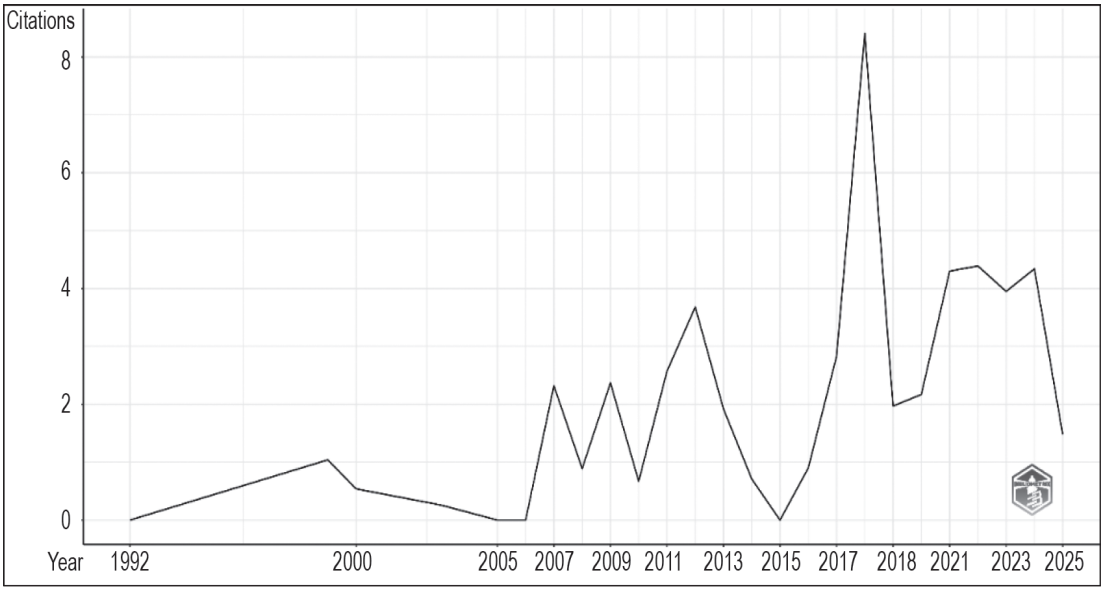
Annual Scientific Productions from 1992 to 2026



The citation pattern is examined next, as illustrated in Figure 4. The figure shows how research on artificial intelligence in the textile and fashion industry has developed over time. During the initial period from 1992 to 2006, scholarly activity was low, with only a small number of publications receiving limited citations. Between 2006 and 2015, citation levels gradually increased, reflecting growing academic attention and acceptance of the topic. The most notable change occurred between 2015 and 2019, when both the number of publications and the average citations rose sharply. In particular, the peak in average citations observed in 2016 indicates a period of strong research influence and impact.

Figure 4

Annually Citation Pattern



The figure indicates that the number of citations on average annually was extremely low and fairly constant since the early 1990s up to mid-2000s. One can notice a gradual growth after 2007, and then evident fluctuations. The maximum height is reached in 2018, which shows the highest average level of citation within the years of observation. Citations drop after this peak with a moderate increase in the period between 2020 and 2023, followed by a slightly decreasing trend in the last year. On the whole, the trend indicates growth with fluctuations in between with an obvious peak in the late 2010s.

Table 1

Most Relevent Sources

Sources	Articles
Textile Research Journal	14
International Journal of Clothing Science and Technology	10
Journal of The Textile Institute	8
Sensors	8
Journal of Donghua University (English Edition)	7
Engineering Applications of Artificial Intelligence	5
IEEE Access	4
Computational Intelligence and Neuroscience	3
Design Journal	3
Expert Systems with Applications	3

The table 1 exhibits the top 10 journals based on the number of articles published related to the application of artificial intelligence with textile fashion. Among the 123 publication sources identified in the field of artificial intelligence integration within the textile, apparel, and fashion industry, ten journals clearly emerge as the most commonly selected by researchers.

The Textile Research Journal stands out as the leading outlet, publishing 14 articles, which reflects its important role in sharing research related to the digital transformation of the fashion industry through artificial intelligence and related technologies.

Other well-recognized journals, such as the International Journal of Clothing Science and Technology, the Journal of the Textile Institute, Sensors, and the Journal of Donghua University, also make notable contributions to this research area. Each of these journals supports the dissemination of studies from different perspectives, ranging from material science and apparel technology to sensing systems and smart manufacturing.

The presence of diverse journals among the top sources highlights the multidisciplinary character of this research domain, showing how sustainability, technology, design, and innovation come together to explore the growing integration of artificial intelligence in the textile and fashion industry.

Table 2

Active institutional affiliations

Affiliation	Articles
Donghua University	118
Donghua University	9
Bangladesh University of Textiles	9
Seoul National University (SNU)	8
Universite De Lille	7
Seoul National University (SNU)	7
Engineering Research Center of Digitalized Textile and Fashion Technology	6
Hong Kong Polytechnic University	6
Shaoxing University	6

Furthermore, table 2 exhibits the most active institutional affiliations. The affiliation analysis indicates that research on the integration of Artificial Intelligence (AI) within the textile and fashion domain is predominantly concentrated in specialized textile and fashion oriented institutions. Universities such as Donghua University, Bangladesh University of Textiles, and Seoul National University (SNU), along with institutions like ENSAIT and Hong Kong Polytechnic University, demonstrate substantial scholarly engagement in this area. This concentration suggests that AI adoption in textile and fashion research is largely being driven by institutions with strong disciplinary foundations in textile engineering, fashion technology, and material sciences. The findings further imply a strategic integration of AI technologies—such as machine learning, computer vision, and automation—within traditional textile and fashion research environments, reflecting a transition toward digitally enabled and innovation-oriented academic ecosystems.

An examination of the Corresponding Author's Countries shown in Figure 8 highlights the leading role played by China in this research area. With a total of 116 published articles, China clearly dominates the field, reflecting its strong research capacity and sustained focus on the application of artificial intelligence within the fashion and textile sector. This high level of output also suggests a substantial influence on the direction and development of related studies.

Other countries also demonstrate meaningful participation, although at a much lower scale. India follows with 19 publications, indicating growing academic interest and involvement in this area. South Korea and the United Kingdom contribute 14 and 8 articles, respectively, showing steady engagement in research that combines artificial intelligence with sustainable

and innovative fashion practices. Together, these findings suggest that while China leads by a wide margin, several other countries are actively contributing to the advancement of artificial intelligence–driven approaches in the fashion and textile industry.

The next stage of the analysis focuses on collaboration between countries, as illustrated in Figure 6. This part of the study is based on 55 publications, since the remaining papers in the dataset were written by authors from a single country and therefore do not reflect international cooperation. The results clearly show that research in the textile and fashion industry is supported by a wide network of global partnerships. Scholars from different countries are increasingly working together to share knowledge and expertise in this area.

Strong collaborative links can be observed between China and France, Bangladesh and Australia, as well as China's partnerships with the United States, Malaysia, the United Kingdom, and Ireland, each involving several joint research efforts. These cross-border collaborations highlight the global character of research related to digital challenges and artificial intelligence in the textile and fashion sector. They also emphasize the value of international perspectives in shaping the future development of AI-driven practices within the industry.

Figure 5

Corresponding Authors Country

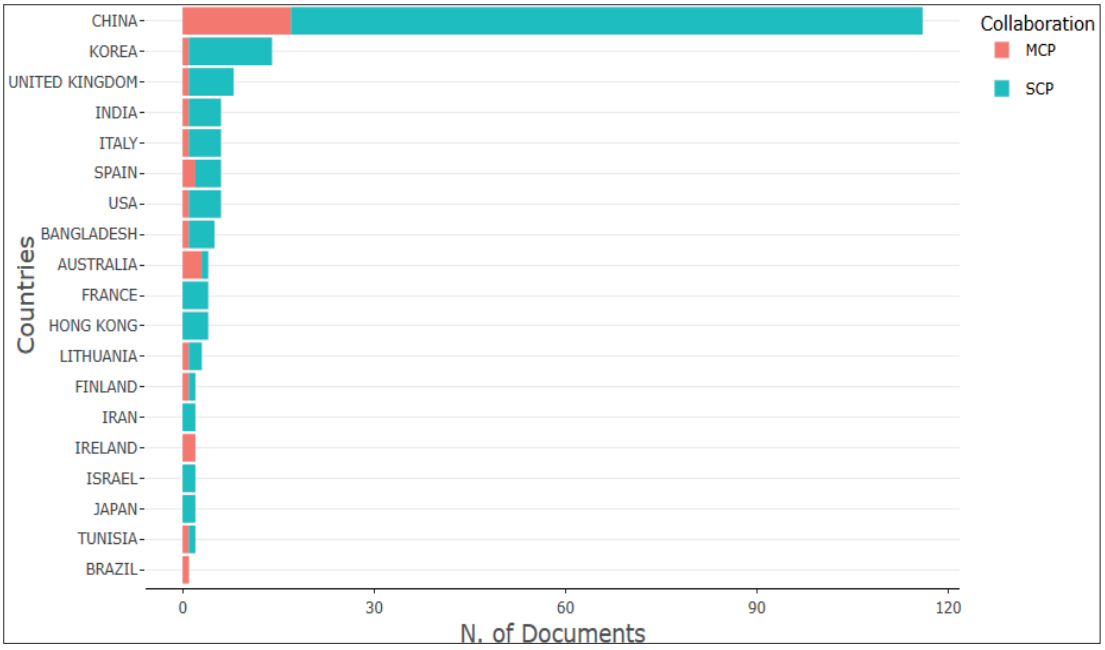


Figure 6

Countries' collaboration world map

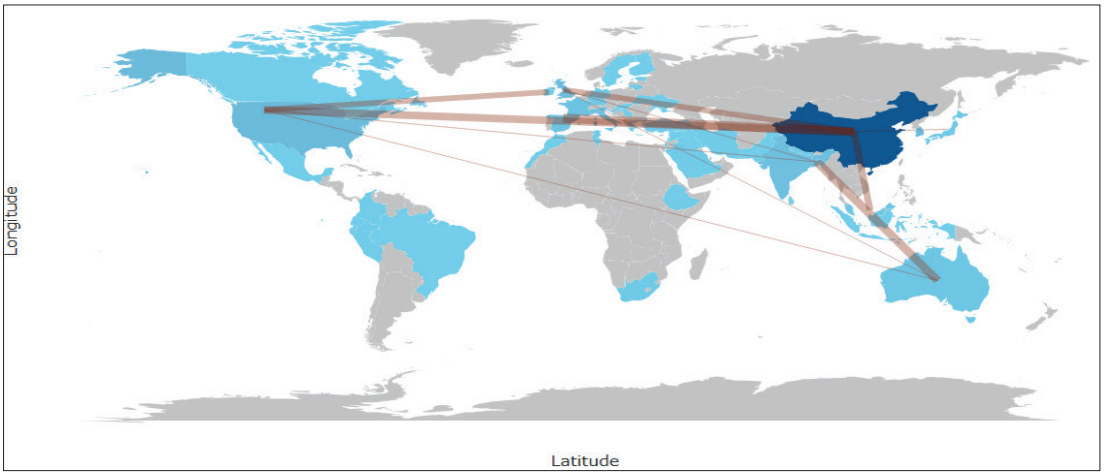
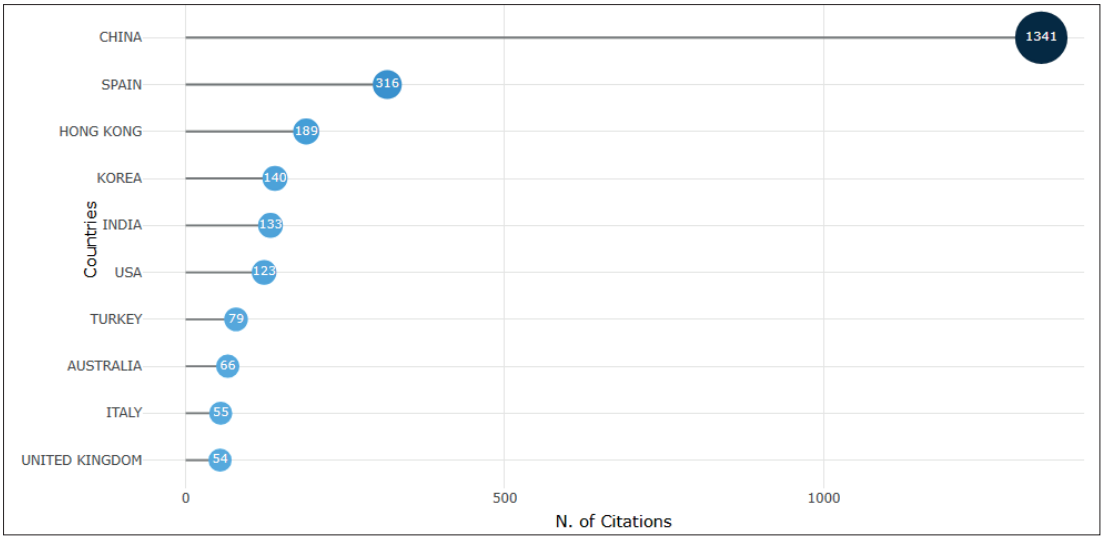


Figure 7

Distribution of total citations by country



The figure 7 illustrates the distribution of total citations by country. China records the highest number of citations (1341), substantially exceeding all other countries. Spain follows with 316 citations, while Hong Kong (189), Korea (140), India (133), and the USA (123) show moderate citation levels. Turkey (79), Australia (66), Italy (55), and the United Kingdom (54)

report comparatively lower citation counts. Overall, the data indicate a strong concentration of citations in China, with a considerable gap between China and the remaining countries.

Table 3

Country wise total and average article citation

Country	Total Citation	Average Article Citations
China	1341	11.60
Spain	316	52.70
Hong Kong	189	47.20
Korea	140	10.00
India	133	22.20
USA	123	20.50
Turkey	79	79.00
Australia	66	16.50
Italy	55	9.20
United Kingdom	54	6.80

The citation profile shows that there is a significant country difference in the research productivity and the per-article impact. China has the highest number of citations (1,341), which suggests that the country produces a lot of output, but the average number of citations is relatively low (11.60), which is a sign of a modest impact per publication. By comparison, Spain (316; 52.70) and Hong Kong (189; 47.20) have far more positive citations on average indicating more qualitative power even with lower total volumes. Turkey has the highest average (79.00) and total (79) which suggests that it has concentrated effects of a few powerful studies. In the meantime, India and United States are performing well, but Italy and United Kingdom are relatively weak in terms of average citation. In general, the results indicate that increased volume of publication is not always associated with increased citation impact.

Table 4

Top 10 Most Relevant Affiliations

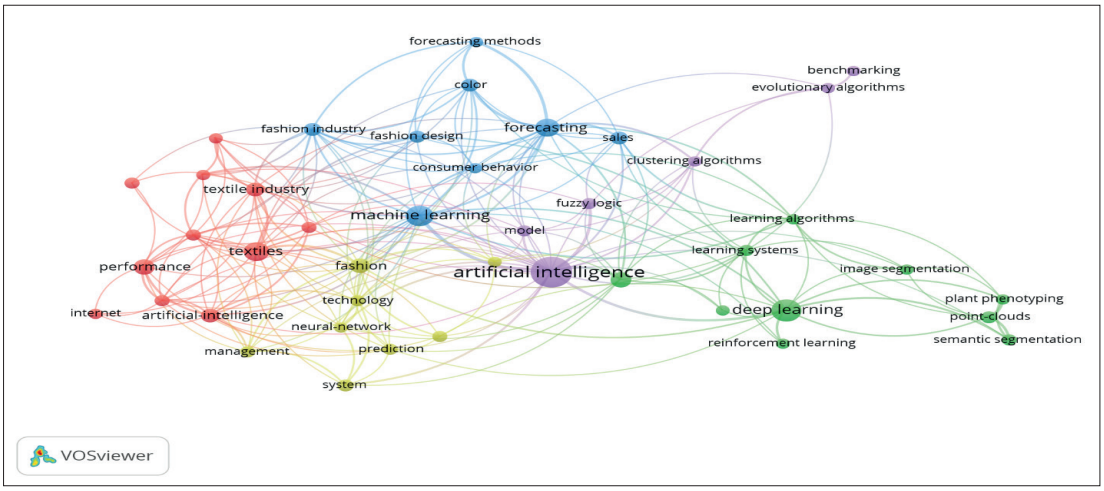
Affiliation	Articles
Donghua University	118
Donghua University	9
Bangladesh University Of Textiles	9
Seoul National University (SNU)	8
Universite De Lille	7

Seoul National University (SNU)	7
Ecole Nationale Superieure Des Arts Et Industries Textiles (ENSAIT)	6
Engineering Research Center Of Digitalized Textile And Fashion Technology	6
Hong Kong Polytechnic University	6
Shaoxing University	6

Keywords occurrence

Figure 8

Keywords occurrence in the documents



The figure 8 shows a co-occurrence network of keywords that represents the conceptual framework of research in the area of artificial intelligence in the textile and fashion sector. The size of nodes is the frequency of keyword and link strength is how much they co-occur. The entity of artificial intelligence can be seen as the biggest and central node, which allows recognizing its central role in the field of research.

It has several thematic clusters. One cluster relates to terms like machine learning, forecasting, and consumer behavior, which are the studies that focus on predicting and the market. There is another cluster with the name of deep learning, image segmentation, and similar words of the algorithms, which means the technology and methodological advancement. Another group includes textiles, textile industry, and performance, and the emphasis is on industrial and production-oriented uses. On the whole, the network displays a high level of thematic interconnections, where artificial intelligence is the key integrative concept in the technological, industrial, and market levels.

Analysis of top 10 articles based on the relevancy

Although bibliometric analysis provides a macro-level understanding of publication trends and intellectual structure, it offers limited insight into the substantive contributions of influential studies. To overcome this limitation, the present study complements the bibliometric findings with a qualitative synthesis of the most relevant articles identified through citation impact and thematic relevance. The analysis reveals four dominant thematic streams in the application of artificial intelligence (AI) within the textile and fashion industry: AI-based forecasting and decision support, generative AI for textile design and education, AI-driven operational modernization and smart textiles, and AI-enabled sustainability and circular fashion systems.

Early research on AI in the textile and fashion domain primarily emphasizes forecasting and decision-support applications, particularly in fashion color and trend prediction. Lin et al. (2010) demonstrate that the GM (1,1) gray forecasting model achieves higher predictive accuracy than hybrid gray–neural network models when applied to volatile and non-exponential fashion color data. Their findings indicate that simpler and more interpretable AI models may be more effective in fashion contexts characterized by uncertainty and limited historical datasets. Such AI-based forecasting tools support strategic decision-making in product development and reduce market-related risks in fast-changing fashion environments (Lin et al., 2010).

More recent studies indicate a paradigm shift toward creative and generative applications of AI. Wu and Li (2024) employ generative adversarial networks (GANs) to develop knitted textile designs and find that AI-generated textiles are perceived as aesthetically appealing and commercially viable when visualized in garment form. Their results suggest that generative AI can function as a powerful design-support tool capable of enhancing creativity and accelerating ideation processes. Similarly, Jung (2024) examines the integration of generative AI in fashion and textile education and reports significant improvements in students' digital competence, creative initiative, problem-solving skills, and communication abilities. Despite these benefits, both studies emphasize that AI complements rather than replaces human creativity, reinforcing the importance of human–AI collaboration in design and learning environments (Wu & Li, 2024; Jung, 2024).

Another major research stream focuses on AI-driven operational modernization and smart textile systems. Sikka et al. (2025) highlight the extensive use of machine learning, neural networks, and image-processing techniques across textile manufacturing processes, including yarn production, fabric formation, coloration, quality testing, and defect detection. Their review demonstrates that AI-based systems significantly enhance efficiency, accuracy,

and productivity while reducing manual intervention and operational errors. Beyond manufacturing efficiency, Luo et al. (2023) illustrate the application of AI in smart textiles through the development of a gesture-recognition glove that integrates flexible textile sensors with machine learning algorithms. The high classification accuracy achieved in their study underscores the potential of AI-enabled textiles in wearable technologies and human–computer interaction applications.

Sustainability-oriented research represents one of the fastest-growing application areas of AI in the textile and fashion industry. Manzo et al. (2025) examine the role of AI-based conversational agents in promoting sustainable fashion consumption and find that such agents positively influence consumer attitudes and purchase intentions toward eco-friendly products. However, their study notes that current implementations are largely limited to text-based chatbots, leaving immersive and embodied AI interfaces underexplored. Complementing consumer-focused research, Nisa et al. (2025) investigate the use of computer vision and deep learning techniques for textile sorting, defect detection, and recycling within circular economy systems. While AI-driven approaches demonstrate strong potential for improving waste reduction and resource recovery, the authors identify persistent challenges related to limited datasets, lack of standardization, and restricted focus on specific garment components rather than complete products (Nisa et al., 2025).

Table 5

Review Matrix of literatures

Author /s	Objective	Methodology	Key Findings	Conclusion	Future Research
(Lin et al., 2010)	Forecast textile fashion color trends using GM (1,1) and compare with GNNM(1,1).	Quantitative forecasting; GM (1, 1) & Gray Neural Network; 6-year historical dataset; R^2 accuracy testing.	GM (1,1) showed higher prediction accuracy (R^2 up to 0.94); outperformed GNNM.	GM (1,1) effective for fashion color forecasting due to suitability with non-exponential trend data.	Develop adaptive or hybrid models tailored to non-exponential fashion trend data.

Author /s	Objective	Methodology	Key Findings	Conclusion	Future Research
(K. Hossain et al., 2025)	Examine organizational readiness for AI & BDA adoption in Bangladesh textile industry.	Qualitative study; 30 semi-structured interviews; deductive thematic coding.	Overall low readiness (human, finance, engagement weakest); leadership barriers present.	Industry not fully prepared for AI/BDA adoption due to structural and financial constraints.	Improve leadership awareness, workforce skills, and financial models for AI adoption.
(Wu & Li, 2024)	Apply generative AI (StyleGAN) in knitted textile design.	Experimental deep learning design; Style GAN; 1,687-image dataset; qualitative evaluation.	AI-generated textiles achieved comparable or superior aesthetic value.	Generative AI has strong creative and practical value in textile design.	Optimize dataset size; refine models; use FID/IS metrics; test other textile categories.
(Jung, 2024)	Enhance soft skills through AI in sustainable fashion education.	AI-integrated curriculum; 27 students; surveys & interviews.	Improved digital competence, communication, problem-solving, initiative.	AI enhances essential soft skills and supports sustainable fashion education.	Expand curriculum duration; use advanced AI tools; increase sample size.
(Sikka et al., 2025)	Review AI applications in textile operational modernization.	Systematic literature review; AI in yarn, fabric, coloration processes.	AI improves automation, testing accuracy, and efficiency.	AI modernizes textile manufacturing and enhances productivity.	Not explicitly stated.
(Luo et al., 2023)	Develop ML-based gesture recognition glove for auditory-impaired users.	Experimental design; flexible strain sensors; Logit Adaboost algorithm.	Achieved 97% recognition accuracy; high sensor sensitivity.	Sensor fusion with ML enables high-accuracy gesture recognition.	Not explicitly stated.

Author /s	Objective	Methodology	Key Findings	Conclusion	Future Research
(Manzo et al., 2025)	Review AI conversational agents in sustainable fashion.	PRISMA systematic review; 15 studies (2019–2023).	Text-based chatbots dominate; focus on consumer adoption.	Growing interest; gap in embodied agents and advanced interaction.	Explore embodied agents, VR integration, NLG, ethical issues.
(Nisa et al., 2025)	Review AI & computer vision for textile sorting in circular economy.	PRISMA systematic review; 49 studies (2016–2024).	CNN and YOLO widely used; dataset limitations exist.	AI enhances textile sustainability and circular economy practices.	Expand datasets; use generative AI; develop lightweight models.
(Singh, 2024)	Artificial Intelligence in the Fashion and Apparel Industry	Systematic literature review	AI can bring new technology to fashion, and possibly can be used together with AR, new applications in fashion shows and events, and possibly can transform the traditional model of business.	AI's potential to enhance consumer experiences, sustainability practices and market efficiency	The future of AI in fashion opens up endless possibilities for brands to elevate customer experiences.

DISCUSSIONS

The attention was paid to the identification of defects, inspection of fabric, testing, and prediction of maintenance. Image processing, neural networks and automation were implemented in a bid to reduce errors and labor expenses. Trend and demand prediction along with analysis of simple supply chain with AI seemed to reduce inventory risk and enhance planning (Rathore, 2023). AI applications in the textile and fashion industry have evolved from early forecasting and quality-control functions toward creative design, education, smart textiles, and sustainability-driven solutions (Lin et al., 2010; Wu & Li, 2024; Jung, 2024). According to the recent research, AI and deep learning are increasingly applied in the process

of clothes design, the creation of virtual samples, and CAD software. These tools enable designers to create new patterns in a short amount of time, to test the way clothes fit, as well as how fabrics react in a computer, and accelerate the entire design process. Due to this reason, AI-powered tools assist the designers to be more creative, work quicker, and make the industry more sustainable(De Lima, 2023). AI-enabled supply-chain optimization enhances demand forecasting, inventory management, and logistics coordination. It enhances the forecasting of the expected requirement, stock control and delivery using facts and real-time processing. The tools reduce unnecessary production, waste, and allocate resources more effectively at every stage of product production. Due to this, AI will render fashion and apparel production more environmentally friendly and contributes to achieving sustainability(Dong et al., 2025).

Second, the effectiveness of AI models is highly context-dependent, with simpler forecasting models often outperforming complex hybrid architectures in uncertain fashion environments (Lin et al., 2010). One of the significant issues in e-commerce fashion retail is demand forecasting since the market is rather dynamic and the competition is competitive. The paper of (Bhaskar.Reddypogu, 2025) considers ARIMA, Long Short-Term Memory (LSTM), and Generative Adversarial Network (GAN) models and demonstrates that GAN is the most accurate in dealing with complex demand trends. The results indicate that with the assistance of generative AI, it is possible to predict demand more efficiently and make retailers more responsive in the markets with high mobility. According to Shi et al. (2021), the fast changing fashion trends require quick and dependable forecasting and to mitigate these shortcomings, the study proposes a data-driven framework using an artificial-intelligence model that was trained on large collections of fashion-images to identify garments, categorize characteristics, such as fabric composition, stylistic characteristics, and design features, and systematically identify emerging trends. Empirical evidence shows that AI-based forecasting provides a more efficient, objective, more accurate and cost-effective alternative to the dynamics of fashion analysis.

Third, AI consistently emerges as an enabling technology that augments human creativity and decision-making rather than replacing human expertise (Wu & Li, 2024; Jung, 2024). The use of artificial intelligence helps employees increase their creativity in answering customer questions in the context of further sales negotiations. High creativity in turn leads to high sales performance. However, this effect is significantly stronger in workers that have higher skills rather than new employees (Jia et al., 2023). The study conducted by Zhang & Liu (2024), found that, AI will assist fashion designers to create not only creatively and visually distinct

garments but also collections of ready to wear items that are commercially viable and close to particular design needs and customer preferences. It also accelerate in the design process providing the ability to generate a range of ideas and perfect the design elements. Furthermore, e-commerce is another area of AI applications that are highly promising with such systems and have the benefit of helping both real and online fashion businesses.

Fourth, AI-driven automation significantly enhances operational efficiency and precision across textile manufacturing systems (Sikka et al., 2025; Luo et al., 2023). Textile production with the help of AI automation plays a major role in enhancing efficiency and precision. The paper of Angelova et al. (2025), analyzes the introduction of smart technologies to the knitting business with a specific focus on industrial flat knitting machines of a large manufacturing company and a high-tech software platform M1plus V7.5. The functionality of the platform to digitally fabricate and simulate complex patterned and structural knits is evaluated by designing 5 experimental samples. After washing, structural properties and dimensional stability after washing are analyzed on each design. The results prove the benefits of software-based optimization in product accuracy, reduced non-uniformities in shrinkage, and intelligent manufacturing methods in the textile industry.

Finally, sustainability has become a central research frontier; however, organizational readiness for AI adoption remains uneven, particularly in developing economies where human, financial, and leadership constraints persist (Hossain et al., 2025). One of the empirical studies done by Hossain et al. (2024), Indicates that the current textile and garment sector in Bangladesh is low in terms of organizational willingness to embrace artificial intelligence and big data analytics. This can be attributed to moderate level of knowledge and leadership readiness and low human finance and engagement readiness of the majority of the business organizations. Furthermore, the study of Dadli & Pareek (2025), shows that AI usage awareness in the textile industry, such as automated design systems, predictive demand forecasting, digital marketing, and supply chain optimization, is on the rise, but the extent of knowledge is rather uneven. In their study a vast percentage of interviewees acknowledges AI as a source of efficiency, innovation, and competitive advantage. Nevertheless, there are significant issues of concern about the costs of implementation, technical skills, and use of the technology which have reliability and validity concerns. Correlation reveals that positive attitudes towards AI have a strong association with entrepreneurial intention to use AI based solutions.

Limitations and Future Research Agenda

Despite notable advancements, several research gaps remain. Future studies should focus on developing adaptive and context-sensitive AI models capable of handling the volatility and non-linearity inherent in fashion data (Lin et al., 2010). Research on generative AI should be expanded beyond knitted textiles to include woven, nonwoven, and smart textile structures, supported by both subjective and objective evaluation metrics (Wu & Li, 2024). Greater emphasis is also required on human–AI interaction, addressing issues of trust, transparency, creativity ownership, and ethical responsibility in AI-assisted design and decision-making (Jung, 2024). Furthermore, empirical investigations into AI adoption in developing economies should be expanded to examine organizational readiness, policy frameworks, and skill development challenges (Hossain et al., 2025). From a sustainability perspective, future research should integrate environmental impact indicators and life-cycle assessment metrics into AI systems while exploring advanced consumer interfaces such as immersive and embodied AI agents to promote sustainable fashion behavior (Manzo et al., 2025; Nisa et al., 2025).

Concluding Synthesis

By integrating bibliometric analysis with a qualitative synthesis of influential studies, this research provides a comprehensive understanding of the evolving role of artificial intelligence in the textile and fashion industry. The findings indicate a clear transition from operational and predictive applications toward creative, educational, sustainable, and smart textile systems. While AI-driven innovations offer substantial benefits in terms of efficiency, creativity, and sustainability, challenges related to data availability, ethical governance, and organizational readiness remain unresolved. Addressing these challenges through interdisciplinary research and context-aware AI development will be critical to ensuring the responsible and sustainable transformation of the textile and fashion industry.

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