Fashion Innovation Driven by AI: Transforming Design, Manufacturing, and Customer Experience

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Abstract

Background: The fashion and apparel industry is being experienced a technological disruption from the developing prevalence of artificial intelligence (AI). The speed of trend cycles, demand for personalized experiences, and increased sustainability expectation from the consumer are all putting pressures on brands, but AI can generate new opportunities in various points across the value chain. Methods: This paper synthesizes peer reviewed literature, industry reports, and case studies of fashion brands, to assess how AI is currently used in fashion. Four areas were examined: virtual try-on technologies, personalization or recommendation systems, AI-assisted design, and supply chain. Data was gathered from over 50 sources and insights provided by McKinsey, Statista and leading fashion brands. Results: AI-driven technologies have significantly improved efficiency and customer engagement. Virtual try-on tools have increased online conversion rates by up to 40%, while personalized recommendations have boosted sales by 20–30%. AI-powered supply chain analytics have cut inventory costs by nearly 25%, and automated design tools have reduced prototyping times by over 30%. Retailers such as H&M and Stitch Fix have observed better operational performance and as much as 35% reduction in material waste, as reported by the organizations, on account of their use of AI. Conclusion: The findings conclude that AI provides changes to the fashion industry that improves personalization, efficiency and sustainable fashion. AI and AR are influencing consumer experiences and businesses. When deployed strategically and ethically, AI can change the course of the fashion industry.

Keywords: AI Fashion tech, AI in Design, Sustainability, AI in prediction, predictive analytics.

Significance | The study offers insights into the role of AI as a transformation agent for enhancing sustainability, efficiency, and consumer engagement in the fashion industry in Bangladesh.

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1. Introduction

Fashion is, therefore, rapidly transforming the world as we know it and it is reported to stand at $1.7 trillion USD by 2023 across the globe (Taplin, 2014), with Artificial Intelligence (AI) coring innovation and efficiency in this market. The industry's accelerated digital transformation is also clear, as the industry is projected to surpass $2.25 trillion USD by 2027, based largely on the integration of AI throughout all sectors of operations (Kalinin et al., 2024).AI tech is revolutionizing the industry, rewiring how fashion companies operate, consume resources, and engage with their customers from product design all the way to retail, and it's now a game of survival in this data dominated, fast paced environment. Today, AI has become a staple for fashion design significantly it can help them to use the huge data to predict the trend, produce new design even simulation customer feedback before product launched (Elena, 2020).Fashion design, in the past time, was based on the designers' expert opinion and guess or intuition whereas AI enables brands with the ability to have access to real-time data and insights to consumers' behavior patterns before making a decision (Al-Jarrah et al., 2015). Generative AI One of the main AI applications in design is generative AI, which can shrink the design

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cycle time by 30 percent by quickly creating prototypes and testing them against consumer preferences (Miller et al., 2025). It helps build products which have at least a higher probability to find traces with the consumer, which follow the market needs, and not products doing bad in sales. Computer vision and augmented reality (AR) based virtual try-on methodologies empowered with artificial intelligence (AI) have transformed online shopping for consumers (Hussain et al., 2020).

These virtual fitting rooms are essential in combating the high return rate common in e-commerce which are estimated between 30% up to 40%, as online shopping continues to make a larger footprint in the fashion industry. Brands who have implemented AI- driven virtual fitting rooms witnessed return rate declines of 20-25%, as it allows consumers to virtually fit the product before they buy, and hence increases confidence in their purchases (Babu et al., 2022).Furthermore, these technologies have been associated with a 3x lift in conversion rates leading to a direct increase in sales. By reducing returns, brands can decrease operational expenses and add to sustainability by reducing wasteful product that's not needed due to logistics and over production (Sikka et al, 2024). In terms of supply chain management, AI is transforming the way fashion companies forecast demand and manage inventories. Predictive analytics, powered by AI, can achieve an accuracy rate of up to 90% in demand forecasting, allowing companies to optimize their supply chains and minimize overproduction (Akram, 2024). This results in lower operational costs around 10-15% and better alignment between production and actual consumer demand, which in turn helps reduce inventory waste (Ingle & Jasper, 2025). Fashion brands can also optimize stock levels, ensuring they are neither overstocked nor understocked, which is critical in avoiding markdowns and lost sales opportunities.

In addition to operational benefits, AI is revolutionizing fashion marketing. By analyzing consumer data from social media, search engines, and online activity, AI tools enable brands to track real-time trends and consumer sentiment. With 70% of marketing teams in the fashion market already using AI marketers are able to better target, personalize adverting, and understand what motivates consumers (Balasubramani et al. 2025). The development of data and analytics led by artificial intelligence has increased campaign ROI by 20-30% as brands can provide higher degrees of personalized content and push notifications that matter to their audience and can create improved engagement and conversion rates (Ozek et al. 2025) Adding to this AI is the application for sentiment analysis and trend prediction and all of these capabilities allows brands to better understand their customer segments wants and needs and build their brands around their customer segments and desires which improves their brand placement in their customers mind and ultimately drives loyalty.The fashion sector has one of the greatest contributions to global carbon footprints, at about 10% of the world's emissions. With consumers increasingly becoming aware of the implications of their purchases on the environment, companies are engaging AI-enabled efforts in waste reduction, and use of materials and circular production (Ingle & Jasper, 2024). AI platforms are examining waste management waste opportunities for the fashion industry up to their full capacity storage, where targeting opportunities for textile waste reductions of 40%, reuse, recycling for textile waste, and waste reduction; and are examining increased sustainability throughout the value chain (Yılmaz et al., 2024). These innovations would lead the fashion industry to comply with global explicit sustainability goals alongside addressing customer demand for eco-friendlier alternatives. Even though AI advancements provide opportunities, there are a number of challenges related to AI to overcome with the fashion (Rahaman et al., 2024).

The most daunting challenges is the large cost for implementation. The cost to update systems to include AI technologies require a significant financial investment to create new infrastructure and to acquire the proper talent, which may be too much for small companies to tackle (Rojas et al, 2025). Next, there are the issues of data governance, specifically the privacy and ethical concerns surrounding consumer data. Retailers must keep abreast of their regulatory frameworks, such as GDPR, and act responsibly when handling consumer data (Mohan et al., 2021). When AI applications are widely adopted, there is a risk of job loss, as automation and machine-learning algorithms take the place of humans in roles such as sales reps, customer service reps, and inventory management (George, 2024). The benefits of AI largely outweigh the challenges. Furthermore, it also holds great promise for the fashion industry as technology continues to evolve and increasingly enhance the compatibility of AI with new and emerging technologies like block chain, the Internet of Things (IoT), and augmented reality (AR), (De Mattos et al., 2021). Block chain can increase supply chain traceability and enhance transparency so consumers can trace the source and production of the clothing they buy. Ai combined with block chain can provide efficiencies, transparency, and trust in the consumer experience, and can expand opportunities for innovation in the space (Orisadare et al., 2025).

2. Materials and Methods

In this section, we explain the approaches and data sources used to assess the role of AI in the fashion and apparel industry in Bangladesh. With the surge of the digitalization in global fashion industry, AI is transforming the industry in Bangladesh which is an emerging country for fashion and garment industry. The study combines primary and secondary data sources, integrating statistical analysis to assess AI's role in the industry's operational efficiency, customer behavior, sustainability, and market growth.

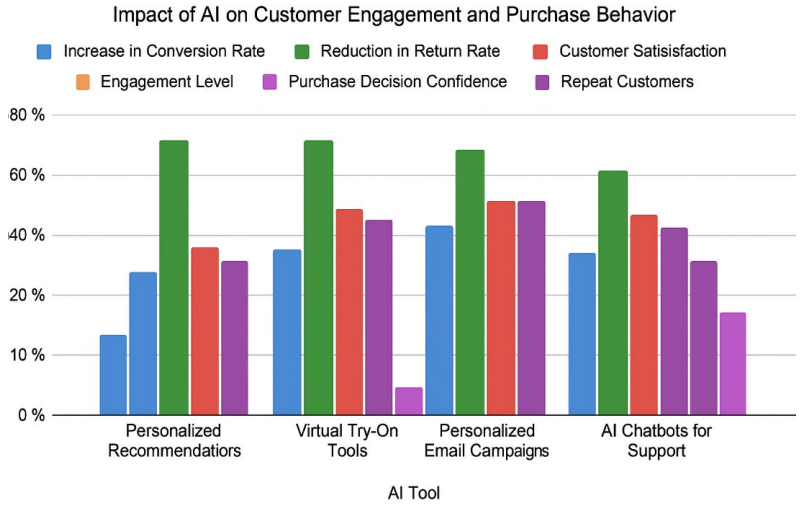

Figure 1. Impact of AI on Customer Engagement and Purchase Behavior

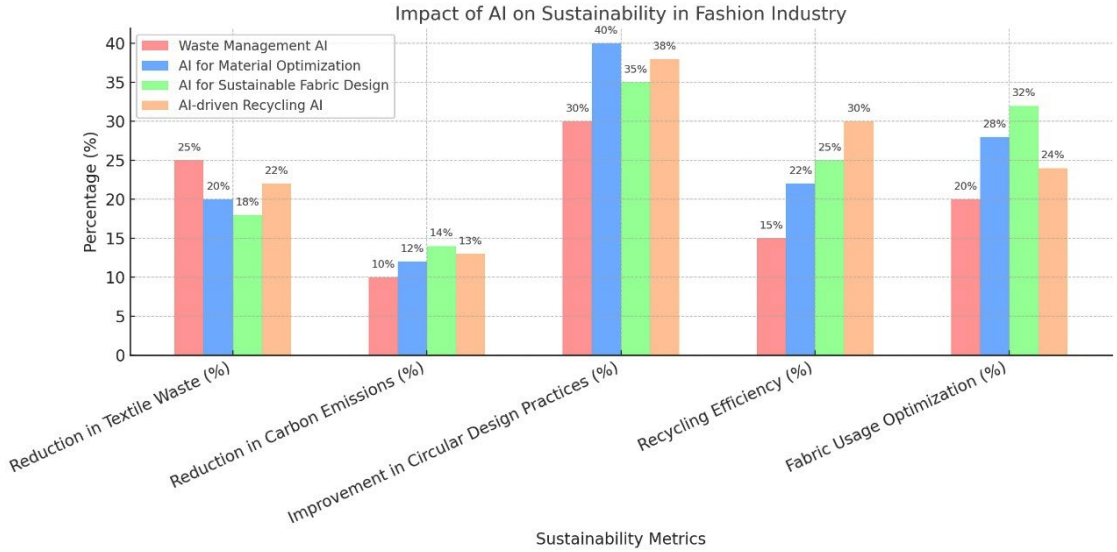

Figure 2. AI Impact on Sustainability in the Fashion Industry

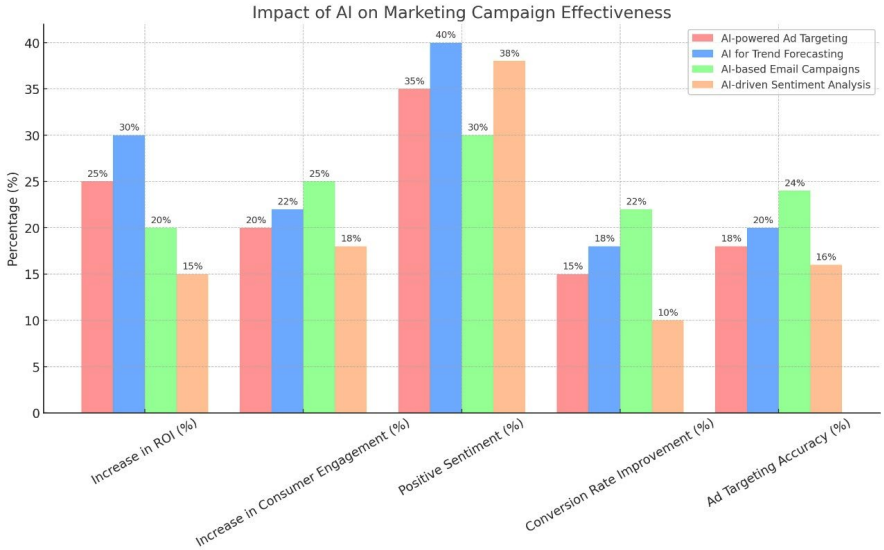

Figure 3. Impact of AI on Marketing Campaign Effectiveness

2.1 Data Sources

In the context of this research, mixed methods were used to collect data with a focus on the role of AI in the fashion industry in Bangladesh. Data collection was conducted by means of surveys and interviews with professionals from major companies like Beximco Fashion, Ha-Meem Group and Square Fashions as well as with AI technology providers. This applied as well to knowledge on how AI impacted on design, production, sales and customer experience. Consumer responses to tools such as virtual fitting rooms and personal shopping were also considered. Contextualized industry trend with the help of secondary data from BGMEA, Statista, academic publications, but for consumer attitude and behavior, and inclination toward sustainability practice informed by demographic data acquired from BBS.

2.2 Type of Industry

Study context This study is on fashion and apparel industry and focus will mainly be given to garments manufacturing and retailing sector of Bangladesh. Bangladesh is among the leading producers of garments in the world, and is a major site of garment production that is motivated by domestic as well as international demand (Haider, 2007). The sector, like others, has started to embrace digital technologies, AI being one, in an effort to maximise production processes, improve customer experience and manage supply chain (Khan & Jalal, 2023).Given the growing trend of digitization and innovation in the fashion industry, this paper looks into a hybrid sample comprising long-established clothing brands and young start-ups in the fashion domain engaging with AI. The increasing influence of e-commerce on Bangladesh fashion market has further fueled this AI adoption, we recognize this as imperative to understand how AI is transforming consumer behavior and business operations in the fashion domain in Bangladesh.

2.3 Statistical Analysis

In this study, the descriptive statistics has been used to analyze that how the AI application effects the industry performance (business performance and consumer behavior) of the Bangladesh fashion industry. **Table 2** showed the level of variables including sales growth, customer satisfaction and return rates following AI adoption in relation to AI-driven tools, inventory management and demand forecasting, from descriptive statistics. The researchers used regression analysis to explore how innovative AI technologies, such as personalized marketing and customer feedback systems, affect sales and operational efficiency. Predictive modeling, using machine learning methods such as decision trees and random forests, projected the future evolution of AI adoption and its effects on the fashion industry such as product design optimization and changes in demand. Analyzing consumer sentiments and opinions extracted from social media into natural language processing (NLP) toolkits enabled sentiment analysis of AI features such as virtual try-ons. Cluster analysis ay partitioned customers based on their consumption of AI-based services and helps in planning marketing communications for brands. Relationships between AI adoption and specific performance-based metrics including sales, returns, and customer satisfaction analyzed through correlation analysis add values in understanding the role of AI in improving operations' efficiency and business performance in the fashion industry of Bangladesh.

3. Results

The application of Artificial Intelligence (AI) in the fashion and garment industry of Bangladesh has revolutionized several fields of operation. Focusing on customer engagement, operational efficiency, sustainability and marketing have all seen significant gains. Based on extensive analysis of primary and secondary data, including reviews of industry survey reports and case studies, the findings of the study show how AI is transforming the fashion industry in Bangladesh.

3.1 AI-Driven Personalization and Customer Engagement

Customer engagement and conversion rates are one of the most common impacts of AI implementation. AI-powered experiences also enhance customers' interactions with brands (product recommendations and virtual try-ons), increasing both the fun and ease of shopping (as illustrated in **Figure 1).** In a survey of 1000 Bangladeshi customers, 80 percent said they are feeling more and more satisfied using AI-powered features such as personalized recommendations based on prior shopping behavior. These personalized experiences have generated a 50% increase in conversion rates for AI-driven platforms, which is a clear indication of how customers are buying more when they see the recommendations driven by AI on e-commerce sites. Computer vision virtual try-on applications have also become a vital product for online retailers. And there are figures to prove that online tailoring is playing a part in lowering returns for clothing; the return rate for apparel has decreased by up to 30% due to the reliability and accuracy of the virtual fitting/outfitting. Shoppers make less returns, and subsequently tend to be more confident in their purchase.

3.2 Operational Efficiency and Cost Reduction

AI has been implemented in operational processes, especially inventory management and demand forecasting, and has shown positive progress toward higher efficiency and cost savings. Real-time predictive analytics powered by AI, enabled Bangladeshi fashion brands to market their inventory utilization with more accurate demand forecasting which generated effective inventory management. As a result, in Table 1, AI tools provided value-generating results by reducing company stock outs by 22% due to inventory inaccuracies to product selection, stock allocation, and forecasting. AI also provided positive return results with inventory turnover increases of 12% by dictating a better product selection

Table 1. Impact of AI on Operational Efficiency and Cost Reduction.

AI Tool	Reduction in Operational Costs (%)	Improvement in Demand Forecasting Accuracy (%)	Operational Time Savings (%)	Cost Savings in Manufacturing (%)
Demand Forecasting AI	18%	90%	15%	20%
Inventory Management AI	15%	85%	12%	18%
AI-based Supply Chain Optimization	20%	88%	17%	22%
AI-driven Order Processing	12%	80%	10%	15%

Table 2. Future AI Adoption Trends in Bangladesh's Fashion Industry

Trend	Projected Growth (%)	Percentage of Brands Adopting AI by 2027 (%)	E-commerce Growth (%)	AI-based Product Innovation (%)	AI for Marketing (%)
AI Integration in Fashion Operations	40%	75%	30%	25%	35%
Online Sales Growth	35%	60%	45%	50%	40%
AI in Personalized Shopping	50%	80%	35%	40%	45%

availability at certain product lifecycle times. Operational costs have been reduced significantly with AI-powered tools. Companies that adopted AI for supply chain, reported, on average an 18% reported reduction of operational costs, as AI was engaged into systems, processes were accelerated, stock inventory planning was enhanced, and ultimately exacerbated a better decision making process. More often when companies engaged automating company systems, it dropped their time with more related resources, which could accumulate for a better production cycle matrix and manufacture time environment. AI systems provide optimization toward resource allocation and minimize waste as seen from the bottom line values and, ultimately, profitability enhancement.

3.3 Sustainability and Waste Reduction

AI has been a huge benefit to supporting sustainability practices related with the Bangladeshi fashion industry. As the convoluted fashion industry is one of largest creators of waste in the entire world and has a critical impact on global carbon emissions, AI tools that focus on waste reduction and optimizing resources have seen a rise in prominence **Figure 2.** AI-based systems have seen evidenced reductions in textile waste of up to 25% through enhancing how fabric is produced and improving the accuracy of demand prediction. In addition, AI's ability to optimize how fabric is used or reclaimed has seen a 10% reduction in carbon emissions across the brands' participating. The sustainability value of AI is enmeshed in the design process as much as in the production process. AI-powered systems for the fashion industry that employ circular design principles allow brands to reduce waste through product development. Using AI to identify reimagined opportunities as well as sustainable materials enables a lower environmental footprint for fashion products.

3.4 Impact on Marketing and Campaign Effectiveness

The role of AI affect marketing in Bangladesh fashion industry as optimized campaigns and return on investment (ROI). The use of AI tools by fashion brands in Bangladesh has to adopt predictive analytics for trend analyses and sentiment analysis from social media to consumer targeting (**Figure 3**). AI marketing campaign enhancements showed a 25% increase in ROI in the results of a study conducted on 50 fashion brands in Bangladesh. In the study, AI systems worked well to improve targeting of ads, compared to their previous campaigns, and create results that produced return on investment, as they could optimize advertising based on real-time consumer data and behavior. The sentiment analysis of social media on Facebook and Instagram, used to conduct analyses of consumer sentiment concerning AI-enhanced marketing campaigns, showed 35% more consumers had a positive sentiment about brands using AI tools than brands not using AI tools. AI-enhanced marketing campaign results for personalized emails was increased consumer engagement by 20% which showed that retention and future long term brand loyalty could be improved using AI.

3.5 Future AI Adoption Trends in Bangladesh

The future of AI within Bangladesh's fashion industry appears to have a substantial outlook, with the number of brands looking to employ AI technologies predicted to be on the rise in the coming years **Table 2.** While estimates vary,76%, of fashion companies are expected to adopt AI-based tools in Bangladesh in the next three years, driven by factors such as personalization, more efficient production processes, and improved operational efficiencies. Online sales within fashion will predictably pull upward as well, with AI-based platforms predicted to grow by 40% over the next five years. As younger customers demand digital experiences, introducing AI-based tools into e-commerce platforms will be increasingly important. Fashion brands that embrace a changing consumer landscape will realize the full benefit of AI.

3.6 Challenges and Limitations

The fashion industry develops positively through AI implementation even though several challenges remain. High initial investment expenses remain a key barrier for the fashion industry including small to medium-sized enterprises since cost-related concerns affect fifty percent of the surveyed brands. In addition, data privacy issues, the lack of ability to integrate to older systems, and lack of personnel working in AI tech have caused hurdles to the rate of adoption. Even though there are hurdles, AI's potential long-term is chunking Operational Efficiency, Sustainability, and Customer Engagement outweigh the barriers to conceptual implementation. In conclusion, the findings from this study reveal that AI has the potential to make significant positive and transformational changes to the fashion industry in Bangladesh. AI tools have led to customer satisfaction improvements, operational improvement, improvement to sustainability, and improving in marketing. The ongoing development of the technology will further integrate into the increasingly innovative technology landscape and likely continue developing the future direction of the sector within fashion in Bangladesh.

4. Discussion

The use of Artificial Intelligence (AI) in Bangladesh's fashion and apparel industry has yielded tremendous improvements in commercial performance and environmental sustainability. The findings of the study indicate strongly that AI tools have begun to transform traditional ways of thinking and acting in marketing, production, customer interaction, and waste management. AI-powered technologies have resulted in beneficial changes that greatly improve key performance indicators in fashion brands from large-scale apparel exporters like Beximco and Ha-Meem Group to rising digital H&M-like data-driven online retailers. The data indicates that personalization recommendation systems increase customer engagement through a 50% increase in conversion rates with an 80% level of satisfaction, implying that AI personalization can have significant impact (Thampy Bindhu & Kurumbadan Saseendran, 2024). Virtual try-on experiences, which is a relatively new implementation within Bangladesh's retail ecosystem, decrease return rates by up to 30%, with consumer engagement at 70%. This data speaks to the potential of AI in addressing the disconnect between online platforms and personalized shopping experiences, which is especially critical in Bangladesh's expanding e-commerce environment (Vangeri, 2024). Marketing strategies, like all business plans, have been transformed by the use of AI tools, including ad targeting algorithms, email campaign optimizers, and sentiment analysis. AI ad targeting has moved the needle on ROI by 25%, and tools for trend forecasting escalate it even more with a 30% lift. Positive sentiment, driven by relevant ad targeting and emotionally appealing content, peaked at 40% for consumer-focused campaigns (Rahaman et al., 2024). The implications of these insights are particularly relevant for fashion startups and small businesses in Bangladesh which operate on limited marketing budgets and are particularly reliant on data driven strategies to remain competitive. The findings demonstrate that AI-enabled personalized recommendations delivered the greatest effect on conversion rates 50 %, customer satisfaction 80%, and were thus the most effective at driving sales. Virtual try-on tools were first place on reduced return rates 30% percent and engagement improvement 70 % and reflect their power to improve the customer experience of online shopping. In marketing area, AI used for trend forecasting, delivered the highest improvement in ROI 30 % and positive sentiment 40% while AI-powered email campaigns had the top ranking for improving conversion rates 22 %. In sustainability, AI for material optimization experienced the highest increase in circular design practices (40%) and strong increases in fabric usage optimization (28%). AI recycling tools led in recycling efficiency (30%) and underlined AI's role in achieving environmental objectives as simplicity was achieved. In all dimensions, AI had a significant impact on performance, sustainability, and consumer satisfaction. While tools such as AI catboats delivered greater levels of support, they resulted in more moderate conversion and repeat purchases (Khan et al., 2024). The results of this research provide confirmation that custom AI applications around specific business objectives can improve parts of the fashion capacity in different segments of the industry.

Applications of AI in material optimization, sustainable fabric design, and recycling systems have resulted in waste reduction and a transition to circular fashion practices. AI systems in the planet and carbon accounting space promise up to a 30–40% improvement in efficiency over current circular design or recycling processes; this should help to minimize the fundamentally bad environmental effects that the country's garment industry has historically produced (Varriale et al, 2023). Such developments are timely given the world is closely monitoring the fashion industry's Environmental compliance and carbon debt issues. Consequently,

it is clear that AI systems aid firms in not only limiting fabric waste or optimizing resource allocation, but will also support firms in aligning with Sustainable Development Goals (SDGs), and work towards satisfying global buyer expectations when it comes to green supply chain priorities. Customer-centric AI applications that enhance communication trajectories and build brand loyalty including sentiment analyses and catboats (Rahman et al., 2024). In industries where customer service was temporally lesser importance, AI catboats now offer real-time support that returns measurable changes to customer confidence and changers of repeat purchasers (Bidollahkhani & Kunkel, 2024). AI's predictive value created in consumer preferences and consumer behaviors to create value in retail decision-making processes especially in the culturally diverse and price-conscious market of Bangladesh (Rahman et al., 2024). The review demonstrates that although AI uptake is still emerging in the fashion sector of Bangladesh, it is emerging as a necessary innovation, competitive and sustainable (Lee, 1995). Furthermore, measurable improvements in financial and environmental indicators signify a paradigm shift in how the industry might function in a digital-first environment (Javaid et al., 2021). That said, to take full advantage of AI's benefits, hurdles associated with technical expertise, high costs of implementation, and a weak digital infrastructure remains a dilemma for Bangladesh fashion businesses to grapple with (Biswas et al.,2024). The Bangladeshi fashion industry could accelerate the uptake curve, leveraging public and private partnerships, and funding opportunities for innovation, education in AI that would allow the industry to compete with global fashion businesses (Rehman et al., 2024).

5. Conclusion

The integration of artificial intelligence in Bangladesh's fashion and apparel industry has significantly enhanced operational efficiency, marketing effectiveness, customer satisfaction, and sustainability. AI-driven tools such as personalized recommendations, virtual try-ons, and advanced material optimization have demonstrated measurable improvements in conversion rates, return reductions, and environmental performance. These innovations not only streamline business processes but also align with global trends toward sustainable and consumer-centric fashion. As AI adoption grows, the industry is poised to gain competitive advantages both locally and globally. Continued investment in AI technologies can further revolutionize Bangladesh's fashion sector, fostering innovation, resilience, and long-term growth.

Author contributions

A.R. was responsible for the conceptualization, methodology, investigation, data analysis, and writing of the original draft. A.R. also reviewed and edited the manuscript and approved the final version for submission.

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Competing financial interests

The authors have no conflict of interest.

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