

The future of the Indian retail industry and AI: a Systematic Review of Sustainability

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Abstract

The fashion industry frequently fails to meet sustainability targets; however new technology developments provide a variety of solutions to this problem. One particularly promising helper in advancing sustainability in fashion is artificial intelligence (AI). This study of the literature examines the possible advantages and drawbacks of AI in relation to the sustainability of the fashion industry. After a systematic literature review and conducting a pilot survey we find that AI has a wide range of uses in the fashion industry, including supporting sustainability initiatives in waste management, supply chain management, creative design, sales and promotion, and data analysis. Even though AI has a lot of promise, it's crucial to recognize its drawbacks, such as the amount of data needed and the accompanying implementation costs. The studied literature emphasises the importance of responsible resource management, accessible services, and effective customer satisfaction, both now and in the future, all of which align with the complex nature of sustainability. In conclusion, AI is an essential ally in steering the fashion industry toward a more sustainable future, despite certain misgivings.

Keywords: Artificial Intelligence, Sustainability, Supply Chain Management

Introduction

Meeting current needs without jeopardising those of future generations is what is meant by sustainability. It entails protecting social welfare and the environment while making sure that economic expansion and development do not endanger these things. In the industry, sustainability is a major problem [Moretto et al]. Social and environmental factors must now be incorporated into business operations and decision-making [Jamwal et al.]. Sustainability has become a key goal in many industries, such as manufacturing, mining, agriculture, and renewable energy, with the goal of reducing negative effects on the environment and society [Ruggerio C. A. (2021)].

According to Kristensen [Kristensen et al. (2019).], Sustainability comprises three main dimensions: economic, social, and environmental. The economic dimension guarantees that production satisfies current needs without compromising future capacity. The social dimension concentrates on parameters for social equity, access to essential services, security, and citizen participation in governance. The environmental dimension stresses responsible resource

management and waste control to prevent overconsumption and environmental degradation. These dimensions are interrelated and essential to sustainable development.

The fashion sector, which is well-known for its lack of sustainability [Wren, Brianna. (2022).], uses a lot of resources to produce apparel and accessories, especially water resources. It is one of the biggest users of water and frequently has insufficient post-use treatment [Moretto et al]. In addition, there is a lot of labour exploitation in the fashion sector, with workers frequently working long shifts that last more than eight hour a day. Greenhouse gas emissions are also made worse by the delivery of apparel and accessories. Additionally, the fast fashion model has hastened garment manufacture and disposal, leading to an increase in waste creation and unsustainable resource usage [Wren, Brianna. (2022)]. In response to all of these issues, the fashion industry is looking more and more for tools and solutions that will help it reach sustainability objectives. Consequently, the fashion sector is using AI more and more to enhance sustainability.

AI is a subfield of computer science that creates systems that mimic human cognitive abilities, particularly in tasks involving problem-solving [Ramos, L. (2022).]. AI is a popular field that is being used in a variety of fields, including industry, science, and medicine (Sahu et al., 2024).

The apparel industry may use AI to optimize a number of steps in the clothing manufacturing process [Pournader M et.al, 2021.]. Additionally, AI algorithms help businesses make better use of their resources, which results in lower costs, greater efficacy and efficiency, and faster production [Thomassey S & Zeng X (2018)]. AI also helps society and the environment by improving the processing and utilization of human and natural resources [Ahmad T et.al.,2021].

This study gives a focused analysis of how AI may improve sustainability in the fashion sector. We focus on analysing particular applications of AI in fashion and evaluate how effectively various AI approaches support sustainability. Our main goal is to identify the advantages and disadvantages of different AI strategies, providing insightful information for professionals and interested parties.

Artificial intelligence and Sustainable Fashion

AI integration can be very beneficial to the fashion business since it offers a viable way to improve sustainability. Fashion sustainability entails taking a broad view and taking into account how social, cultural, ecological, and financial systems are interconnected. Artificial intelligence (AI) is becoming a crucial component in achieving these goals as technology continues to advance.

AI's incorporation into sustainable fashion is transforming the sector. At every level of the fashion lifecycle, it is promoting sustainable practices, increasing efficiency, and reducing waste. This partnership promotes social equality and economic resilience in addition to the environment.

Finding materials with the least negative effects on the environment is one of the main issues in sustainable fashion. To suggest the most environmentally responsible choices, Carbon Trail's patented AI algorithms can evaluate enormous databases of material attributes, supplier

data, and sustainability certifications. AI can assist brands in making well-informed choices regarding procuring materials that support their sustainability objectives by taking into account variables like biodiversity, water usage, chemical toxicity, and carbon footprint. The fashion supply chain is intricate, including numerous parties and procedures in different parts of the world. To find inefficiencies, cut waste, and enhance overall sustainability performance, supply chain data management and analysis are essential.

With the ability to process data from millions of items, Carbon Trail's AI technology allows brands to track product authenticity, find sustainable materials, and improve supply chain visualization. Additionally, by using AI to interpret unstructured data, retailers are able to make more educated decisions and innovate by gaining deeper insights into consumer behavior, market trends, and sustainability potential.

In order to evaluate and reduce the environmental impact of fashion products over the course of their lifecycle, corporate carbon accounting is crucial. By automating the carbon accounting process—which entails measuring, tracking, and reporting greenhouse gas emissions—AI provides a solution. Fashion firms can precisely measure their carbon footprint by combining AI algorithms with data from several sources, including production processes, transportation, and energy consumption. Carbon Trail and other AI-driven carbon accounting solutions offer real-time insights into emissions, allowing brands to pinpoint areas for improvement and carry out focused sustainability activities (Agarwal & Rai et al., 2025).

Fashion firms may find it difficult to comply with industry standards and legal requirements for sustainability reporting. AI-powered software can save time and money by automating the process of gathering, evaluating, and reporting sustainability data.

AI algorithms can provide thorough reports that adhere to laws like the Carbon Disclosure Project (CDP) and the Corporate Sustainability Reporting Directive (CSRD) by combining data from multiple sources. This makes it possible for brands to monitor their development, point out areas that still need work, and show stakeholders how committed they are to sustainability.

AI systems are skilled at analysing vast amounts of data and deriving useful conclusions. In the context of sustainability, AI can produce unique tables, charts, and analytics that let brands monitor important performance metrics and see how they affect the environment.

AI is a revolutionary technology that is propelling the fashion industry toward a more sustainable future. AI allows firms to design goods, source resources, report sustainability measures, and optimize operations in ways that were previously unthinkable by utilizing data analytics, machine learning, and automation. Adopting AI as a sustainable accelerator will be crucial for firms hoping to prosper in a quickly evolving fashion industry.

Objective of the Study

- To find the possible areas in which AI can improve sustainability in fashion industry.
- To analyse the impact of AI in the sustainability of retail industry.

Research Methodology

The secondary data obtained by the review of relevant research papers and articles is part of the methodology used to achieve the stated objectives, and the theoretical analysis approach is applied for data analysis.

Discussion

The analysed articles revealed four major application areas where AI can help to increase sustainability in the fashion sector. Each of these is explained below.

➤ **Supply chain optimization**

The supply chain refers to the complete process, from product or service development to delivery to the end user. It can be represented as a network [Carter, C. et.al.2015] of human and material components, all aiming to reduce costs and maximize efficiency while maintaining the quality of the end product or service. However, real-world supply chains face several issues [Wu, L et.al.2016], such as shortages, late deliveries, and difficulties adjusting to changing market needs [Wu, L et.al.2016]. Sustainability has been a key theme in supply chains, particularly in the fashion sector. However, many supply chains in this area still need to improve their sustainability [Farooque M. et.al. 2019]. AI provides a plethora of benefits to supply chains that would otherwise be unavailable [Wu, L et.al.2016].

It offers a variety of tools that may be used at every stage of the supply chain, from buying and processing raw materials to making, shipping, and delivering the end product, all while encouraging sustainability.

➤ **Waste Management**

AI provides creative answers to various waste management problems. An intelligent knowledge-based system is used for sustainable garbage management. This thorough method examines several aspects of garbage processing, transportation, and collecting. It also takes into account important aspects of sustainable development, such as health, clean water, well-being, and climate change. offers an expert system for waste management in the context of supply chains (Shahid et al., 2024). The return of products to different supply chain components at the end of their life cycle for reuse and value recovery is the main focus of this system. Notably, it uses blockchain technology, which promotes a circular economy by allowing transparent data processing and recording throughout the whole product lifecycle.

➤ **Design and sale of sustainable clothing**

Sustainable fashion is often viewed as less exciting, of inferior quality, or not in line with current fashion trends. Despite this misperception, the sustainable fashion business and its products frequently struggle for market relevance. However, AI appears as a potentially beneficial tool for sustainable fashion enterprises, assisting in the design and promotion of apparel that is in line with current fashion trends [Müller, O et.al.2018]. These technologies have the potential to dramatically increase the buying and use of sustainable clothes.

Effective waste management is crucial for the fashion industry's sustainability, especially given its history of poor environmental effect. In recent years, the spread of fast fashion and a throwaway culture has resulted in a considerable increase in textile production and consumption. Unfortunately, the vast majority of textiles and clothes end up in landfills, with just a small fraction recycled, making textile waste a significant global concern.

➤ **Analysis of data**

Data analysis is critical in the fashion business, providing significant insights and predictive capabilities that can be used to drive sustainability initiatives [Müller, O et.al.2018]. Customer segmentation enables fashion companies to acquire a better understanding of their target audience. By adapting strategies to specific market niches, these businesses may effectively promote and sell sustainable clothes to a wide range of customers. Furthermore, predictive analytics enables fashion companies to make informed judgments and anticipate industry trends. Sales forecasting and style forecasting allow these businesses to optimize inventory management, streamline supply chains, and anticipate future issues, all of which are critical for sustainable fashion practices.

Conclusion

The report concludes that artificial intelligence is boosting operational effectiveness, spurring innovation in the retail industry, and equipping Indian merchants to more effectively compete in a globalized market. But there are a lot of difficulties and barriers, like the need for skilled workers, data privacy, integrating AI with the existing system, etc. Even in tiny cities, the Indian retail business will expand despite several obstacles.

From the reviewed articles, it was possible to highlight four main application areas in which AI can help to improve sustainability in the fashion industry i.e. supply chain optimization, data analysis, design and sale of sustainable clothing, waste management.

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