

Digital transformation in fashion design, sustainability and consumer communication with artificial intelligence in design

Abstract

In today's era of digital transformation, fashion is undergoing significant changes in multiple aspects such as design, pop culture, fashion production, and the communication process. The basis of this transformation is formed by artificial intelligence. Artificial intelligence is introducing positive innovations in terms of efficiency, while also strengthening infrastructure efforts to reduce environmental impact. It uses resources in an efficient and sustainable manner. In this sense, it is also creating more meaningful, data-driven communication dynamics that will contribute to the design and production process which is in line with consumer expectations.

AI-supported algorithms not only optimize excess stock and storage in management but also optimizes the use of fabrics and accessories in fashion design. This advancement strengthens environmentally friendly communication with consumers also providing personalized design recommendations. With this understanding, AI contribution to sustainable fashion by transforming consumer relations through research on design and the production process generates significant benefits to the product life cycle. Design tools shaped by artificial intelligence are crucial in achieving sustainability goals. At the same time, the impact of using artificial intelligence-based tools for communication strategies has on environmental responsibility and sustainability in the fashion industry is being evaluated.

Today, the development and change of digital technologies such as AI are driving a profound and rapid transformation in fashion both as a culture and an industry. This change comes not only in terms of product design and manufacturing but also in terms of communication. How the industry engages with its consumers has changed. The way we can now interact with and receive consumer behavior, feedback in production process, and the capacity for personalization in design are leading to a new perspective on design and consumer communication at every level of the fashion industry. These efforts are integrating with the goals of "sustainability," which is an important to this transformation, to minimize negative environmental impacts also as viewed by the consumer.

This study aims to examine the impact and role of artificial intelligence on sustainable fashion design and consumer communication; it discusses the technological transformation of the fashion industry, design, production processes, efficient and sustainable approaches to resources, and communication dimensions through a literature review.

Keywords: AI, consumer, communication, fashion design, sustainability

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Introduction

The fashion industry is one of the world's most environmentally polluting sectors in terms of water consumption, chemical use, and waste production.¹ For this reason, the efficient use of resources and the transition to environmentally friendly methods have become important cornerstones in fashion production. Digital technologies and artificial intelligence respond to these expectations in design demand forecasting, material optimization, waste management, and the efficient use of sustainable resources. Integrated, artificial intelligence is not limited to production efficiency, but also plays an active role in interactions with consumers and in responding to design expectations. In particular, personalized recommendation systems, digital design platforms, and customer experience-based applications are effective in spreading sustainable fashion consumption habits. From this perspective, artificial intelligence develops sustainability efforts in fashion in conjunction with production, environmentally friendly or bio-textile materials, while also representing a new approach to communication in fashion.

The concept and characteristics of sustainable fashion

Today, sustainability is a concept that has gained great importance in all stages of human life. It is vital for humans to build a sustainable life, use the world's limited resources efficiently, and ensure that future generations can continue to use them. From this perspective, sustainability research and activities planned and carried out in the textile and fashion industry, which bears a very large burden in terms of natural resource consumption and fashion production, have become more vital than ever today with the use of artificial intelligence.

Sustainable fashion is defined as a multi-stage approach that encompasses not only environmentally friendly production, but also social justice, economic sustainability, climate, and responsible production and consumption principles.¹ Today, sustainability is no longer just a concern for environmentalists and ecologists, but also for individuals. Sustainability means defining individuals and society in fundamental ways, ensuring that the renewable and non-renewable resources on which civilization depends remain the same and are protected throughout life.²

This approach is growing alongside concepts such as circular economy, slow fashion, minimal waste production, and functional designs. Reducing resource use in the design process, creating durable and functional products, and guiding users toward conscious consumption are among the fundamental principles of sustainability efforts.^{3,4} Sustainability in fashion aims to create a structure that prioritizes quality and values products with a long life cycle. According to Sue Thomas, an ethical fashion theorist and academic, “sustainability refers to designers, consumers, or production methods that have a positive impact on workers, consumers, animals, society, and the environment.” Thus, sustainability in fashion is not limited to economic concerns, but aims for a holistic approach in which social responsibility and nature- and human-friendly production are prioritized.⁵

Artificial intelligence in fashion design in the textile industry

Digitalization is transforming not only production processes and the use of consumer demand data in fashion design in the textile industry, but also the concept of creativity. Creativity in fashion design means producing alternative, unpredictable, and data-driven designs by adapting artificial intelligence learning mechanisms to the design process.⁶ By integrating artificial intelligence into the fashion design process, traditional creative processes have been transformed from the perspective of design and designers, leading to a new aesthetic understanding. While contributing to the designer in the context of printing, embroidery pattern creation, model production, and creating a holistic collection with the model idea, the process also reveals a different creativity structure based on human-machine collaboration.⁷

In the fashion industry, artificial intelligence is an important tool, but it can also be considered a creative partner. At this stage, it is important for fashion designers to correctly create and analyze data based on their knowledge, equipment, and experience and enter it into the system.⁸ Generative adversarial networks (GANs) enable designers to guide their aesthetic decisions, consumer behaviors, and experiences based on data, while making it possible to create personalized collections based on user data.⁹ This situation reveals a creative practice that complements and sometimes even transforms the intuitive creativity of traditional designers. In a period of rapid technological development and change, artificial intelligence has become a critical tool for achieving sustainable production and design goals in the fashion industry as a new design element. The use of data-driven decision-making mechanisms in many processes, from design to production, inventory management to supply chain tracking, contributes to reducing environmental impacts.⁷

In the fashion industry, artificial intelligence-supported analysis systems process data on consumer behavior and expectations to generate demand forecasts for brands before they create their collections. These forecasts reduce unnecessary production, material, and accessory use, preventing resource waste.¹⁰ With the emergence of digital technologies, this system has also begun to be applied in the fashion industry to determine consumer communication and expectations. In the United States, Rent the Runway, Golden Tote, Stitch Fix, and Le Tote; in Japan, Air Closet; and in China, Y Closet, Ms Paris, and Dora's Dream, among others, are digital fashion platforms that use algorithms to analyze user preferences and provide personalized recommendations, thereby minimizing both the production process and post-sale waste rates.¹¹

The use of artificial intelligence in fashion design is also associated with minimizing production waste and increasing production

efficiency, prototyping, and simulation applications in line with sustainability goals. These applications create a basis for designing more with fewer resources, preparing functional collections, and guiding consumers to contribute to the design.¹² Additionally, AI-based CAD (Computer-Aided Design) software reduces the need for physical model production by digitally preparing products. These efforts also accelerate the delivery of diverse approaches and collections to consumers in the fashion industry.

Examples of artificial intelligence applications by fashion brands

In the textile industry, the application of artificial intelligence (AI) in fashion design plays a critical role in driving innovation, improving production efficiency, and enhancing consumer experiences through high-quality designs. Fashion brands have increasingly adopted AI across various stages, including design, production optimization, and operational restructuring, to enhance efficiency and innovation. Beyond serving as a rapid data-processing tool, AI has introduced an integrative approach to creativity and growth within fashion design. It allows brands to respond to the evolving demands of conscious consumers, influenced by environmental considerations and popular culture. AI is not only a technological transformation but also a determinant of how consumers experience fashion and how design and consumption will shape the future of the industry.¹³

Several brands have pioneered AI applications in fashion:

Stitch Fix personalizes customer clothing preferences and analyzes feedback to identify patterns and trends that designers might overlook. By leveraging AI, Stitch Fix has strengthened the connection between brand and consumer, providing personalized fashion recommendations and expanding its subscription base. This application has directly contributed to increased profitability.

Zalando, a major online fashion platform, uses AI algorithms to analyze trends and convert them into personalized fashion recommendations, creating a more user-friendly shopping experience.

Tommy Hilfiger employs AI to enhance trend forecasting in fashion design. The AI system scans historical trend images and fashion archives to predict future fashion trends. This approach not only accelerates the design process but also generates combinations and styles aligned with predicted trends, enhancing designers' creative potential.

The North Face has developed an AI-based online shopping assistant. By asking customers about model preferences, intended use, materials, and product features, the AI system delivers a highly personalized product selection. Leveraging natural language processing and machine learning algorithms, it anticipates customer needs and fosters a more sustainable shopping experience by creating a strong dialogue between product and consumer.

Consumer communication and artificial intelligence in the fashion industry

Artificial intelligence not only transforms fashion production processes, but also makes communication between fashion brands and consumers more personalized, faster, and more effective.¹⁴ This plays an important role in effective communication in terms of sustainability, spreading environmental awareness, increasing brand trust, and promoting production and ethical consumption.¹⁰ Brands can provide 24/7 sustainability-focused information and guidance through AI-based chatbots. Thus, providing consumers with information about fashion products, sustainability, product production

stages, carbon footprint, or the recycling stages of products that have reached the end of their useful life makes consumers more aware.¹⁵ This can be described as a structure that strengthens and reinforces the brand's sustainability identity.¹⁶ In AI-supported fashion design systems, consumers are not just buyers but active participants who can actively produce content and participate in the design process. Consumer behavior is also being restructured through the use of communication tools.¹⁷

With digitalization, communication between consumers and the fashion industry in the context of brands has become a much more interactive and personalized system than traditional advertising. These forms of communication, carried out using AI-supported recommendation systems, chatbots, and digital design platforms, are explained by written concepts.

- a) User experience
- b) Relational marketing
- c) Participatory consumers are among the new concepts used to explain these systems.¹⁰

Along with these concepts, meaningful communication theories play an important role in effectively conveying sustainability and sustainable fashion design manifestos to consumers.

The use of artificial intelligence in consumer communication by fashion brands

Fashion brands are increasingly leveraging artificial intelligence (AI) to strengthen brand perception, analyze consumer satisfaction, and optimize consumer spending in fashion purchases. AI aims to encourage higher spending by emphasizing quality and unique designs. A study conducted in collaboration between Vogue Business and Google examined how AI influences brand perception and consumer purchasing behavior among fashion consumers in Italy, the United Kingdom, France, and the United States.

In this survey-based research, AI was used to identify which factors consumers prioritize in their purchase decisions, such as the uniqueness of designs and the quality of craftsmanship. The study also explored consumer expectations regarding environmentally friendly, sustainable practices and corporate social responsibility in fashion. The research included data from 2,976 consumers of various fashion brands. The findings revealed that consumers show a preference for designs that use high-quality materials, extend the lifespan of garments, and reduce the likelihood of products becoming waste. Notably, 31% of respondents stated they would increase spending on more sustainable and functional designs. Additionally, there was a clear perception that AI can positively enhance a designer's creativity.¹⁸

Overall, AI not only strengthens a designer's creative capabilities but also serves as a supportive tool in managing costs, classifying trends, and responding quickly to consumer expectations. Furthermore, AI contributes to improving production processes, enabling comparisons, and providing rapid insights into environmental impact and post-consumer recycling, thereby broadening perspectives for sustainable and eco-friendly fashion design. By efficiently balancing supply and demand, AI can make the economic and environmental sustainability of fashion brands more trackable. It can also help prevent waste in inventory management and material sourcing. By analyzing consumer data, AI facilitates needs-based shopping, allowing brands to tailor their offerings. Moreover, AI programs can help fashion companies analyze trends across different geographies and cultures, optimize

design and production, and support the efficient use of resources through sustainable products.

Conclusion

In conclusion, while artificial intelligence positively enhances the designer's power in fashion design, it also serves as a supportive tool in terms of cost, classifying trends, and quickly meeting consumer expectations. Furthermore, it will create a wide range and perspective for environmentally friendly and sustainable fashion designs with fast data on improving production processes, making comparisons, environmental impacts, and the reuse of brands' products after use. By efficiently balancing supply and demand, it will make the economic and environmental sustainability of fashion brands traceable. It will contribute to preventing waste in stock product holding and material procurement. It is expected to open up opportunities for needs-based shopping by analyzing consumer data. The contribution of artificial intelligence programs to the fashion industry should be strengthened by developing programs that support the efficient use of resources with environmentally friendly products, enabling brands to analyze trends in different geographies and cultures and use their designs and production more efficiently.

In addition, it is seen that artificial intelligence has not yet provided sufficient answers regarding original design such as design, form and texture. Discussing this topic with designers and consumers on influential platforms in the fashion industry would be an important development.

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Conflicts of interest

The author declares that there is no conflict of interest.

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