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# AI - The New Technologies in Fashion: Reshaping and Revolutionizing the Value Chain and Design Process

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**Abstract**

The transformative fast technological shift of Artificial Intelligence (AI) on fashion product development is reshaping and revolutionizing the industry's impact, evolving in an era of technology, innovation, and efficiency. Artificial intelligence (AI) is now an integral part of every industry, and it is used for a lot of benefits and functions in businesses and the economy, as well as creative industries like fashion, art, and design. Artificial intelligence and its powerful tools can be applied to every step of the fashion value chain: production, concept and design, retail, source of materials, and logistics. It can bring improvements such as speeding and relieving processes, handling amounts of data that humans can't, and offering consumers new ways of experiencing retail. AI is proving to be a powerful innovation, starting from the initial stages of design through production and offering predictive insights, enhancing creativity, and optimizing processes. AI algorithms and data structures have the potential to improve operations, drive innovation, and create personalized experiences in the fashion industry, benefiting both businesses and consumers. In fashion, human skill and creativity often hold the key to brand differentiation. From product development to robotic manufacturing. Different tools, applications and programs used properly can free designers from manual tasks to focus on creative work. Human designers will remain key, while Gen AI will enable their roles to be orientated around curation. This potential must be communicated clearly to creatives to ensure the technology is adopted without undermining the role of the designer.

*Keywords:* Artificial intelligence, technology, fashion, innovation, design

## The Basic Concepts of Artificial Intelligence (AI)

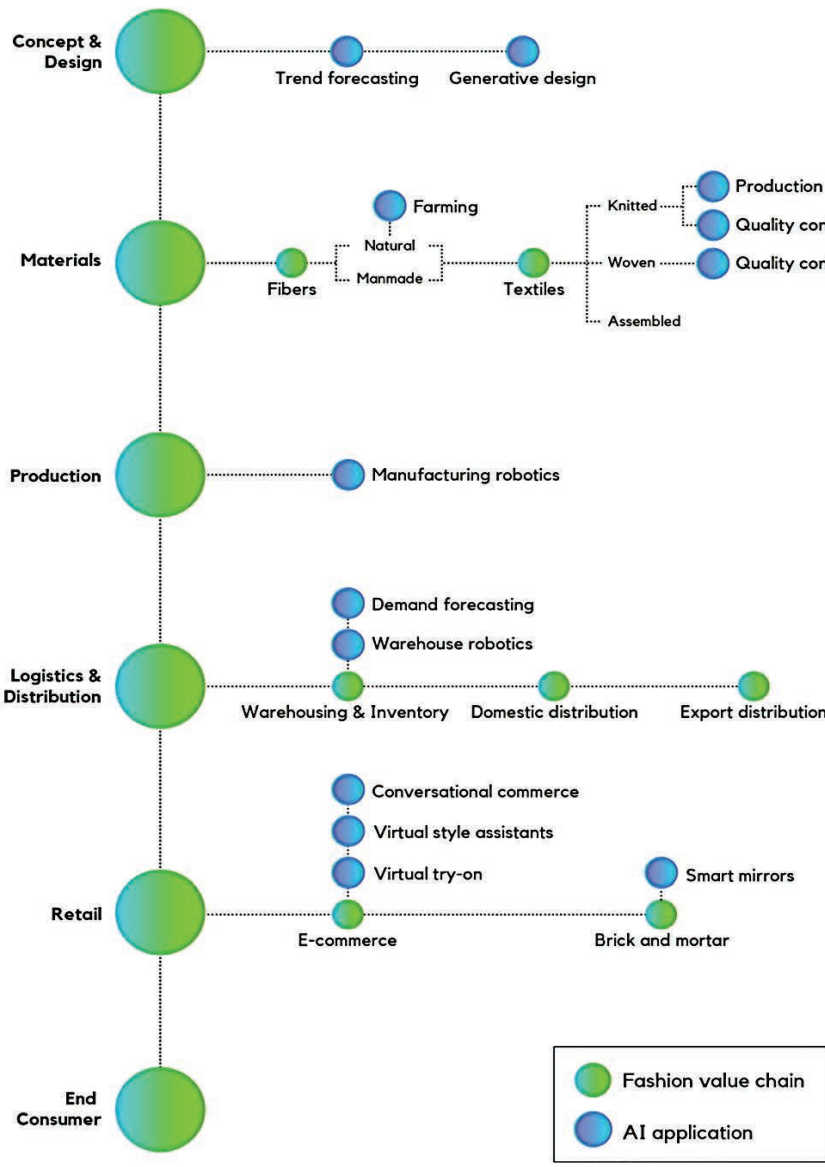
Historically, researchers defined intelligence in terms of fidelity to human performance, while others prefer an abstract, formal definition of intelligence called rationality. Considering intelligence to be a property of internal thought processes and reasoning while focusing on intelligent behavior as external characterization. The pursuit of human-like intelligence must be, in part, an empirical science related to psychology, involving observations and hypotheses about actual human behavior and thought processes. A rationalist approach, on the other hand, involves a combination of mathematics and engineering and connects to statistics, control theory, and economics (Russell & Norvig, 2021). Value chain is a basic concept of AI and set of steps necessary to deliver a product or service to the market.

The fashion value chain and the current AI application to each phase -(2020) Artificial intelligence in fashion: how consumers and the fashion system are being impacted by AI-powered technologies

Artificial intelligence is present in all areas of the fashion value chain composed of the following parts: Concept and design, including research, briefing, mood board and sketching; Materials, including natural and manmade fibers as well as the textiles production, which can be knitted, woven or assembled; Production, which is the manufacturing of the garments; Logistics and distribution, including warehousing and inventory, domestic and export distribution; Retail, including both e-commerce and brick-and-mortar stores and The end consumer. (Evangelista, 2020)

**Figure 1**

*The fashion value chain and the current AI application to each phase -(2020) Artificial intelligence in fashion: how consumers and the fashion system are being impacted by AI-powered technologies*



## Optimizing Supply Chains

AI is optimizing and revolutionizing the process of how the fashion industry operates. The most complex and challenging aspect of the fashion industry is the supply chain. To ensure efficient delivery, from sourcing raw materials to managing inventory, there is always potential for inefficiency and wastage. For better inventory management and to predict demand accurately, AI algorithms can analyze historical data. The major issue in the fashion industry contributing to environmental damage can now be minimized through overproduction. Fashion brands can reduce waste and become more sustainable, just by producing in line with the predicted demand. AI can also help in managing the logistics of the supply chain. Additionally, by ensuring that products are delivered in the most efficient manner, AI systems can track and analyze shipping data. Reducing carbon footprint, saving time, and making the supply chain more sustainable. Minimizing stockouts and markdowns while maximizing profitability by leveraging AI algorithms in fashion retail ensures the right products in the right quantities at the right time (Christou, 2024). A global supply chain manager of AI in supply chain optimization, for example, is Li & Fung. They use AI to connect retailers with suppliers in real-time, developing a digital supply chain platform to make it more efficient and responsive. Fashion brands like H&M are utilizing AI to adjust the quantities of each garment for each store analyzing store receipts and returns. Reduces the chances of having too much unsold stock with data analysis they are cutting costs and promoting sustainability.

AI algorithms: Gen AI (generative) and AIDA (AI-based Interactive Design Assistant) in Fashion industry

The most significant impact that AI has is in the design of collections and the production of advertising campaigns to sell these collections. There are various AI tools that assist fashion designers in creating their proposals for designing these collections. Based on a concept provided by the designer or from a sketch with tools that provide garment ideas. To develop the final garments, the designer has a wide range of ideas that only need to be adjusted accordingly. In 2023, as powerful new tools hit the market, Gen AI algorithms can create new complex content because they were pre-trained on large volumes of data such as text, images, and code, often fine-tuned with other corporate data. While strong open-source alternatives are challenging proprietary models, multiple platforms and tools have since entered the market, and a dizzying array of start-ups are seeking to leverage these (Bov Team Mckinsey & Company, 2023). As use cases move beyond one-off

projects and become embedded within fashion's value chain, the early experiments have offered a promising start, and the transformative power of gen AI will become more evident. It could be one of the most transformative technologies for the fashion industry in a long while. The overall financial impact of gen AI on the industry is potentially significant. The survey of global fashion executives BOF McKinsey State of Fashion 2024 found that 73% of respondents said gen AI would be an important priority for their businesses. Yet while many are experimenting with the technology, just 28% said their businesses have tried it for design and product, indicating that fashion companies are not yet capturing its value in the creative process.

In fast fashion, by injecting more agility from trend detection to product development and leveraging analytics data to rapidly produce large numbers of new designs, gen AI can accelerate the design process. Also, in luxury, gen AI allows us to experiment with rapid iterations, compile mood boards that draw from diverse sources, and curate the output. With the ability to visual designer's concept, it can equip less technically skilled designers. The tools can even provide inspiration with unexpected results produced by AI. Companies developing gen AI software for fashion say the technology can reduce manual tasks that take days to mere hours or even seconds. AIDA (short for AI-based Interactive Design Assistant) reportedly can produce a dozen fashion templates within 10 seconds. The system uploads sketches, materials, and color palettes to a virtual mood board with the help of a tagging tool for accelerated product searches. AIDA then creates templates that designers can finesse and augment. Another example is CALA, a fashion supply chain interface that includes gen AI in its design tools and can help designers produce more than 100 sketches in a single day.

But with AI algorithms, there is a risk that fashion will become less individual and less creative with drawing designs and marketing decisions. This could lead to a decline in the popularity of the overall industry and in the quality of fashion products. It's up to the industry to ensure that AI is used in a way that promotes creativity and diversity (Gingsberg, 2023). Anyway, AI is offering businesses new opportunities to streamline their operations and reach new heights just by its ability to analyze data and make predictions. From improving supply chain management to revolutionizing the design process, AI is transforming the fashion industry and changing the way businesses operate. While AI has the potential to revolutionize the fashion industry, it also poses new challenges that businesses will need to address. However, as with any technology, the benefits and drawbacks of AI in

fashion are all a matter of perspective. And with the right approach, businesses can use AI to drive growth and improve their bottom line.

## AI-based Garment Design Generation Technology

The early 2000s was the beginning of research on the AI-based garment design process. Since then AI has evolved from image recognition and synthesis to image generation in fashion garment design (Choi & Jang, 2023). Garment design studies pass this information to the next generation, incorporating AI and using genetic algorithms (GA) that favor the evolution of the information of the previous generation, such as the genetic phenomenon of an organism. The research was conducted to combine the design attributes of fashion products that have already been released and to suggest new styles. Garment design is a process that involves making various choices by combining different design attributes.

## The Art of AI

The human artist consciously works toward a creative or conceptual goal; artificial intelligence can simulate creativity, but there is also the question of the artist's intention. In 1956, Dartmouth College in the United States was first founded in the field of artificial intelligence as an academic discipline. Since then, advancements have been made in leaps and bounds, debating about the definition of AI. The English Oxford Living Dictionary explains AI as The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages. A much more concise definition gives Merriam Webster: the capability of a machine to imitate intelligent human behavior. Today, the accepted definition of AI is that technology imitates human intelligence to outperform the human brain (Mollard, (2020).

When creativity comes, then technology can imitate the thinking processes of humans. Throughout history, creativity explains humankind's progress, and it is this critical thinking that sets humans apart from the rest. Connotations of hard logic seem to take away the process of traditional creatives, so for those in the creative fields, there is often suspicion toward artificial intelligence. Today, it has become an extension of the creative process, but 100 years ago, the idea of using the Internet was inconceivable.

## 3D and AI Technology in Fashion Design

Some fashion brands see a sustainable solution for the world with 3D collections as the future. The Amsterdam-based brand The Fabricant, which uses 3D AI technology to produce its clothing, stated that its work exists beyond the current concepts of catwalks, photographers, studios, and sample sizes. Imagination is their only atelier, and their fashion stories are free from the constraints of the material world. Due to its potential to pinpoint precise consumer desires and, in turn, to reduce excessive waste, 3D and AI technology will stay for a variety of different reasons. To bridge the gap between artificial intelligence and creativity, Artificial intelligence could innovate the established ways of the fashion industry. Assisting AI, fashion brands through technology can predict analytics that can provide insight into fashion trends, purchase patterns, and inventory-related guidance. Social media has become a new creative space where consumers and designers alike express their favorite styles, and these metrics remain useful, while in the past, fashion brands have largely based this off of sales numbers and fashion shows.

## Artificial Intelligence in Fashion: An Unstoppable Trend

Many fashion brands have already begun testing and implementing AI tools at various stages of their processes. They are evaluating how AI can enhance their processes and foster creativity in their daily operations, design conception, and production of advertising campaigns. Emerging as a transformative force, generative artificial intelligence in the fashion industry has evolved from being a futuristic idea to becoming a tangible reality for many companies in the sector. AI requires a learning and adaptation process like any advanced technology. As some brands might imagine, it is not a magical solution that will instantly solve all challenges. AI effectiveness depends on proper understanding and use because it's a powerful and revolutionary tool capable of performing tasks. This technology is already revolutionizing the fashion industry and changing processes.

## Advantages and Disadvantages of Artificial Intelligence in Fashion

Worldwide fashion brands are accepting Artificial intelligence (AI) and new fashion technology, offering both opportunities and challenges and has made a significant impact on the world of fashion. At the same time, they begin to weigh all the advantages and disadvantages of its implementation (Roser, 2024):

**Advantages:**

Increased Creativity: AI is a technology that generates many more ideas than with a traditional creation process;

Innovation: Implementing a new revolutionary technology and having a significant advantage in the future;

Speed: AI assists brands in creating garments, collections, and campaigns much faster;

Sustainability: Reducing the carbon because AI allows brands to create campaigns from their 3D designs without needing to produce the garments;

Cost Reduction: Brands perceive cost savings in their campaigns.

**Disadvantages:**

Very New Technology: Generative AI is a very recent technology, which is complicated now but makes many actions that can be easy to achieve in the near future;

Fear of Technology: Society see it as a threat thinking it could replace certain jobs, but the reality is that this technology will be a tool to enhance human work.

## Manufacturing Apparel With AI

In the fashion industry AI is also transforming the garment manufacturing process. Most effective production lines are made by Algorithms, increasing efficiency and reducing waste. Also AI can predict demand for specific products and adjust production schedules accordingly, minimizing over and under-production (Fishman, 2023). Completing work in a fraction of the time with increased accuracy, the typical manufacturing robots used for decades are now being powered by AI. Robots are being used for cutting/ sewing fabrics, improving the safety of workers, reducing production costs and performing tasks that are too repetitive/ dangerous for human workers.

## Quality Control in Fashion Product Development

Developing the products with predefined standards and specifications, refers to the systematic process. Starting from the design and prototyping stage to manufacturing, distribution, and ultimately reaching the end consumers, it is a critical aspect of the entire product lifecycle. To deliver products that meet or exceed customer

expectations is the goal of quality control in terms of design, craftsmanship, durability, and overall performance (Baukh, 2024). AI can analyze large datasets, identify patterns, and automate tasks, leading to more efficient and accurate quality control just by leveraging advanced algorithms and machine learning techniques. Quality control of AI tools in several ways:

Automated Inspection: Automatically inspect and analyze visual aspects of products with AI-powered computer vision systems. Including identifying defects, irregularities, variations in color, stitching, and overall workmanship. Reducing the reliance on manual labor, speeds up the process, and provides consistent results.

Quality Analytics: Analyze data from production processes, inspection results, and customer feedback. Allowing organizations to make data-driven decisions for continuous improvement that provides insights into overall product quality.

Supplier Quality Management: Assessing and managing the quality of components and materials provided by suppliers. AI tools help organizations make informed sourcing decisions and ensure that materials meet quality standards by analyzing supplier performance data.

Automated Documentation and Reporting Generating comprehensive reports and automating the documentation of quality control processes, improving efficiency and providing a detailed record of quality control activities for audit and compliance purposes.

## Fashion Detection

The automated analysis and recognition of various fashion-related attributes, elements, and categories within images is called Fashion detection (Guo at all, 2023). The primary objective of detection in clothing is to enable automated analysis, understanding, and interpretation of fashion-related elements, contributing to a range of applications. An important role in enabling the efficient analysis of extensive datasets comprising fashion images is the improvement of the detection model. By classifying and accurately detecting various fashion elements, clothing items, styles, and patterns, the reliance on manual identification by designers is alleviated. Enhancing productivity and freedom for designers to devote more time to creative pursuits such as ideation and design (Zhang & Liu, 2024).

## AI is Reshaping and Revolutionizing the Fashion Industry

Trend forecasting: Analyzing large volumes of data from social media, fashion blogs, e-commerce platforms, and other sources, AI can predict future trends. Algorithms can provide accurate trend predictions by identifying consumer patterns/preferences and helping fashion brands with collections, inventory, and marketing strategies (Marku, 2023).

Design and Creativity: Generating innovative designs by analyzing large amounts of data, including customer preferences, historical trends, and market insights. Suggesting design variations and combinations autonomously generates new designs, increasing creativity and speeding up the design process.

Personalized recommendations: By analyzing customer data AI can enable personalized shopping experiences, including past purchases, browsing behavior and preferences.

Virtual try-on and fitting: Virtual try-on technologies allow customers without physically trying on to visualize how clothing items will look. AI can also help accurately measure body dimensions, facilitating better-fit recommendations and reducing return rates. Using computer vision and augmented reality (AR), enhancing the overall online shopping experience, customers can virtually try on different clothes, styles and colors.

Supply chain optimization: AI algorithms can increase inventory accuracy, reduce overstocking or out-of-stock issues and optimize the production and distribution process, by analyzing data from various sources. Optimizing the fashion supply chain by improving inventory management, demand forecasting and logistics.

Sustainability and ethical practices: AI can optimize manufacturing processes, reduce waste, improve energy efficiency, trace/verify the origin of materials, and ensure transparency and ethical sourcing.

Influencer Marketing: Fashion brands can partner with influencers that match their target audience, leading to more effective marketing campaigns. By leveraging algorithms, it can also analyze social media data, follower demographics, engagement rates and content relevance.

## Conclusion

In the fashion industry, Artificial Intelligence is a technological revolution with the potential to improve operations, drive innovation, and create personalized experiences, benefiting both businesses and consumers. The future is guiding us toward a new era where innovation knows no bounds but limitless possibilities and boundless creativity emerge when humanity embraces the tools of AI. Freeing designers from manual tasks to focus on creative work, AI technology can amplify the creative process, thus augmenting human capability while retaining designers' artistic skills and knowledge. Whether it's streamlining supply chain processes, optimizing pricing strategies, or revolutionizing marketing approaches, Artificial Intelligence serves as a driving force behind the industry's evolution. As we look to the future, the synergy between human and machine intelligence and creativity promises an evolving AI fashion industry. Artificial intelligence, with its technologies in fashion design, has a huge impact on the entire system in the industry, starting from design, production, marketing, and all the way to sales. The fact that it simplified the whole system is not excluded, but also, with the robotization of the machines in the production sector and the introduction of computer programs and applications, they helped in speed, quality, and creativity.

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