



Transforming Fast Fashion: The Digital Pathway to Sustainable Supply Chains

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Abstract. Fast fashion provides current popular styles and elements, characterized by low prices and various styles, to stimulate consumer interest and satisfy consumer demands. Based on these advantages, fast fashion brands have achieved great success around the world. Yet, It also caused huge ecological and environmental problems. This paper seeks to dissect and explore this complex interplay between financial imperatives and environmental responsibilities for fast fashion industry. The paper analyzes the reasons of the troubles in sustainable supply chains in fast fashions and the necessity to address these problems. At the end, this paper believes that digital transformation could be the effective solution to this problem in the fast fashion.

Keywords: Fast fashion; Supply chain; Digital transformation.

1 Introduction

In a world that's spinning ever faster, the fast fashion industry has capitalized on consumer demand for quick, affordable style, turning it into a multi-billion-dollar global enterprise. The appeal of fast fashion is straightforward: It's an industry designed to churn out the latest styles at breakneck speeds, appealing to a broad swath of consumers. According to recent data from Statista [1], the global fast fashion market was valued at an eye-popping \$106 billion in 2022. The projections are even more staggering; by 2027, this figure is expected to soar to around \$185 billion (See Figure 1 and Figure 2).



Fig. 1. Fast fashion market value forecast

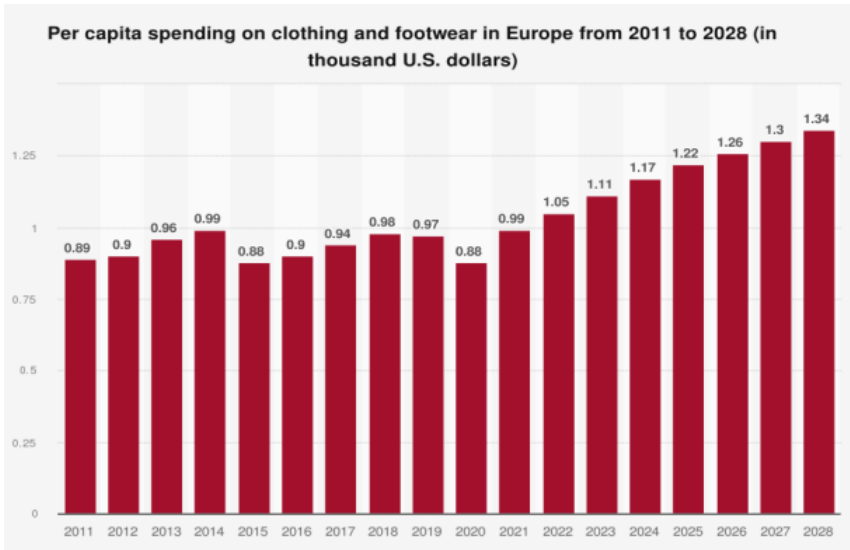


Fig. 2. Per capita spending on clothing and footwear in Europe

Yet, this commercial success comes at an environmental toll. The industrial sector is the third-largest contributor to global carbon emissions, and the fashion industry has come under scrutiny for its role in climate change. Also, according to data from Statista, with escalating apparel production, the pressure is mounting for transparency and sustainability, figures from annual reports of leading European fashion retailers highlight this, with Swedish giant H&M releasing over 60 thousand tonnes of Scope 1 and Scope 2 greenhouse gas emissions in the 2022 financial year, much of it tied to its supply chain operations (See Figure 3).

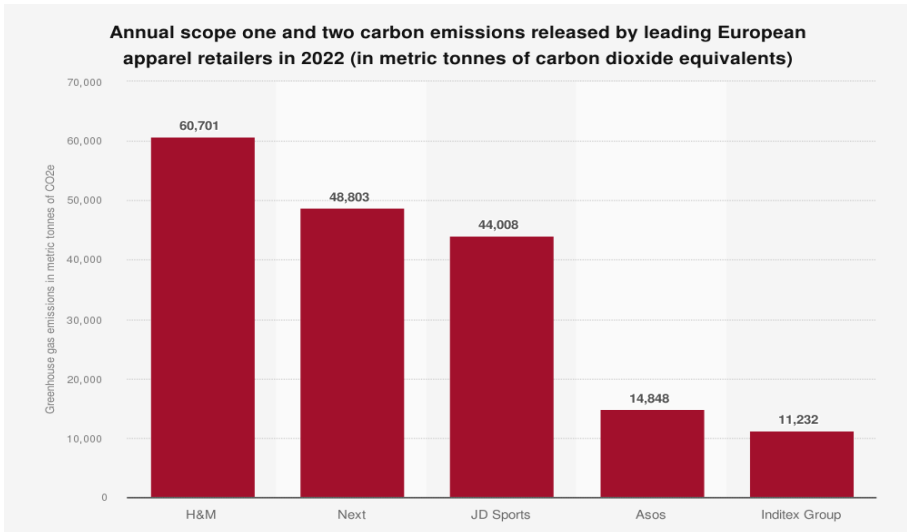


Fig. 3. Annual scope one and two carbon emissions released by leading European apparel retailers in 2022

In sum, the fast fashion industry is at a pivotal juncture. Its financial ascent is undeniable, but so too is its environmental footprint. The challenge ahead lies in balancing rapid growth with sustainable practices—a task easier said than done.

2 Dissecting the sustainability conundrum in fast fashion's supply chain

The architecture of the fast fashion supply chain could be divided into the following part: velocity; efficient turnaround; cost management; high-Volume Production and fleeting fashion. In such process, high-volume production emphasizes on large-scale production, often using environmentally harmful materials, contributes to a troubling ecological footprint, from emissions to waste [2]. Fleeting Fashion: means that the industry thrives on transient, trend-based products that have a short lifespan, adding to the cycle of waste and disposability [2]. This two parts will cause trouble to the environment.

As the spotlight on environmental responsibility intensifies, the fast fashion industry finds itself increasingly scrutinized. In a mere 15 years, production rates have doubled, with an alarming 43% increase projected by 2029 [2]. The environmental cost of such speed and efficiency is sobering. The industry's annual consumption of 93 billion cubic meters of water and the dumping of microfibers equivalent to 50 billion plastic bottles into oceans underscore the gravity of the situation [3].

The fast fashion industry is at a precarious crossroads—where innovation in logistics is offset by environmental degradation. The pressing question is whether the industry can adapt without compromising its core ethos. What's more, a global survey of fashion

executives in 2022 disclosed two primary challenges in enhancing corporate sustainability. First, the absence of standardized metrics to evaluate sustainability performance, and second, the high costs associated with sustainable materials (See Figure 4)

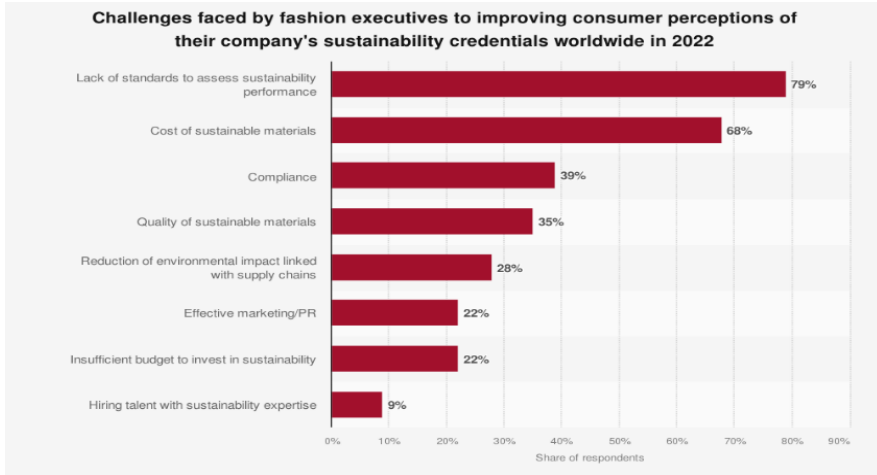


Fig. 4. Challenges faced by fashion executives to improving consumer perceptions of their company's sustainability credentials worldwide in 2022

In essence, the fast fashion supply chain is a high-stakes balancing act. On one side lies commercial viability and on the other, an urgent need for sustainable transformation. The path ahead is fraught with challenges, both operational and ethical.

3 The imperative to resolve the sustainability dilemma in fast fashion's supply chain

The call for sustainability in the fast fashion industry is necessary for the development of the fast fashion. On the one hand, the ethical fashion market is rising. On the other hand, there still exist the trust deficit between the customers and fashion industry.

According to industry data, the ethical fashion market—defined here as incorporating fair trade, sustainability, and a lack of exploitation at any supply chain stage—is poised for significant growth. Its value is expected to jump by \$3 billion between 2021 and 2025, reaching an estimated \$10 billion. This trend isn't merely a flash in the pan; it reflects a broader consumer shift towards responsible consumption. In 2021, nearly 60% of global consumers indicated that sustainability was at least somewhat important to them when shopping for apparel (See Figure 5).

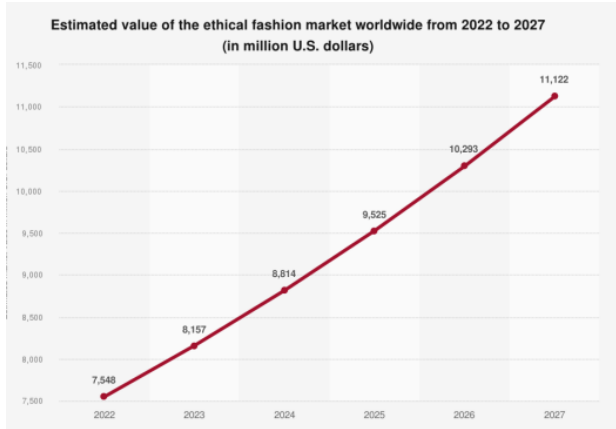


Fig. 5. Estimated value of the ethical fashion market

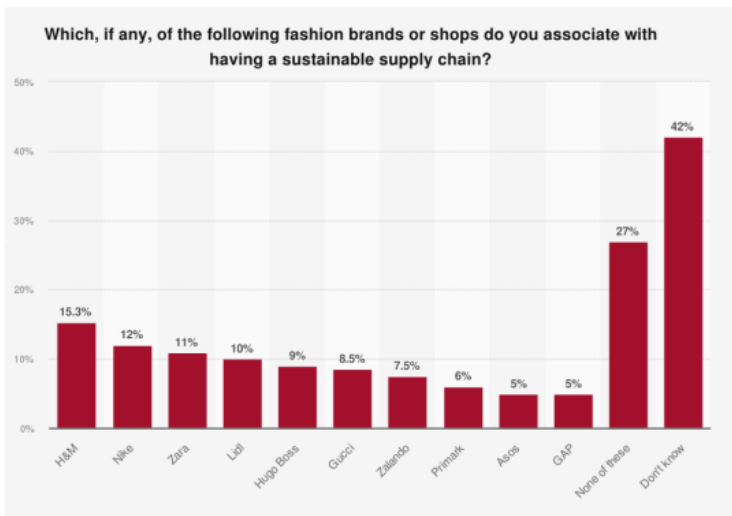


Fig. 6. Customer’s impression of fast fashion with sustainable supply chain

However, consumer trust in the industry’s sustainability efforts remains skeptical at best. A 2018 survey spanning six European countries found that only 15% of respondents associated H&M with a sustainable supply chain. For brands like GAP and Asos, the figure plummeted to a meager 5%. This trust deficit underscores the pressing need for meaningful, transparent action on the sustainability front (See Figure 6).

The conundrum facing the fast fashion industry is clear: Can it realign its supply chain to meet the triple bottom line—people, planet, and profit—without compromising its core business model?

4 The solution to the sustainable transformation in the fast fashion supply chain

As the fast fashion sector continues its meteoric rise, known for its quick-to-market apparel and cost efficiencies, it's increasingly coming under fire for its sustainability shortcomings. Digital transformation could be the industry's ticket to balancing the scales of profitability and responsibility.

4.1 Artificial intelligence

In the rapidly evolving landscape of the fast fashion industry, a new technological ally has emerged to address the complex challenge of sustainability: Artificial Intelligence (AI). By harnessing machine learning algorithms and rich data analytics, AI can take on tasks that are either too complex or too voluminous for humans to handle efficiently [4].

The first function could be the new auditor for real-time sustainability. According to dos Santos et al. (2021), AI technologies offer an unprecedented avenue for real-time sustainability audits in the fast fashion industry [5]. With the capability to parse through complex data sets, AI algorithms can instantaneously assess the carbon footprint of a garment at each phase—ranging from the sourcing of raw materials to its journey through retail channels. Given that the creation of a single kilogram of fabric can emit between 20-23 kg of greenhouse gases, the industry's contribution to global emissions is startling. Estimates place the fashion industry's share at 4-10% of all human-caused greenhouse gas emissions, overshadowing even the aviation industry, which accounts for a mere 2.4% [2].

What's more, a sizable 70% of these emissions are attributed to the production phase, including the creation of fibers and the manufacturing of the clothing items themselves. With AI's real-time analysis, brands have the opportunity to pinpoint these high-impact zones within their production process. This allows for on-the-spot adjustments that bring operations more in line with sustainability objectives.

The second function of AI is to collect and analyze multifaceted data—ranging from social media trends to e-commerce behaviors and even the latest runway hits—brands can not only anticipate consumer demand but also minimize waste. This smart data integration allows retailers to create an optimized product mix that aligns with both consumer preferences and sustainability objectives. Take Intelistyle, for example, a company that employs AI-powered styling to personalize the retail experience, both online and in-store. Intelistyle's AI algorithms analyze not just consumer behavior but also the latest fashion trends from catwalks and social media. This dual focus enables the generation of outfit recommendations that are both stylish and targeted, allowing retailers to scale their human styling services economically. More importantly, by accurately predicting what consumers are likely to buy and wear, Intelistyle's AI minimizes overproduction and inventory waste, contributing to a more sustainable fast fashion supply chain.

4.2 Block chain

As the fast fashion industry faces increasing scrutiny for its sustainability practices, Blockchain and Distributed Ledger Technologies (DLTs) present a transformative solution. These technologies offer a level of traceability and transparency that could revolutionize the industry, making it more ethical, sustainable, and efficient [6].

The obvious advantage of blockchain technology is enhancing traceability and transparency by revolutionizing the fast fashion supply chain. Take a simple t-shirt for example; its blockchain record could reveal a wealth of details, from the specific cotton farm where the raw material was sourced, to the factories where it was spun and stitched, all the way to its logistical journey to the retail store. This detailed level of information is not just enlightening; it's transformative for the industry.

The second advantage of blockchain technology is providing a immutable and trustworthy records. The inherent unalterable nature of blockchain records provides a robust foundation for verifying sustainability claims, thereby serving as a catalyst for increased confidence among consumers and stakeholders. Take Hugo Boss, for example, a brand that is in the exploratory phase of integrating blockchain technology to bring about unparalleled transparency in its supply chain operations. The goal is far-reaching: By using blockchain, Hugo Boss aims to track ownership and the transfer of goods transparently, from raw material suppliers to manufacturing units and all the way to retail outlets. It's worth noting that blockchain's utility isn't just about tracking physical goods. Its potential spans multiple dimensions of sustainability, such as lifecycle assessment, proof of authenticity, and tamper-resistant documentation. These capabilities make blockchain an invaluable asset for establishing a new standard of trust and ethical practice in the fast fashion industry.

The third advantage of blockchain technology is streamlining operational efficiencies. Blockchain doesn't just benefit consumers; it also offers significant operational advantages for brands. Currently, the multiple stakeholders in a production line have their individual records, leading to inefficiencies and delays. According to Caldarelli, Zardini, and Rossignoli [7], Blockchain centralizes this information on a single digital platform, substantially reducing the time it takes to identify material origins and streamline supply chains.

5 Conclusion

Based on the above information, the fashion industry will realize that digital transformation isn't an optional upgrade; but it's the industry's lifeline to sustainability. According to a survey published by Bergur Thormundsson on November 30, 2022, there's a notable uptick in the adoption of digital technologies among companies in supply chains and manufacturing. In 2022 alone, more than a third of executives anticipate widescale incorporation of Artificial Intelligence (AI) in their operations. But it's not just AI that's capturing the industry's attention. Blockchain, the immutable ledger technology, is making headway too. A 2021 survey revealed that 10% of supply chain professionals had already implemented Blockchain, and another 14% had integrated AI into their operations. Looking ahead, both technologies are slated for significant

growth, with Blockchain expected to see a 65% adoption rate and AI a staggering 75% over the next half-decade.

These aren't just numbers. The supply chain is at the cusp of a digital revolution—one that could address its longstanding sustainability conundrums. AI can optimize logistics and predict demand, reducing waste. Blockchain can track a product's journey, verifying its sustainability claims. And Internet of Things (IoT) sensors can monitor production in real-time, ensuring compliance with environmental standards. In essence, to navigate the labyrinthine challenges of sustainability in fast fashion, digital transformation may very well be the silver bullet. As consumer demands for transparency rise and as investors increasingly prioritize ESG criteria, the fast fashion industry finds itself at a pivotal crossroads. It can either embrace digital transformation as a pathway to sustainability or risk becoming a relic of unsustainability. The choice, and the future, lies in the hands of industry leaders.

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