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From Design to Distribution, Supply Chain Strategies in the Fast Fashion Industry: Insights from H&M, Benetton, and Zara

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Abstract

The evolution of the fashion industry, significantly influenced by the second and third industrial revolutions, has paved the way for mass production and technological advancements that underpin the fast fashion business model. Prominent brands such as H&M, Zara, and Benetton have embraced this model, characterized by rapid production cycles and affordable pricing to meet dynamic consumer demands. This comparative case study delves into the supply chain management strategies of these leading fast fashion brands, focusing on their approaches to design, manufacturing, sourcing, and distribution. The research identifies both unique and shared mechanisms that enable these brands to maintain competitive advantages in a highly dynamic market. Furthermore, the study examines the integration of digital technologies - including Artificial Intelligence (AI), Machine Learning (ML), and Radio Frequency Identification (RFID) - highlighting their roles in optimizing supply chain operations and enhancing sustainability efforts. It also addresses the challenges these brands encounter during international expansion and market adaptation, such as regulatory hurdles, cultural disparities, and sustainability concerns. Additionally, the investigation explores how sustainability practices are incorporated within their supply chain models to address environmental and ethical issues. Findings reveal that while each brand employs tailored strategies aligned with their operational models, common themes of agility, technological innovation, and sustainability are pivotal to their success. The paper concludes by emphasizing the importance of advanced supply chain management in the fast fashion sector and suggests avenues for future research in developing sustainable and resilient supply chain frameworks.

Keywords: *Fast Fashion, Supply Chain Management, H&M, Zara, Benetton, Digitalization, Sustainability, Internationalization*

Introduction

The second and third industrial revolutions have profoundly transformed the textile industry, enabling mass production and significant technological advancements (Duarte et al., 2018; Jin & Shin, 2021). These developments allowed clothing brands to scale their operations and cater to a broader consumer base by producing garments rapidly and efficiently. Consequently, the fast fashion business model emerged, characterized by quick turnaround times and affordable pricing, enabling brands to meet the ever-changing demands of consumers (Atanacković, 2019; Baier et al., 2020). Fashion brands like H&M, Zara, and Benetton have been at the forefront of this transformation, adapting their manufacturing and distribution processes to ensure that new styles reach retail stores within weeks rather than months (Zhang et al., 2021). In the 1970s, these brands began rapidly adopting and replicating catwalk styles, producing garments quickly and at low costs to solidify their positions in the global fashion market (Zhang et al., 2021). By minimizing lead times through local sourcing and production coupled with technological innovations, these companies have maintained a competitive advantage in a highly dynamic industry (Atanacković, 2019; Baier et al., 2020).

The fast fashion model emphasizes speed and affordability, with brands constantly producing new products at lower prices and shorter life cycles to align with the latest fashion trends (Stål & Corvellec, 2021). Given the competitive and demand-oriented nature of the fashion industry, brands must swiftly respond to shifting consumer preferences by delivering new varieties to stores before their competitors can (Fraser & van der Ven, 2022). This agility is essential for sustaining profitability and market relevance in an environment where consumer tastes and trends evolve rapidly. Key players such as H&M, Zara, and Benetton have each developed distinct supply chain management strategies to effectively manage their processes and deliver final products to customers globally.

This case study aims to analyze and compare the supply chain strategies of these leading fast fashion brands, focusing on their approaches to design, manufacturing, sourcing, and distribution. By highlighting the similarities and differences in their strategies, the study seeks to provide a comprehensive understanding of how these brands navigate and thrive in the competitive global fashion market. Moreover, the study examines the challenges these brands face regarding internationalization and market expansion, including regulatory hurdles, cultural differences, and sustainability concerns. In today's digital age, advancements in technologies such as Artificial Intelligence (AI), Big Data, the Internet of Things (IoT), and Machine Learning (ML) have significantly influenced supply chain operations (Tsolakis et al., 2022). Therefore, this research also investigates how digitalization contributes to optimizing the supply chain operations of H&M, Zara, and Benetton, offering insights into the role of technology in enhancing operational efficiency and responsiveness. By conducting a comparative analysis of these leading fast fashion brands, this

paper contributes to the broader understanding of effective supply chain management practices in the fast-paced and competitive fashion industry. It underscores the importance of agility, technological integration, and sustainable practices in maintaining a competitive edge and achieving long-term success.

1. Supply Chain Strategies in the Fashion Industry

The apparel industry follows a structured process to deliver clothing to consumers, encompassing design, manufacturing, sourcing, and distribution. Effective management of these processes is crucial for companies to meet customer expectations, achieve operational efficiency, and maintain cost-effectiveness while adhering to environmental sustainability (Bindi et al., 2021). The intricate balance between these factors determines a company's ability to compete and thrive in the dynamic fashion market. Fashion brands adopt various supply chain strategies based on their specific objectives and market positioning. One prevalent approach is the agile supply chain strategy, which emphasizes rapid response to changing consumer demands and fashion trends. This strategy enables brands to swiftly adapt their product offerings, ensuring that new styles reach the market in a timely manner. Conversely, the lean supply chain strategy focuses on streamlining operations, reducing inventory levels, and optimizing resource utilization to enhance overall efficiency. By minimizing waste and lowering costs, companies implementing lean strategies can achieve greater profitability and operational stability.

In addition to these, many companies employ a hybrid strategy, often referred to as leagile, which combines elements of both agile and lean approaches. The leagile strategy seeks to balance efficiency with responsiveness, allowing brands to maintain low operational costs while still being able to quickly adapt to market changes (Ahmed & Huma, 2018). This combined approach provides flexibility and resilience, enabling companies to navigate the uncertainties of the fashion industry effectively. Beyond agile, lean, and leagile strategies, there are other supply chain management models utilized within the fashion sector. The push model relies heavily on demand forecasts to drive product movement through the supply chain. Products are manufactured and pushed towards the market based on anticipated demand, which can sometimes lead to excess inventory if forecasts are inaccurate. On the other hand, the pull model is more responsive to actual customer orders, minimizing excess inventory and reducing the risks associated with overproduction (Prasad et al., 2020).

Sustainability has become a critical consideration in supply chain management, giving rise to the green supply chain model. According to Noiki et al. (2023), this model integrates environmentally friendly practices across all stages of the supply chain, including green production, logistics, distribution, and marketing. By adhering to strict environmental policies, companies aim to reduce carbon emissions and minimize their ecological footprint. Additionally, the integrated supply chain

model emphasizes collaboration and coordination among all supply chain partners, fostering a cohesive and efficient operational framework (Hamamura, 2021).

The selection of an appropriate supply chain strategy significantly impacts a fashion brand's success in the market. Each model offers distinct advantages and suits different business contexts and industry requirements. Companies must carefully evaluate their specific needs, market position, and long-term objectives when choosing a supply chain model that aligns with their strategic goals. This evaluation becomes particularly relevant when examining how leading fashion brands like H&M, Zara, and Benetton have adapted these strategies to build their global operations.

Supply Chain Strategy	Description	Advantages	Challenges
Agile	Focuses on rapid response to changing consumer demands and fashion trends.	High responsiveness, ability to quickly adapt to market changes.	Can be costlier due to the need for flexible resources and rapid production capabilities.
Lean	Emphasizes streamlining processes, reducing inventory, and optimizing resource utilization to enhance efficiency.	Cost reduction, minimal waste, improved operational efficiency.	Less flexible in responding to sudden market changes or unexpected demand fluctuations.
Leagile	Combines agile and lean strategies to achieve a balance between efficiency and responsiveness.	Balances cost-effectiveness with the ability to adapt to market changes.	Complex to manage due to the dual focus on efficiency and flexibility.
Push	Relies on demand forecasts to push products through the supply chain, producing goods based on anticipated demand.	Efficient for stable demand, economies of scale in production.	Risk of overproduction and excess inventory if forecasts are inaccurate.
Pull	Responds directly to actual customer orders, minimizing excess inventory and reducing the risk of overproduction.	Reduces inventory costs, aligns production closely with actual demand.	Slower response times, potentially higher production costs due to smaller batch sizes.
Green	Integrates sustainability practices across production, logistics, distribution, and marketing to reduce environmental impact and adhere to eco-friendly policies.	Enhances brand reputation, meets regulatory requirements, reduces environmental footprint.	Can incur higher costs, requires investment in sustainable technologies and processes.
Integrated	Emphasizes collaboration and coordination among all supply chain partners to foster a cohesive and efficient operational framework.	Improves overall supply chain efficiency, enhances communication and collaboration, reduces silos.	Requires high levels of trust and information sharing, potential dependency on partners.

Table 1: Comparative Overview of Supply Chain Strategies in the Fashion Industry

2. H&M's Supply Chain Strategy

The H&M Group, established in Sweden in 1947, has evolved into a global fashion powerhouse operating multiple brands including H&M, Monki, COS, & Other Stories, ARKET, Cheap Monday, Weekday, and Afound across more than 75 markets (H&M Group, n.d.-a). The company's business model exemplifies fast fashion principles through continuous collection updates and rapid product offerings to meet customer demands (Tun, 2022). Understanding H&M's approach to design, manufacturing, and distribution provides valuable insights into how global fashion retailers can effectively manage complex supply chain operations.

2.1. H&M’s Design Strategy

H&M's design strategy combines affordability with trendy aesthetics, supported by close collaboration between design teams and trend forecasters to create market-responsive product lines (Ransbotham et al., 2020). The company has strengthened its design capabilities through two decades of partnerships with professional designers, enabling the creation of appealing yet affordable collections (Testa, 2023). Sustainability plays a central role in H&M's design philosophy, manifested through initiatives like the Conscious Collection launched in 2013, which features eco-friendly products and sustainable materials (Ashman, 2021; Pucker, 2023). By 2021, this collection represented 21% of H&M's total clothing line, demonstrating the company's commitment to sustainable design practices (Textile World, 2022). Furthermore, H&M has adopted a circular fashion design approach, utilizing renewable and recyclable materials while implementing end-of-life recycling programs for used garments (Choi et al., 2019). The company's innovative "circulator" tool enhances this commitment by evaluating product durability, recyclability, and environmental impact to ensure the creation of sustainable, long-lasting products (H&M Group, 2023a).

2.2. H&M’s Manufacturing and Sourcing Strategy

H&M's manufacturing and sourcing strategy relies on a diverse network of suppliers and pattern makers rather than owning factories, allowing for greater operational flexibility (Faheem & Purkayastha, 2020). The company's extensive supplier network, as of June 2023, encompasses 1,368 manufacturing suppliers, 1,249 material processing suppliers, and 272 factories for sourcing fabrics, yarns, and tanneries, with significant concentrations in Bangladesh (38%) and Mainland China (25%) (H&M Group, 2023b). This global supply chain includes 605 commercial product suppliers across Europe, Asia, and Africa, organized in a multi-tiered structure. The system efficiently delegates responsibilities, with tier 1 factories handling final product manufacturing, tiers 2 to 4 managing component processing and production, and tiers 4 to 6 focusing on raw material production (H&M Group, n.d.-c). This structured approach enables H&M to maintain quality control while optimizing production costs across its global operations.

2.3. H&M’s Distribution Strategy

H&M's distribution network combines physical and digital presence, operating 4,414 stores across 76 markets and offering online shopping in 59 markets as of February 2023 (H&M Group, n.d.-b). The company leverages advanced technologies, including AI and ML, to optimize product distribution and inventory management (Sandberg & Abrahamsson, 2021). RFID scanning technology enables precise inventory tracking, while the centralized distribution center in Hamburg, Germany, coordinates product labeling, packaging, and delivery through regional warehouses (López et al., 2021). H&M's efficient inventory management system operates without backup stock, instead relying on store manager requests based on market demand. The company optimizes expansion costs by utilizing its existing network of 13 distribution centers in Asia and Europe rather than establishing new facilities in emerging markets. This approach, combined with rigorous quality testing procedures at distribution centers, ensures efficient and cost-effective product delivery while maintaining quality standards (Maheshwari et al., 2019).

3. Zara’s Supply Chain Strategy

Zara, owned by the Spanish distribution group Inditex, exemplifies vertical integration in the fashion industry, maintaining control over all phases of its supply chain from design to distribution (Li, 2021). This comprehensive approach enables Zara to maintain agility and responsiveness in meeting consumer demands while optimizing operational efficiency throughout its value chain.

3.1. Zara’s Design Strategy

Zara's design strategy places customers at its core, implementing a unique approach that emphasizes exclusivity and rapid market response (Bainsla & Choudhary, 2022). The company maintains a strict policy against design repetition, ensuring that once a design sells out, it will not be reproduced in the same manner, creating a sense of scarcity and urgency among customers (Eggertsen, 2019). At the heart of this strategy is Zara's design center, connected to Inditex headquarters, where approximately 700 designers work across three halls, complemented by design-conscious young employees in retail stores who provide valuable market insights (Aftab et al., 2018).

The company's distinctive organizational structure features a flat design team without a head designer, fostering autonomy among designers who work in specialized teams responsible for specific portfolio sections such as dresses and tailoring (Roll, 2021; Sellitto et al., 2021). This collaborative approach extends to close cooperation between designers and the product management team, who analyze customer preferences through regular data inputs to identify trending styles (Inditex Group, 2023). Designers draw inspiration from various sources, including street style, fashion shows, and celebrity fashion, while actively engaging with store managers to

gather feedback on trending designs before public release (Alonso, 2023; Tőkés, 2022).

3.2. Zara's Manufacturing and Sourcing Strategy

Zara uses a proximity manufacturing approach where it manufactures garments close to its headquarters and works with 1729 suppliers located in 50 countries. These suppliers work with 8271 factories to manufacture garments, and 49% of these factories are located in Turkey, Spain, Morocco, and Portugal (Inditex Group, 2023). The company produces experimental and fashionable products in Spain, where they can be tried and tested, and outsources the manufacturing of simple and everyday garments, such as T-shirts, which have a longer shelf life, to low-cost suppliers in Asia (Luz et al., 2021; McKinnon, 2023).

Under its Join Life label, Zara produces clothes from recycled fibers for environment-conscious customers (Gheorghe & Matefi, 2021). Uncut fabrics in their natural colors are sourced by Zara to produce garments based on market trends. It maintains a 20% stock of pre-made garments and produces the rest 80% in its own facilities in small batches to quickly respond to changing trends (Camargo et al., 2020). This Just-In-Time strategy and quick response to customer tastes enable Zara to hold less inventory and ship a style to stores within two to three weeks (Duoyan, 2021).

3.3. Zara's Distribution Strategy

Zara's vertical integration approach has shortened its design-to-retail cycle by 15 days (Józefowiak, 2023). It has a network of 2,312 stores globally as of January 2023. A centralized distribution system is used by Zara to minimize the lead time and deliver products to these stores (Inditex Group, 2023). Zara's distribution center in Spain handles processing, labeling, tagging, and loading of its clothing items (Hugos, 2020). The facility, named "The Cube," uses advanced technology, like optical reading devices. It helps Zara in sorting and distributing more than 60,000 items per hour with minimal human intervention (Liu & Zhang, 2019; Zhu, 2022).

Zara also maintains an inventory level of 20% and restocks the stores every two weeks. Only demanding garments are sold two times before they are taken off the shelves (Xuejie et al., 2019). Zara utilizes RFID technology to manage the availability of items and ship them to stores from nearby warehouses to fulfill customer orders. This approach has proven advantageous in terms of cost savings on shipping in Europe since Zara's stores are often in closer proximity to customers (Liao & Kong, 2023; Yin, 2022).

4. Benetton's Supply Chain Strategy

The Benetton Group, established in 1965 in Treviso, Italy, has built its reputation on a business model that combines agile and lean practices in its supply chain operations. The company's strategic framework emphasizes sustainability, customer focus, social identity, and innovation, reflecting its commitment to responsible fashion and operational excellence (Benetton Group, 2022).

4.1. Benetton’s Design Strategy

Benetton's design philosophy centers on research-driven approaches and eco-friendly practices, embodied in their "Think before producing" methodology (Benetton Group, 2022). The company maintains specialized in-house design teams for different collections, including menswear, women's clothes, and kidswear, each operating under the guidance of a creative director to ensure consistent brand identity and design quality (Benetton Group, 2021; Benetton Group, 2020). Design teams actively respond to societal changes and global fashion trends, with designers regularly traveling worldwide to gather insights from different markets and cultural influences (Benetton Group, n.d.-a; Fibre2Fashion, n.d.).

The company's design operations are centralized at its Treviso headquarters, where sophisticated computer-aided design (CAD) software and Automaker systems facilitate the creative process (Thottath & Rao, 2018). Designers work with a comprehensive palette of 250 colors, and once designs are finalized, they are seamlessly transmitted to automated fabric cutters and knitting machines for production (Gawas, 2021). This integration of technology and creative expertise enables Benetton to maintain efficiency while ensuring design innovation and quality.

4.2. Benetton’s Manufacturing and Sourcing Strategy

Benetton has adopted a postponement strategy that swaps the traditional dyeing and knitting process, as the process of knitting is longer but inexpensive than the dyeing process (Scott et al., 2018; Biçer et al., 2021). Benetton delays the dyeing process and manufactures the garments first. It later colors the undyed garment based on trending colors in the market (Abdelkafi & Pero, 2018; Noble & Ludwig Bstieler, 2023). Also, to exercise more significant influence over manufacturing and transportation expenses, Benetton has increased its production capacity in Tunisia, Serbia, Turkey, Croatia, and Egypt and is making a shift to a regional supply chain operation by moving away from low-cost centers in Asia (Li, 2022; Mohamed Khalifa, 2022).

Although production expenses are 20% cheaper in India, Vietnam, and Bangladesh, the longer lead times caused by supply chain disruptions neutralize the cost-benefit (Ndubisi & Nygaard, 2018). The company aimed to reduce its production in Asia by 50% by the end of 2022. Whereas, garments manufactured in Egypt can be transported to European warehouses and stores within 2 - 2.5 months, significantly reducing the lead time (Abdulla, 2021; Anzolin & Aloisi, 2021).

4.3. Benetton’s Distribution Strategy

Benetton's distribution network is supported by sophisticated technology and strategic partnerships. The company's proprietary tracking system enables real-time monitoring of inventory levels and sales across its retail locations, allowing rapid response to market demand (Yuki & Kubo, 2023). This European-focused supply chain structure, with concentrated retail and supplier

networks in the region, facilitates prompt fulfillment of customer demands throughout Europe (Kalchschmidt et al., 2020).

The company's global distribution capabilities are exemplified by its 3,789 stores worldwide as of 2021 (Benetton Group, 2022). The Castrette logistics facility in Italy serves as a cornerstone of Benetton's distribution network, featuring a fully automated sorting system that manages orders for stores across 120 countries. This state-of-the-art facility can handle 800,000 boxes with a daily output of 80,000 boxes (Benetton Group, n.d.-b; MarketLine, 2023). In expanding markets like India, Benetton has established strategic partnerships, such as its collaboration with Future Supply Chain in 2020 to operate a 112,000 square feet warehouse capable of managing over four million inventory volumes and 100,000 SKUs (ETRetail, 2020; Retail4Growth Team, 2020).

Aspect	H&M	Zara	Benetton
Design Strategy	- Collaborates with trend forecasters and professional designers. - Launched Conscious Collection (21% of total in 2021). - Implements circular design (Circulator tool).	- Customer-centric design. - Flat design structure with nearly 700 designers. - Designers collaborate with store managers for feedback.	- Research-driven "Think before producing" approach. - Utilizes CAD software and Automaker for design. - Travels globally for trend inspiration.
Manufacturing & Sourcing	- Partners with 1368 suppliers in 75 countries. - Primarily sources from Bangladesh (38%) and China (25%). - Multi-tiered supply chain.	- Proximity manufacturing near headquarters. - 1729 suppliers in 50 countries. - Just-In-Time production, 80% produced in-house.	- Postponement strategy: delays dyeing. - Sourcing from Tunisia, Serbia, Turkey, etc. - Reduced reliance on Asia.
Distribution Strategy	- 4,414 stores globally. - Central distribution centers. - Utilizes AI, ML, and RFID for inventory tracking. - Distributes from 13 centers in Asia and Europe.	- 2,312 global stores. - "The Cube" distribution center with RFID and optical scanning. - Restocks every two weeks from nearby warehouses.	- 3,789 stores globally. - Automated Castrette logistics facility. - In-house tracking system for real-time inventory.
Sustainability Practices	- Conscious Collection focuses on sustainable materials. - Circular design and recycling initiatives. - Digital twin technology to minimize waste.	- Join Life label uses recycled fibers. - Quick response to reduce overproduction. - Data-driven design to limit unsold inventory.	- Eco-friendly design practices. - Focus on recyclable materials. - Postponement strategy reduces overproduction waste.
Digitalization Efforts	- Automated warehouses with RFID. - Digital twin for virtual try-ons. - 3D fashion design to minimize fabric waste.	- Data analytics for customer preferences. - Consumption information system. - RFID microchips for real-time tracking.	- Limited digitalization adoption. - Utilized Metaverse for marketing. - Early adoption of e-commerce platforms.

Challenges in Internationalization	- Regulatory barriers and cultural disparities in China. - Heavy reliance on Asian suppliers makes it vulnerable to economic fluctuations.	- Labor practice criticisms. - Joint venture conflicts. - Pricing strategy affected by geopolitical events like Brexit.	- Controversial advertising impacting market acceptance. - Slow expansion in markets like the US. - Store closures during COVID-19.

Table 2: Multi-dimensional Analysis of Fast Fashion Supply Chain Operations

5. Market Expansion and Internationalization challenges faced by H&M, Zara, and Benetton

As a result of globalization, fast fashion brands have expanded their supply chain operations to countries with cheap labor costs to maximize profit (Bick et al., 2018). However, it has led to various social and environmental issues due to the exploitation of labor and resources (Arrigo, 2020). Brands face environmental challenges due to the nature of the industry, where brands need to continuously bring new varieties to customers. This results in increased water consumption, carbon emission, solid waste disposal, and sludge release in water bodies (Abbate et al., 2023; Sakib, 2022). Adapting the design processes to cater to diverse consumer preferences is another challenge for fashion brands. Fashion trends vary across countries and cultures, requiring retailers to conduct extensive market research to understand local fashion sensibilities (Brown & Vacca, 2022; Zou et al., 2022). Failure to address these design limitations can lead to a mismatch between the retailer's offerings and the local consumers' tastes and preferences (Out and About Mag, 2019).

Each of the studied brands has encountered unique challenges in their international expansion efforts. Benetton has faced ethical challenges when expanding its footprint globally. It has been primarily criticized for its controversial and unconventional advertising practices regarding social issues like HIV and LGBTQ+ (Duffy, 2017; Sharma & Singh, 2021). Its advertising campaigns in Japan have been subject to impoliteness (Suzuki, 2021). The brand has also faced lawsuits from its retailers, who reported that Benetton's advertising campaigns have resulted in the loss of sales (Muljadi et al., 2022). Also, Benetton's expansion in the American market has been slow. It did not have any physical stores in the US until 2019 when it opened a store in Los Angeles despite having stores in other parts of the world (Suhrawardi, 2019). Benetton has faced stiff competition from other fast fashion brands during Covid-19 forcing Benetton to close stores (Filieri, 2023).

Brands also face regulatory hurdles, political instability, and cultural differences that vary by country while expanding (Boyles, 2022; Maly, 2022). In October 2021, the European Union and in December 2021, US President Joe Biden signed a law prohibiting companies from importing products to Europe and the US from Xinjiang, China, due to products being manufactured by forced labor (Mani et al., 2022). While Zara has achieved success in foreign markets, however, it

has also been subject to censure for labor practices in its supply chain operations (Impact International, 2021). It has also faced difficulties with joint ventures when entering a competitive market, as it needs to align its strategy and control of sales with its partner. This can create conflicts between the partners, harming the joint venture's overall success (Jin & Cedrola, 2016). Zara's pricing in the UK has been higher than its pricing in Spain due to Brexit. This pricing strategy may not work in other markets where consumers are more conscious of price (Collinson, 2022).

H&M prefers to open multiple stores simultaneously in the targeted country instead of opening stores gradually, which requires significant planning and availability of premises resulting in delays in its expansion plans (Paavola, 2021). The brand has also faced challenges in China due to regulatory barriers and cultural disparities (Bloomberg News, 2022). H&M's heavy reliance on Asian suppliers (nearly 70%) leaves the brand vulnerable to economic fluctuations and market saturation in Asia (Sekliuckiene & Rybakovas, 2023). In addition, sourcing from a single location can increase vulnerability to risks such as disruptions in the supply chain, trade disputes, or natural disasters. Diversifying sourcing locations and building resilient supply chains can help address these risks and ensure the continuity of operations (Hedrich et al., 2021). One significant event that brought attention to these issues was the tragic collapse of the Rana Plaza factory in Bangladesh in 2013, which resulted in numerous deaths of textile laborers (Frenkel et al., 2022; International Labour Organization, 2023). Also, COVID-19 and Russia-Ukraine conflict has resulted in many deaths and has disrupted the global supply chain putting the operations of brands at risk (Allam et al., 2022). The unavailability of materials and finished products to deliver to customers has forced the companies to reassess their supply chain operations in China and Eastern Europe (Amed et al., 2022; Passarelli et al., 2023).

6. Digitization in the Supply Chain of H&M, Zara, and Benetton

The fourth industrial revolution, characterized by the convergence of physical and digital realms, has fundamentally transformed technological innovation in the fashion industry (Ivaldi et al., 2021; Ross & Maynard, 2021). This technological evolution has compelled fast fashion brands to integrate sophisticated tools including data analytics, artificial intelligence (AI), Radio Frequency Identification (RFID), big data analytics, Quick Response (QR) codes, and blockchain technologies into their supply chain operations, revolutionizing traditional business models (Aravindaraj & Rajan Chinna, 2022; Deepthi & Bansal, 2022).

Each of the studied brands has approached digital transformation differently, with varying degrees of success and innovation. Benetton has demonstrated its commitment to digital innovation through selective technological adoption. In 2022, the company made a bold move into virtual retail by opening a store in the Metaverse, implementing an innovative approach where customers can engage in digital games to earn QR code-enabled reward points redeemable in physical stores

(Carrera, 2022; Harjai, 2022). This initiative builds upon Benetton's earlier digital ventures, including its 2012 launch of an e-commerce platform in the European market (Champman, 2012) and the subsequent expansion of online shopping capabilities to the Indian market to strengthen its sales channels (Martins, 2022).

However, Benetton's relationship with certain technologies has been cautious, particularly regarding RFID implementation. The company's 2003 RFID trial met significant resistance from privacy advocates concerned about potential customer tracking (Lin et al., 2022; Swystun, 2021). While Benetton officially attributed its decision to abandon RFID technology to insufficient benefits in sales and productivity during trials (Benetton Group, 2003), this early experience appears to have influenced their long-term approach to technology adoption, as evidenced by their continued absence from RFID usage for inventory tracking through 2023.

H&M has emerged as a leader in technological integration across its operations, strategically leveraging various technologies to achieve multiple objectives. The company's European warehouses showcase advanced automation and RFID technology for real-time inventory tracking (Jocevski, 2020), demonstrating their commitment to operational efficiency. H&M has also embraced customer-facing innovations, implementing digital twin technology to enable virtual try-ons (Leonards, 2022) and utilizing three-dimensional fashion design technology to create zero-waste patterns, advancing both customer experience and sustainability goals (Mixson, 2021).

Zara has distinguished itself through comprehensive data analytics integration throughout its supply chain. The company equips store staff with personal digital assistant devices to capture customer preference data, which is transmitted to Inditex headquarters for analysis (Song, 2021). This data-driven approach is further enhanced by their consumption information system, an advanced platform that enables the design team to create products aligned with customer expectations (Sartal et al., 2017). The company's commitment to technological innovation extends to inventory management through RFID microchip implementation across their product range, enabling precise real-time tracking and analysis (Ovezmyradov & Kurata, 2022). This technological infrastructure is complemented by sophisticated point-of-sale data collection and analysis systems, allowing Inditex to identify emerging fashion trends and optimize ordering, delivery, and distribution processes (Chunling, 2020).

The strategic implementation of these technologies offers significant advantages to fast fashion brands, enabling them to circumvent traditional distribution channels and streamline communication and coordination among supply chain partners. Furthermore, the ability to make data-driven decisions based on clearly visible patterns has become increasingly crucial for maintaining competitiveness in the fast fashion industry (Mičić et al., 2019; Mittal et al., 2022).

Concluding Remarks

The supply chain operations of H&M, Zara, and Benetton reveal distinct strategies tailored to each brand's unique business models and market positions, enabling them to achieve specific business objectives and sustain competitive advantages within the fast fashion industry. H&M leverages low-cost sourcing from Asian countries and employs advanced technologies such as RFID tags and digital twins to manage inventory efficiently and minimize waste. This strategy has resulted in notable reductions in inventory holding costs and waste generation, enhancing operational efficiency and cost-effectiveness. However, H&M's heavy reliance on Asian suppliers introduces vulnerabilities related to economic fluctuations and political instability in these regions, necessitating continuous monitoring and risk mitigation strategies.

In contrast, Zara adopts a just-in-time manufacturing model, emphasizing local production and a customer-centric approach. This strategy has significantly contributed to Zara's successful international expansion by enabling rapid response to market trends and reducing lead times. Empirical data indicates that Zara's ability to swiftly introduce new styles has increased product turnover rates and enhanced brand responsiveness. Nevertheless, Zara faces challenges in managing joint ventures and diverse entry modes, as well as maintaining consistent pricing strategies across different markets, particularly in the wake of geopolitical events such as Brexit. These challenges underscore the complexities of sustaining rapid expansion while ensuring strategic alignment across diverse regions.

Benetton, primarily operating within Europe, utilizes a postponement strategy by delaying the dyeing process to align garment colors with current market demands. This approach has led to improved inventory management efficiency and reduced overproduction waste. Unlike H&M and Zara, Benetton does not employ RFID technology, distinguishing its inventory management practices and presenting both advantages and limitations in tracking and transparency. Additionally, Benetton faces the necessity of adapting its advertising strategies to resonate with cultural sensitivities in conservative markets, which has resulted in both strategic advantages and criticisms. This balance between innovative supply chain strategies and culturally sensitive marketing exemplifies the ongoing challenges faced by global fast fashion brands.

Despite advancements toward sustainable garment production, these fast fashion brands continue to grapple with significant sustainability and ethical concerns. The industry's relentless drive to introduce new product varieties to maintain competitiveness has resulted in overconsumption by consumers and substantial environmental degradation, including increased water usage, elevated carbon emissions, accumulation of landfill waste, and pollution of water bodies from production-related waste (Abbate et al., 2023; Sakib, 2022). These issues highlight the intrinsic tension between maintaining rapid production cycles and committing to sustainable practices. Integrating circular economy principles and renewable energy sources within supply chains

emerges as essential for enhancing sustainability and resilience, addressing both environmental impact and operational longevity.

To sustain their competitive edge and address these multifaceted challenges, H&M, Zara, and Benetton must continue to innovate and integrate emerging technologies such as Artificial Intelligence (AI), virtual reality (VR), and advanced data analytics into their supply chain strategies. Empirical evidence suggests that AI-driven demand forecasting and IoT-enabled inventory management systems can significantly reduce lead times and improve supply chain transparency, thereby enhancing overall performance and sustainability. Furthermore, the adoption of blockchain technology could enhance supply chain transparency and traceability, mitigating ethical concerns related to labor practices and environmental sustainability. These technological advancements not only enhance operational efficiency and responsiveness but also support sustainability initiatives by optimizing resource utilization and reducing waste.

Future research should delve into the long-term impacts of integrating blockchain technology to enhance supply chain transparency and traceability, thereby addressing ethical and sustainability concerns comprehensively. Investigating the role of AI and machine learning in predicting consumer behavior and optimizing supply chain operations can provide deeper insights into their potential for driving efficiency and personalization in fast fashion. Moreover, developing comprehensive sustainability metrics tailored to the fast fashion industry will enable more accurate assessments of environmental and social impacts, fostering informed decision-making and accountability among industry players. Examining the resilience of fast fashion supply chains amidst global disruptions and the effectiveness of risk management practices can offer valuable lessons for enhancing supply chain stability. Additionally, exploring the potential of advanced materials, such as biodegradable fabrics and smart textiles, in transforming supply chain sustainability presents an innovative research direction, promoting significant advancements in sustainable fashion. Lastly, understanding how digital marketing innovations, such as augmented reality (AR) and influencer-driven demand, interact with supply chain responsiveness can uncover novel strategies for enhancing consumer engagement and supply chain agility, fostering a more interconnected and responsive supply chain ecosystem.

As these brands expand globally, they must adeptly navigate regulatory barriers, cultural variations, economic fluctuations, and political instability, necessitating continuous evaluation and adaptation of their strategies to align with shifting market conditions and global trends. This adaptability is crucial for maintaining operational continuity and resilience in the face of unforeseen disruptions such as pandemics and geopolitical conflicts. Additionally, the integration of localization strategies that respect and adapt to cultural differences is vital for effective internationalization, ensuring that fast fashion brands can thrive across diverse global contexts.

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