

# ***Innovative Applications and Challenges of AI in the Fast Fashion Industry***

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**Abstract:** This research explores the impact of post -COVID 19 global economic situation on fashion industry, especially fast fashion. Analysis of the current challenges and opportunities facing the industry are included. Existed researches have already elucidated that fast fashion industry faces dilemma of gloomy outlook of future market due to global inflation, climate crisis and other factors. By analyzing the global market data and combining the application of generative AI in fashion design, marketing and supply chain optimization, this paper discusses the development strategy of the fast fashion industry. The study found that AI technology shows great potential in product design, supply chain management and user engagement. Meanwhile, environmental regulations and data privacy concerns induce serious challenges to the industry. The findings of this paper provide a new perspective on how the fashion industry can balance technological innovation and sustainability in the future, and provide effective advice for companies to cope with market changes.

**Keywords:** Fast fashion industry, Generative AI, environmental impact, data driven, privacy and data security.

## **1. Introduction**

In recent years, fast fashion industry faces unprecedented challenges due to changes of global economy and the increase in environmental regulation. Although the fast fashion industry flourished by the ability to quickly replicate runway trends at low cost, customers and governments are increasingly aware of sustainability and morality. Thus, the business model of fast fashion faces pressure. Additionally, the rise of generative AI technology provides new opportunities for companies in various aspects such as products' design, supply chain management and customer experience. This research discusses the core competence of fast fashion industry, emphasizes the potential of AI to benefit this industry, and explores the challenges companies like Shein and Temu face as they adapt to this reality.

## **2. Macroeconomic View in the Fashion Industry**

The global economy, including various industries, has been significantly impacted and diminished after a prolonged battle with Covid-19. The fashion industry, in particular, has felt the effects of this global crisis. In 2024, there is a slower and normalized growth in the fashion industry, which can be separated into non-luxury and luxury. In the US, non-luxury growth is forecast at 0-2 percent amid

declining consumer sentiment, and inflation may cause a higher growth rate. However, the luxury sector is expected to grow at 2-4 percent a year in 2024, compared to 1 percent in the first half of 2023 and between 1 percent and 3 percent in the second half. This represents a significant recovery and slightly stronger sales driven by higher-end aspirational brands.[1] Overall, luxury has a higher growth than non-luxury sector, offering hope for the industry's future.

#### Slower but normalised growth is anticipated across regions in 2024

Retail sales year-on-year growth by region and segment.



Figure 1: The growth rate of Non-Luxury and Luxury goods.[1]

Furthermore, the outlook of the fast fashion industry declined evidently, by having 38% of executives holding a negative outlook and 37% of executives holding a neutral outlook in 2024, compared with 9% of executives holding a negative outlook and 29% of executives holding a neutral outlook in 2022. One factor is the increasing rate of inflation, around 2-3 percent in 2024, which also causes 25% of companies to increase more than 5% of the price, and 44% of companies plan to grow 1%-5% percent of the price. Another factor is the challenge of the climate crisis. The European Union and the US will “require brands and manufacturers to double down on initiatives aimed at cutting greenhouse gas emissions and waste, while building business models that protect and preserve natural resources”[1] in order to make this industry more sustainable, which will challenge and pressure the fast fashion industry.

#### Uncertainty reigns as executives reveal no clear consensus on the outlook for 2024

Expectations for how fashion industry conditions will evolve in the year ahead compared to prior year, % of respondents

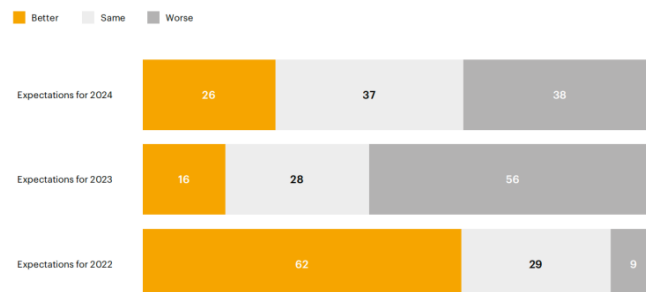


Figure 2: Executives' different expectation from year 2022 to 2024.[1]

As the fashion industry grapples with the dual challenges of sustainability and rapidly changing consumer demands, emerging technologies offer new avenues for innovation. Among these, generative AI stands out as a powerful tool with significant potential to revolutionize design and

product development. It can benefit the fast fashion industry in various aspects simultaneously. For instance, according to McKinsey forecasts, “companies will likely see the largest profit gains from gen AI in product design and assortment, followed by content-focused marketing, and sales and customer experience.”[1] From a marketing perspective, gen AI is able to accelerate the creation of marketing content. For sales and customer experience, gen AI can enhance digital experiences. Gen AI is redefining the art through its sophisticated technology. For example, the data demonstrating that “40% of worldwide retailers and brands are experimenting with gen AI” and “up to 74% of retail and e-commerce companies plan to increase gen AI spending”, [1] such as Zara and Uniqlo, generative AI is shown to be an indispensable innovation tool in the future fate of the fast fashion industry. In the following sections, we will investigate the core competencies of the latest fast fashion business model and explore options to integrate AI technology.



Figure 3: A design made by generative AI.[1]

### 3. Fast Fashion’s Core Competencies

The fast fashion business model can be roughly viewed as three generations. The first generation introduced the concept of trendy runway-inspired fashion at affordable prices. Zara and H&M are examples. The second generation soon challenged and pressured the former through its digital-first fast fashion, such as Asos and Boohoo. Now, it is the age of the third generation, which uses innovative strategies like “gamification, micro-incentives, and social media communities”[1] as their main pathways to improve customer experiences. Players such as Temu and Shein, having “future purchase intent for 18% higher than the first generation players” [1], are showing outstanding performance in the fast fashion industry. Temu has even transcended Amazon’s downloads and became the most downloaded shopping app in the US, which shows its huge potential in the future. Furthermore, the game in Shein causes many teenagers to get addicted because “every 100 points can be 1 US dollar.”[2] Third-generation fast fashion companies have implemented several notable strategies to stay competitive and meet consumer demands.

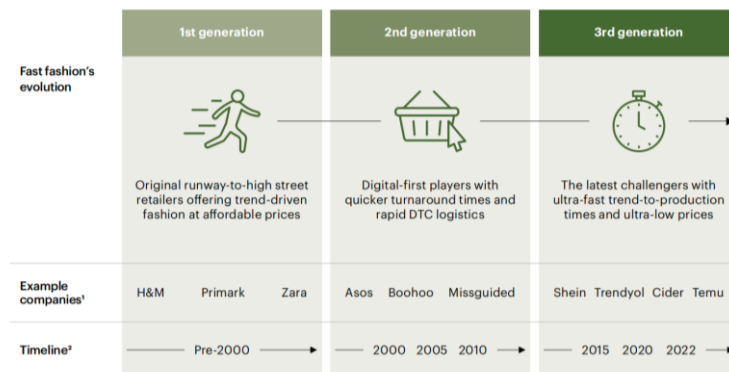


Figure 4: three generations of fast-fashion companies. [1]

### 3.1. Manufacturer-to-consumer supply chains & first-party, owned-inventory model

Promote low-price sales of unbranded goods. These supply chain models provide third-generation fast fashion companies with the ability to respond quickly to market demand while ensuring supply chain reliability and cost-effectiveness.

### 3.2. Data-driven product design and testing

This process incorporates various data sources, from the latest trends and viral products to consumer insights. To ensure precise inventory control, real-time analysis is conducted by comparing the hit rates of product page visits to actual sales.

### 3.3. Loyal and growing customer bases

Third-generation retailers have prioritized building strong, loyal communities. Shein's affiliate marketing and social media efforts have fueled viral user growth and kept customer acquisition costs low. Temu focuses on rapid expansion and has invested heavily in marketing by posting more than twice as many Facebook ads. It spent "\$14 million on two 30-second Super Bowl ads in 2023", with quarterly marketing investments nearing "\$500 million".[1]

### 3.4. High app adoption rates and engagement tactics

In-app gamification, which allows customers to earn loyalty points by undertaking a variety of steps, including setting up an account, uploading reviews, watching live streams, and participating in outfit challenges, can efficiently increase users' stickiness

## 4. Case Study -- How Shein Succeeds the Competition

### 4.1. Direct-to-Customer Business Model

"By adopting a DTC retail model, brands can leverage advantages such as internalizing the trade margin, gaining more control over the customer experience, and access to real-time consumer data." [3]. The DTC model allows Shein to sell products to consumers directly on its online platform instead of utilizing traditional retail channels and third-party trustees, cutting distributors and local stores out, significantly reduces costs. Because of this advantage, Shein offers products at a competitively lower price than other retailers. In addition, this DTC model enables Shein to have a better grasp on the whole shopping process in a transparent way, from browsing pages to checkout through personalization. The collected consumer propensity and behavior data optimizes merchandise refining and tweaking marketing strategies.

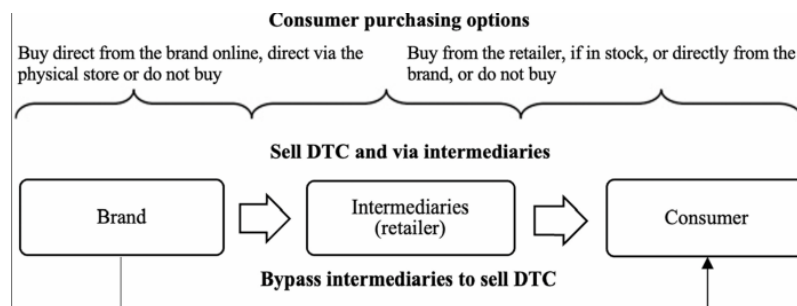


Figure 5: Direct-to-consumer model's graph.[4]

source: The evolving direct-to-consumer retail model: A review and research agenda

## 4.2. Data-Driven Design and Testing

This data-driven method of design and testing distinguishes Shein from its competitors. Supported by advanced big data analytics, Shein could access what consumers care about, how they complete their purchases, and the fashion trends. These real-time data empower Shein to make swift adjustments and launch new hits that align with customers' needs. Shein establishes dynamic experiments to test new designs in small numbers of items based on customer feedback. Using the sales data and feedback, Shein can effectively scale best-selling more or down of those unpopularized items. This repeating process helps minimize the amount of produced waste but also positions Shein to stay with trends and shift faster to dynamics than traditional brands that follow the market.

## 4.3. Exploiting Trade Benefits and Cost-Efficient Production in China

Shein takes advantage of the Sino-US trade benefits by leveraging the duty-free shipping policy for orders under \$800. This allows the company to reduce import tax costs and offer competitive prices to customers. Additionally, Shein benefits from lower production costs due to China's inexpensive labor force, which contributes to the company's profitability and market competitiveness.

## 4.4. AI-powered performance-based supply chain optimization

Performance-based supply chain optimization is a managing strategy to continuously improve and optimize different aspects of the supply chain through real-time KPI analysis. It can help Shein to adjust and improve its operation strategy based on supply chains' performance and thus ensure the supply chains can work effectively and respond to changes in the market quickly. In this mode, companies will reference a series of KPIs such as order accuracy, inventory carry rate, production cycle, and delivery time. In this case, AI is can be an indispensable tool for this strategy. AI is able to monitor performance indicators of the supply chain and provide suggestions for improvement. For example, if there is a bottleneck along a supply chain, the AI will automatically warn and suggest a solution.

## 4.5. Gamify users' engagement

There are various games in Shein's app in order to increase customer loyalty, such as Sandy Jackpot and Puppy Keep, etc.



Figure 6: Games in SHEIN's app  
source: SHEIN's app author made up

In Sandy Jackpot, users need to collect crystals through lottery to get high-value coupons. However, the opportunities for the lottery are limited, and users are asked to engage their friends to win more opportunities, such as sharing.

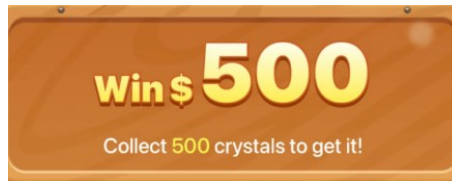


Figure 7: the game of sandy jackpot.

The gameful experience can be defined as “the positive emotional and involving qualities of using a gamified application”. “It is a multidimensional construct and is co-created by the user and the gamified service. The goal of creating these experiences is to motivate future service use and a target behavior.”[5] The games in Shein's platform use psychological tactics to trick consumers into thinking they will soon receive a gift or coupons through the lottery. By letting users share links with their friends for an opportunity for a lottery, this game design actually helps SHEIN expand and spread with low promotion cost. However, the probability of actually receiving large benefits is set to be extremely low, which ensures that the overall operating costs are controlled. AI technology plays a key role in intelligently controlling the odds of winning, thereby precisely managing the number of rewards and further optimizing the cost-effectiveness of the brand.

## 5. Opportunities and Risk

However, challenges to the third-generation companies exist simultaneously. Although these companies have done well in the market, they're facing increasing challenges from the public and regulators. Plus, their efforts in sustainability and ethical marketing haven't really paid off yet. As time goes on, they'll likely need to keep inputting resources into dealing with stricter regulations and competition to stay ahead. Third-generation fast fashion companies like Shein are working hard to stay competitive by diversifying and adapting to new market conditions.

With the huge opportunities brought by generative AI, there are also significant challenges that fast fashion companies are facing, which is the personal information and privacy problems. Fast fashion platforms like SHEIN and Temu have high reliance on tracking user data, sometimes even incentivizing users to provide information by offering promotions or discounts. Furthermore, CNN has reported that many cybersecurity teams found the malware on the application of PINGDUODUO, which is the mother company of the TEMU. “The malware enabled the PINGDUODUO app to bypass user security permissions and access private messages, change settings, view data from other apps, and prevent uninstallation.” [6]After obtaining these data, they utilizes AI algorithms to analyze user interactions and search history, allowing them to identify emerging fashion trends and preferences. Therefore, they can manufacture and deliver clothes to market ahead of competitors. However, this strategy diminishes information security simultaneously.

It is equally important to address the complex geopolitical situations that companies like SHEIN and TEMU must navigate in their global operations. Reports often highlight problems within these companies through targeted investigations and negative publicity, but these issues are not unique to Chinese companies—they exist throughout the fashion industry. Geopolitical tensions tend to magnify these problems for Chinese companies, potentially limiting their development in the US market. For example, In 2022, Shein faced scrutiny from U.S. lawmakers who were concern about the company's labor practices. Although forced labor issues are not unique to Chinese companies, the geopolitical tension between the U.S. and China amplified the focus on it. This heightened scrutiny could hinder the company's growth in the U.S. market. To mitigate the risk of sanctions, companies need to improve their customer protection practices by considering separating the personal information they collect from their Chinese parent companies to avoid suspicions regarding the purpose of this data.

As these geopolitical challenges continue to intensify, environmental concerns are emerging as another formidable hurdle, causing increasing scrutiny from both consumers and regulators who demand accountability in the industry's environmental practices. This is because the business model of fast fashion encourages people to buy new clothes frequently, which leads to a higher amount of waste from old clothes that are hard to break down. This kind of waste contributes to environmental damage, such as ocean pollution and harm to wildlife. Also, 10 percent of annual global carbon emissions are caused by the fashion industry. The greenhouse gas emissions are likely to "exceed 50 percent by 2030" if the industry keeps growing at this rate. Fast fashion companies are deteriorating this phenomenon by producing large amounts of cheaply made clothing. For example, "95.2 percent of Shein's products are made of new plastics rather than recycled materials". [6] Furthermore, the lead in children's jacket achieved lead limit, which is harmful to children and shows its material problem. Efforts like New York State's Fashion Sustainability and Social Accountability Act aim to closely monitor where clothes come from and their environmental impact, which could pose a challenge to the business models of companies.

## 6. Conclusion

To effectively tackle the challenges that the fast fashion industry is facing, it is necessary for companies to adopt more flexible and innovative approaches in both data privacy and brand's sustainability. Below are a few recommendations that can help companies keep competitive in the market while building trust with consumers.

Firstly, as mentioned before, informational problems always exist as huge concerns for customers and the government. Therefore, a computing mode --- Edge computing --- can be an effective way to improve data security. Edge computing is able to process data locally on the users' devices instead of being transferred to the cloud or company servers. In simpler form, "edge computing is to provide services and perform calculations at the edge of the network and data generation"[7]

This means users' data can be analyzed, and the result can be generated in their own devices, so uploading users' information to a centralized database will not be needed anymore. This computing mode can decrease the risk of personal data leakage because sensitive information doesn't need to be transmitted on the internet. This model is also able to satisfy the real-time requirements of the business. Many regions have increasingly stringent regulations on data protection, such as the European Union's General Data Protection Regulation (GDPR). By reducing data collection, fast fashion companies are able to more easily comply with these legal requirements, avoiding possible fines and legal risks.

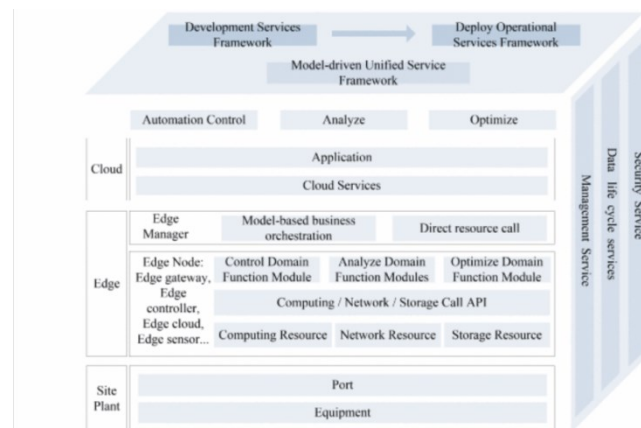


Figure 8: Edge computing reference architecture 3.0.[7]

Environmentally, develop a "circular fashion" system to reduce the environmental burden is a feasible way for fast fashion businesses to avoid problem of wasting cloths and thus causes less environmental pollution. To be specific, businesses such as Shein, Temu, and Zara can launch a trade-in service or recycling plan by setting online recycling platform or store, which can encourage customers to recycle old clothes so these materials can be used to manufacture new products, forming a closing-loop fashion. Simultaneously, businesses can try to encourage consumers to exchange green products through point system to promote environmentally friendly purchases.

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