

Apparel Supply Chain Management and Practice under the Perspective of Sustainable Development

Xinyi Shu^{1,a,*}

¹Textile and Clothing College, Hebei University of Science & Technology, Shijiazhuang, 050091, China

a. ZefengWu@stu.sqxy.edu.cn

**corresponding author*

Abstract: This study explores the challenges faced by the apparel industry and the means of attaining sustainable development via effective supply chain management amidst the backdrop of global economic integration and the evolving information technology landscape. Firstly, the current situation of the apparel industry is analyzed, including factors such as the increase in consumers' personalized demands, the increasingly fierce competition, the rising costs of labor and raw materials, and the growing consciousness of environmental preservation. The development status and problems of apparel supply chain management are then analyzed, including the excessively long supply chain, the lack of flexibility and adaptability in management, the opacity of information, the lack of a supplier evaluation system, and the neglect of sustainable development by enterprises. It further discusses achieving sustainable development in the apparel industry, including reducing water consumption and pollution, addressing the adverse consequences arising from the rapid turnover of fashion trends, promoting the construction of a circular supply chain, etc. Corresponding solutions are proposed. Finally, this study concludes how supply chain management and sustainable development practices can inject new vitality into apparel enterprises and achieve the industry's sustainable development goals.

Keywords: Clothing industry, Supply chain management, Sustainable development, Environmental protection, Globalization

1. Introduction

With the deepening of economic globalization and informatization, the challenges faced by clothing enterprises are constantly increasing. For example, consumers' requirements for clothing quality and personalization continue to increase, the competition between domestic and foreign clothing brands becomes more intense, and the competition means constant upgrading. In addition, the continuous rise of domestic labor and raw material costs, the gradually deepening social awareness of environmental protection, and increasing concern about environmental issues are all factors. In the face of many development problems, breaking through and achieving sustainable development in the industry has become an important issue.

The clothing industry holds a significant position in the global economy and constitutes a vast and influential sector across the world. Against the backdrop of globalization, more and more clothing companies are outsourcing production to relatively low-cost countries, making the clothing supply

chain increasingly globalized. Based on the statistics provided by the CNTAC, China has emerged as the preeminent producer and exporter of clothing globally, with a complete industry chain and huge labor resources. Hence, the clothing industry holds a pivotal position in the realm of economic development, meeting market demand, and providing job opportunities. In this context, how can inject new vitality into clothing enterprises and achieve the goal of sustainable development by managing their supply chain?

2. Analysis of the Current Situation in the Clothing Industry

The textile and clothing industry is currently facing some challenges. With increased personalized demand from consumers, fluctuations in clothing consumption demand have become more unpredictable. Traditional clothing enterprises' planned production supply chain processes cannot adapt to this rapidly changing demand. Therefore, clothing companies need to constantly innovate the supply chain management model to meet market demand. At the same time, the rise of e-commerce platforms has intensified the fragmentation of orders, which requires the clothing supply chain to have stronger rapid response capabilities and small-volume production capabilities. As economic globalization deepens, competition among national brands becomes increasingly fierce, and the means of competition, such as price wars and marketing wars, change rapidly, posing higher requirements for the market. As China's demographic dividend advantage gradually disappeared in recent years due to the aging population and the supply-demand relationship in the labor market, labor costs have shown sustained and rapid growth, and China's average wage level has been increasing year by year. With the increase in costs of land, labor, energy, and other factors, some clothing enterprises are facing the challenges of cost pressure and industrial relocation. With the increasing environmental awareness of society, how to reduce pollution during production is also an issue that needs to be addressed.

Although some studies have focused on the clothing supply chain management and sustainable development field, there remain certain areas that require refinement and enhancement. Currently, the research on this industry is still relatively superficial and requires further exploration of its various aspects. Furthermore, the research involves many links and participants, thus demanding a holistic perspective. Moreover, the study of the supply chain involves many links and participants, so it requires an overall view. Still, current research needs more systematicity, with most studies focusing on only certain links. Secondly, as “sustainable development” requires cooperation from many disciplines and aspects, and the principal area of research within the textile and clothing industry primarily centers on design, production and sales, research on sustainable development is not yet deep enough and comprehensive.

3. Current Development and Problem Analysis of Supply Chain Management in the Clothing Industry

3.1. Development Status and Problems

Martin Christopher, a renowned supply chain expert hailing from the United Kingdom, initially postulated in 1992 that the competition in the 21st century would shift from being inter-company to inter-supply chain. Consequently, the significance of supply chains in today's market is self-evident.

Some things could be improved in the traditional clothing industry supply chain, such as the long chain. Clothing production needs to undergo design, material procurement, production, quality inspection, and the market; the period is long with more links but a slow response. However, the demand for the clothing industry often changes rapidly. Clothing brands launch new styles every quarter, and most products are short-lived, which lacks reliable historical sales data and brings difficulties to sales forecasts. Moreover, fashion sales are greatly influenced by seasonal and weather

factors, leading to large fluctuations in demand. Therefore, it is difficult for fashion supply chains to predict sales volume [1] accurately. Therefore, the supply chain's accurate and rapid response capability is crucial. However, many enterprises need to pay more attention to supply chain management, which leads to efficient supply chain management [2]. Therefore, the supply chain's accurate and rapid response ability is very important. However, many enterprises need to pay more attention to supply chain management, which leads to efficient management [2]. Next, the problems of opacity of information and insufficient information technology cause asymmetric information among various cooperative enterprises, resulting in "bullwhip effect". The emergence of these problems further leads to inventory backlog, increased production costs, and delayed delivery [3]. Moreover, the immature selection of suppliers or the mode of cooperation of some clothing enterprises has further affected the supply chain operation [4].

3.2. Cause Analysis

Through the collation and summary of relevant literature, the emergence of development problems within the textile and apparel industry can be attributed to the following reasons. Firstly, clothing companies lack a scientific and clear supplier comprehensive evaluation index system, so when selecting partners, decision-makers tend to rely more on subjective factors [4]. Secondly, due to the lack of awareness of common goals and common interests among enterprises in various nodes of the supply chain, enterprises, out of protection of their interests, worry about being placed in a weak position in cooperation due to disclosing too much information to upstream and downstream enterprises, and neglect the interests of the entire supply chain, thus leading to a lack of awareness of information sharing and collaboration, and without effective cooperation mechanisms and platforms, it is unable to provide a good cooperative environment and opportunities, and form effective cooperation relationships [5]. Moreover, modern inventory management systems have yet to be formed in the clothing industry. Companies often need to consider actual market demand when purchasing, thus increasing the pressure and cost of inventory [4]. When it comes to environmental and social awareness and culture, various organizations must diligently assess the sustainability-related challenges that arise within the supply chain management framework, while prioritizing economic interests. Failure to do so often results in issues such as resource waste, environmental degradation, and social disparities[5]. Agrawal et al. pointed out that due to consumer preferences and the constantly changing fashion trends, the clothing supply chain needs to adjust and update its products frequently, increasing the complexity and difficulty of the supply chain [6].

Moreover, as the clothing supply chain involves many links and partners, and each partner is usually located in different regions, during cross-border cooperation and coordination in this case, there will be inaccuracies or delays in the transmission and communication of information, thereby affecting the efficiency of supply chain cooperation and increasing the difficulty of supervision [7]. Karen et al. found that the clothing supply chain management needs more flexibility and adaptability. To solve the flexibility problem, multiple supplier relationships can be established to find alternative suppliers in case of supply disruptions or demand peaks, and additional logistics channels can be activated to enhance the enterprise's competitive edge in uncertain market environments [8]. Chi believes that textile and clothing production is usually in less developed and low-cost countries. However, because some enterprises only focus on short-term interests and ignore the protection of local labor rights, coupled with inadequate supervision and imperfect legal systems, workers in these countries tend to encounter exploitation and unfair treatment. This reflects that some clothing enterprises need to attach more importance to CAR, and their participation level could be higher [9].

4. Sustainable Development in the Textile and Clothing Industry

4.1. The Proposal and Significance of Sustainable Development

The concept of sustainable development traces its origins back to the influential report titled "Our Common Future," which was released in 1987 and served as the inaugural platform for its introduction and elaboration. As human society develops, the depletion of natural resources continues to intensify, and environmental problems are prominent. The sustainable development of resources is of utmost significance, as it involves fulfilling the present era's requirements while ensuring the viability of meeting the demands of future generations without compromising their overall well-being. This approach is crucial for ensuring a sustainable future, its significance lies in promoting the unity of ecological, economic and social benefits, emphasizing the coordinated development among economy, society and environment, and pursuing long-term sustainability [10].

4.2. The Sustainable Development of the Textile and Apparel Industry

The textile and clothing industry, being a resource-intensive sector, it is one of the largest polluting industries in the world. It consumes much water, energy and raw materials and produces many wastes and pollutants. As stated in the report published by the UNEP, the quantity of wastewater discharged by textile mills globally comprises over 20% of the total industrial wastewater generated. In addition, according to the WHO research report, the sewage of textile mills usually contains many toxic substances, such as heavy metals, dyes, and chemicals. These substances pose a serious threat to human health. Therefore, it is necessary to rethink its strategy to reduce resource consumption and waste, optimize production processes, and achieve environmental protection and effective resource utilization. But nowadays, the emergence of "fast fashion" has increased waste and contamination. Due to the particularity of "fast fashion", the design life of these products is relatively short. Consumers will discard them after a period, increasing the negative environmental impact [11]. The question of mitigating the adverse consequences of fast fashion is also one that merits thorough examination and discussion.

The primary manifestation of the clothing industry's environmental impact lies in its significant water consumption, industrial pollution, CO₂ emissions. Relevant literature research has found that reducing water consumption and treating wastewater is crucial. As the global water resource shortage problem intensifies, data research from ITMF has shown that effective sewage treatment systems can remove harmful substances from sewage. However, it is crucial to acknowledge that not all textile companies or factories possess sewage treatment systems [12]. The investment cost of this system is usually high. According to environmental protection technology consulting company ECT research, constructing and operating an efficient sewage treatment system may require millions or even tens of millions of dollars of investment. The need for appropriate maintenance and management may also lead to the system's failure in its operation. Therefore, the treatment effect of sewage will be affected. In this regard, it is imperative to enhance the supervision of textile enterprises' wastewater discharge, ensure that the enterprises conduct wastewater treatment according to the regulations, and provide them with environmental protection training and propaganda education. At the same time, it is imperative to enhance the collaboration and synchronization among stakeholders to achieve optimal outcomes. Including local government, enterprises and environmental utility operators, it will jointly promote improving wastewater treatment systems and the sustainable utilization of water resources [13]. Finally, by combining clean production practices with the principles of a blue economy, a blue economy strategy can be adopted to reduce environmental impacts and increase economic returns, thus promoting sustainable development [14].

To mitigate the impact of fast fashion on sustainable development, one can transfer items to different owners under the same item, extend the life cycle of items, or establish some second-hand markets for leasing and trading so that the more recyclable and reusable textiles there are, the less raw fibers and environmental impact will be needed [15]. Moreover, if consumers can extend the service life of clothing by 9 months, they are likely to reduce waste by 22% and save 33% of water resources [16]. So, to extend the service life of clothing, encourage consumers to make responsible purchases, and finally introduce the concept of slow fashion to minimize and mitigate harmful environmental impacts, thereby improving the enduring viability of the fashion supply chain [17].

Zhang and Li discussed the importance of technological innovation in promoting environmentally friendly growth of the textile and apparel sector is of utmost importance, encompassing environmental conservation, social responsibility, and economic viability. They believed that digital technology and the metaverse concept could play an important role in the clothing industry. Digital technology can be applied to the design and production of clothing, improving precision and reducing unnecessary waste of resources. The metaverse concept can bring new services and experiences to the industry, increasing brand awareness, broadening sales channels and reducing carbon emissions in the industry chain [7]. Karen and his colleagues proposed that the circular economy be promoted by clothing enterprises working with suppliers and partners to create a circular supply chain promoting sustainability, thereby guaranteeing the recycling of raw materials and products, or to adopt renewable or recycled materials to reduce dependence on natural resources and meet the needs of consumers for sustainable products at the same time [8]. Cai et al. discussed sustainable textiles and sustainable fashion supply chains. According to the research in the reference information, recycling and reusing clothing and textiles can reduce resource consumption, environmental impact, and costs by managing circular supply chains. It can effectively reduce carbon emissions and waste [18]. Shen et al. integrated sustainable value into the textile and clothing supply chain. They used green supplier evaluation and selection methods, which could be chosen through the triple-bottom-line evaluation method. Secondly, some gaps exist between individuals and enterprises regarding ethics. By managing these gaps, it is possible to promote the implementation of sustainable policies and reduce obstacles [19]. Catarina Costa et al. summarized some environmental protection measures that the textile industry could take in terms of sustainable development, such as using renewable materials in the selection of raw materials (similar cotton, wool, silk, flax and other natural fibers, or viscose, lyocell and other artificial cellulose fibers) and biodegradable fabrics (such as recyclable polyester fibers, nylon, etc.). Regarding chemical treatment, technologies that are more environmentally friendly (such as enzyme treatment, plasma treatment, microwave and ultrasonic treatment, or natural dyes) are adopted [11].

5. Conclusion

Given the textile and garment industry in today's market environment, a series of problems exist in the supply chain and how to develop sustainably; through the collation and summary of relevant literature, some suggestions are put forward. The problems of the garment supply chain include too long a chain, lack of flexibility and adaptability of supply chain management, a modern inventory management system that has not yet been formed, and enterprises' lack of attention to supply chain management. In terms of cooperation, there is a lack of scientific and clear supplier comprehensive evaluation index system and a lack of common goal and interest consciousness among enterprises at each node of the supply chain. Regarding social awareness, many organizations do not fully consider environmental and social sustainability issues pertaining to supply chain management that disregard the safeguarding of labor rights and interests, and cause resource waste and environmental pollution in production. In terms of sustainable development, it first summarizes some solutions to the problems of water resource consumption and pollution that urgently need to be solved in production. Secondly,

in terms of fast fashion and how to reduce the negative impact brought by fast fashion, this paper also makes some related documents. Finally, it summarizes how to develop sustainably next. This paper can help managers of textile and garment enterprises and other relevant practitioners understand the importance of supply chain and sustainable development through collating relevant literature.

References

- [1] Thomassey, S. (2010) *Sales forecasts in the clothing industry: The key success factor of supply chain management*. *International Journal of Production Economics*, 2, 470-483.
- [2] Köksal, D., Strähle, J., Müller, M., & Freise, M. (2017) *Social sustainable supply chain management in the textile and apparel industry literature review*. *Sustainability*, 9(1), 100.
- [3] Wang, Q. (2020) *Process Design and Optimization of Clothing Supply Chain from the Perspective of Core Enterprises* (Master's thesis, Zhejiang University of Technology).
- [4] Geng, C. L. (2012) *Research on Supply Chain Management Mode of Brand Apparel Enterprises* (Master's thesis, South China University of Technology).
- [5] Ghadimi, P., Wang, C., & Lim, M. K. (2019) *Sustainable supply chain modeling and analysis: Past debate, present problems and future challenges*. *Resources, Conservation & Recycling*, 72-84.
- [6] Agrawal, T. K., Kumar, V., Pal, R., Wang, L., & Chen, Y. (2021). *Blockchain-based framework for supply chain traceability: A case example of textile and clothing industry*. *Computers & industrial engineering*, 154, 107130.
- [7] Zhang, L. H., & Li, Y. (2023) *Exploring the Sustainable Development Path of the Textile and Apparel Industry under the Background of Science and Technology Innovation*. *Light Industry and Technology*, 06, 116-119.
- [8] Ngai, E. W. T., Moon, K. K. L., & Poon, J. K. L. (2012) *Design and Implementation of a Supply Chain Learning Platform*. *Journal of Educational Computing Research*, 3, 293-327.
- [9] Chi, T. (2011) *Building a sustainable supply chain: An analysis of corporate social responsibility (CSR) practices in the Chinese textile and apparel industry*. *Journal of the Textile Institute*, 10, 837-848.
- [10] Parris, T. M., & Kates, R. W. (2003) *Characterizing and measuring sustainable development*. *Annual Review of Environment and Resources*, 1, 559-586.
- [11] Wang, L. (2023) *Discussion on Fast Fashion Marketing and Supply Chain Management in the Apparel Industry*. *Textile Report*, 04, 41-43.
- [12] Bailey, K., Basu, A., & Sharma, S. (2022) *The Environmental Impacts of Fast Fashion on Water Quality: A Systematic Review*. *Water*, 7, 1073-1073.
- [13] Lyu, Y., Liu, Y., Guo, Y., Tian, J., & Chen, L. (2021) *Managing water sustainability in the textile industry through adaptive multiple stakeholder collaboration*. *Water Research*, 117655-117655.
- [14] Oliveira Neto, G. C., da Silva, P. C., Tucci, H. N. P., & Amorim, M. (2021) *Reuse of water and materials as a cleaner production practice in the textile industry contributing to blue economy*. *Journal of Cleaner Production*, 305, 127075.
- [15] Sandin, G., & Peters, G. M. (2018) *Environmental impact of textile reuse and recycling – A review*. *Journal of Cleaner Production*, 353-365.
- [16] Iran, S., & Schrader, U. (2017) *Collaborative fashion consumption and its environmental effects*. *Journal of Fashion Marketing and Management: An International Journal*, 4, 468-482.
- [17] Niinimäki, K., Peters, G., Dahlbo, H., Perry, P., Rissanen, T., & Gwilt, A. (2020) *The environmental price of fast fashion*. *Nature Reviews Earth & Environment*, 4, 189-200.
- [18] Cai, Y. J., & Choi, T. M. (2020) *A United Nations' Sustainable Development Goals perspective for sustainable textile and apparel supply chain management*. *Transportation Research Part E: Logistics and Transportation Review*, 141, 102010.
- [19] Shen, B., & Li, Q. (2017) *Market disruptions in supply chains: A review of operational models*. *International Transactions in Operational Research*, 4, 697-711.