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Bin Shen · Qingliang Gu · Yixiong Yang
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Fashion Supply Chain Management in Asia: Concepts, Models, and Cases

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Preface

Fashion products face a high level of demand uncertainty because of the fast-changing consumer tastes and other unpredictable market volatilities. To match supply and demand, an efficient supply chain system is highly needed in the fashion industry. This is particularly true in Asia. Asia is the major apparel and textile manufacturing place with the diversified market in which the mature market includes Korea and Japan, and the emerging market includes China, India, Vietnam, Burma, and Nepal. Efficiency enhancement models for accommodating the fast-changing consumer demand are popularly launched and exercised in the fashion industry. An effective supply chain system is critical for long-term success and business sustainability of the supply chain members. The valuable concepts of cases of fashion supply chain management techniques in Asia are meaningful to summarize and learn.

Fashion Supply Chain Management in Asia: Concepts, Models, and Cases focuses on reporting both quantitative research and exploratory studies on supply chain management in Asia. This book helps both academicians and practitioners better understand the latest development and models in Asia's fashion supply chain management. It is a pioneering text which focuses on Asia and reports many important research results in fashion supply chain management.

This book includes three important parts, namely (i) Fashion Supply Chain Management Concepts, (ii) Fashion Supply Chain Management Models, and (iii) Fashion Supply Chain Management Cases.

- Introduction to Fashion Supply Chain Management in Asia
- Regional Comprehensive Economic Partnership (RCEP): Impact on the Integration of Textile and Apparel Supply Chain in the Asia-Pacific Region
- Sustainability Issues in Asian Fashion Supply Chains: Retailers versus Suppliers
- Cashmere Value Chain in China
- Existence and Causes of Bullwhip Effect: An Empirical Study on a Designer Footwear Supply Chain
- Application of Human Rights Due Diligence and the LeanIn Concept for Addressing Pregnancy-Related Discrimination in Cambodia's Garment Sector

- RFID-embedded Smart Washing Machine Systems in the Big Data Era: Value Creation in Fashion Supply Chain
- The Impacts of Transshipment on Dual Channel Coordination: a Fashion Company Case Study in China
- The Value of Online-to-Offline Channel for Start-up Fashion Designer Brands: Lessons from China

Before closing, we would like to take this opportunity to express our hearty thanks to the operation team in Springer for their support and constructive advice. We are indebted to all the anonymous reviewers who have provided timely review reports on the submissions. We are grateful for all the authors who have contributed their important research to this book. This book project is partially supported by Shanghai Style Fashion Design & Value Creation Collaborative Innovation Center (13S107024), the National Natural Science Foundation of China (grant number 71401029), and Chenguang Program (grant number 2016020012).

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Chapter 1
Introduction to Fashion Supply Chain Management in Asia

Bin Shen and Moritz Mikschovsky

1 Introduction

Textile and apparel production is labor-intensive and creates millions of job opportunities in the emerging countries (Gereffi 1999). The textile and apparel industry has great impact on GDP generation and the stability of national politics. This especially holds true for developing countries such as India, Bangladesh and Vietnam. In order to continuously reap the benefits created by the textile and apparel industry, some Asian country's governments introduced low export taxes to attract international buyers and investors (Frederick and Gereffi 2011).

Global textile and apparel sourcing is currently in a state of change (Teng and Jaramillo 2005). China, the world's garment manufacturing powerhouse, is not only facing rising labor costs, but also labor shortage especially in coastal provinces (Lu 2016b). Also, the strength of the Yuan is squeezing manufacturers' margins. The steady appreciation of the Chinese Renminbi makes Chinese exports more expensive to international buyers. Brands find that they cannot pass along higher prices to their customers, but instead must focus on minimizing production costs (Zhen 2015). China at present aims to shift its manufacturing focus to high-end products, thus moving low-end and labor-intensive production outside China is acceptable. This naturally has led to a growth of textile and apparel manufacturing capacity in other Asian countries such as Bangladesh, Vietnam and India (Chen et al. 2017).

Fashion products face a high level of demand uncertainty because of fast-changing consumer tastes and other unpredictable market volatilities. Fashion firms that want to succeed in matching supply and demand have to design and implement an efficient

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supply chain system, leveraging the unique capabilities of every single supply chain member. In this paper, the aims are (1) to introduce the concept of fashion supply chain management, (2) to discuss the abilities of China, India, Bangladesh, and Vietnam in terms of their textile and apparel industry, and (3) to investigate several important new challenges and opportunities which Asia fashion supply chains are facing.

The structure of this chapter is given as follows. Section 2 provides the key knowledge about fashion supply chain management. Section 3 describes the textile and apparel industry in Asian countries. Section 4 discusses new challenges and opportunities of Asia's fashion supply chain and Sect. 5 concludes the paper.

2 Fashion Supply Chain Management

The objective of a supply chain is to fulfill buyer's requests and maximize the total supply chain benefits. A supply chain consists of many different members which all have their own interests and aim at maximizing the profit they can make from operating in the supply chain. This makes a supply chain system highly complex. A typical fashion supply chain includes raw material farmers/producers, fiber and textile producers, apparel manufacturers, transporters, warehousers, and retailers. Sometimes, after the products were sold to consumers, old/unused products are collected by third party collectors who remanufacture or reuse the old/unused products. The result is a closed-loop supply chain. Figure 1 depicts the stages of such a fashion supply chain.

The complexity of fashion supply chain structures increased as globalization and dynamics. Due to the fact that transportation cost steadily decreased over the last couple of decades, it became more viable for buyers to tap sourcing regions far away from the products' target markets. Hence, the geographic spread of fashion supply chain members increased and made it more difficult to manage the flow of information, products, and payment between them. Moreover, the number of participants in supply chain systems are increased. As consumers's demand is dynamic and

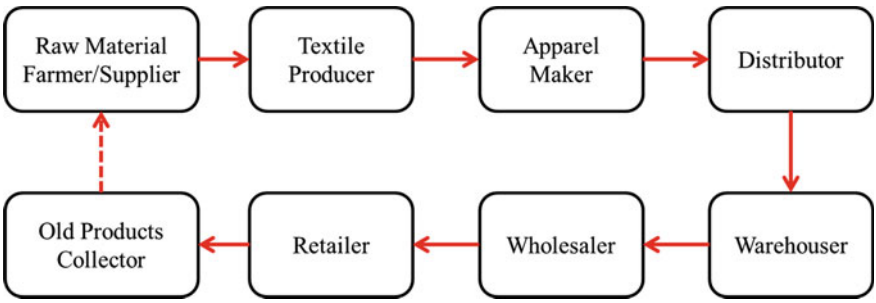

Fig. 1 Flow fashion supply chain model (closed-loop)

increasingly high, many fashion brands could not continue to produce their products in-house, and have to outsource parts of their apparel production to the cost efficient countries such as China. Therefore, new members were added to their supply chain. More exacting consumer demands required fashion firms to find suppliers which can produce the required specifications. Also, fiercer competition in the industry forced suppliers to specialize in producing certain types of textile and apparel products in order to differentiate from competing suppliers and attract more buyers.

In order to fulfill upstream buyers' requests, each supply chain member needs to work hard in his area of responsibility such as new product development, raw material sourcing, manufacturing and operations, distribution, marketing, finance, and customer service. To achieve centralized profit maximization, collaboration is strongly needed. Supply chain coordination includes that decentralized participants in different parts of the supply chain all work together and provide joint efforts toward reaching centralized decisions. Only then can shared processes be streamlined and maximum supply chain profit be realized. For example, the apparel maker may not only be in contact with the next party located up- and downstream in the supply chain, but also with parties located further up and down the stream, such as raw material suppliers or retailers. This of course makes communication and decision-making more difficult. However, information sharing in that way is likely to increase overall supply chain efficiency.

A supply chain is dynamic and consists of a constant flow of information, product, and payment between different members in various stages. In terms of information, retailers receive customer requests, which are important demand information, whereas suppliers observe machinery conditions and labor efficiency from time to time, which are important supply information. For example, retailers as the supply chain member being closest to consumers can convey information of customer feedback and customers' buying preferences to apparel makers which can check whether they and their suppliers are capable of creating products that respond to that knowledge about customers. Different ways of sharing information in a fashion supply chain are the reason why some supply chains work more efficiently than others. It is a fairly complex task to share valuable information not only between two parties, but make it available to multiple supply chain participants which can then work with the data and also make changes to it. The Internet and information technology enable supply chain members to continuously share information with each other and update information on a real-time basis. Nowadays, information systems such as Enterprise Resource Planning (ERP) systems integrate many different types of information in one commonly shared platform and are the backbone of successfully operating fashion supply chains. In the future, information sharing capabilities will even become more important for members in the textile and apparel industry when it comes to creating and maintaining a competitive advantage.

In terms of products, some fashion items face a high level of demand uncertainty because of fast-changing consumer tastes. They are so-called fashionable products. However, some products are basic such as a blank t-shirt which is functional, i.e., consumer demand for them is relatively stable. Whereas fashionable products have a short life cycle and are sensitive to the latest fashion trends, basic items are charac-

terized by a long life cycle and are used by consumers on an everyday basis. Thus, these two categories of products have different production requirements and satisfy different consumer needs. In order to increase speed to market for fashionable products, many apparel brands source these items in countries that allow for a fast transportation to the target market. For European countries as target markets, Turkey is often times chosen as sourcing location. On the contrary, basic items are often sourced in Asia although their target markets might be in Europe or North America. Brands benefit from lower production costs and can offer lower prices to consumers, and do not have to be afraid that after the long transportation lead time consumers' demand for these products has changed significantly so that they could not sell the products anymore.

In terms of payment, based on the bargaining power of different supply chain participants, buyers pay in advance, pay when the products arrived, or pay after the products are sold. Whereas buyers want to pay for the goods as late as possible, suppliers are eager to get paid as early as possible. In general, suppliers producing basic items have less bargaining power in the payment negotiations than suppliers of fashionable items. This is because basic items can be produced by many suppliers, whereas the production of fashionable items often requires special expertise and production equipment. The timing of payment significantly influences supply chain members' cash flows, which further affects supply chain efficiency. Figure 2 illustrates the constant flow of information, product, and payment in the fashion supply chain.

In the fashion supply chain, competitiveness refers to quality, responsiveness and cost. Quality consists of product quality, i.e., whether the manufacturer can produce the products with satisfying or the expected quality. Cost is the price for how much the manufacturer produces the product. The lower the cost of producing fashion items, the lower the price that can be offered to consumers. Hence, to be a competitive manufacturer/buyer, cost reduction is critical, especially when consumers are highly price-sensitive and their purchasing decisions heavily depend on product prices. Responsiveness is crucial in fashion because the right timing determines the success of a trendy fashion product in retailing. Fashion consumers are dynamic in terms of their tastes of fashion. If the retailer does not manage to sell its fashionable items

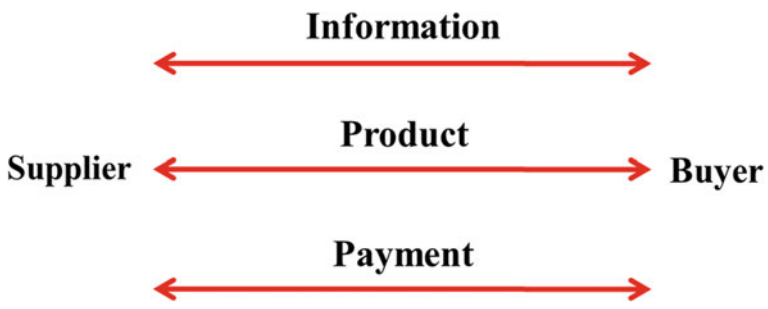

Fig. 2 Flow of information, product, and payment in the fashion supply chain

soon after retail introduction, the products have to be discounted or soon become out-of-season stock. To be truly responsive, manufacturers should be in the right place to produce the right products with right prices by making use of the right manufacturing skills. There always exists a trade-off between quality, cost, and responsiveness. For instance, if a manufacturer wants to produce high-quality products, its responsiveness might decrease and its production cost might increase compared to producing lower-quality products. In contrast, if the manufacturer wants to be more responsive, the product quality may not always be guaranteed or the cost may not be acceptable. Only fashion brands that know in detail about their consumers' needs and wants, and about the peculiarities of the market they operate in, can make appropriate decisions that find the best combination of quality, cost, and responsiveness. Figure 3 shows the three factors that determine competitiveness in the fashion supply chain.

3 Textile and Apparel Industry in Asia Countries

It is important to discuss fashion supply chain management in Asia in more depth. At present, Asia possesses of a more comprehensive supply chain system than other continents such as North America and Europe where the focus lies on product design and retailing, not on manufacturing (Chen et al. 2017). Whereas the textile and apparel giant China has already built up momentous textile and apparel manufacturing capac-

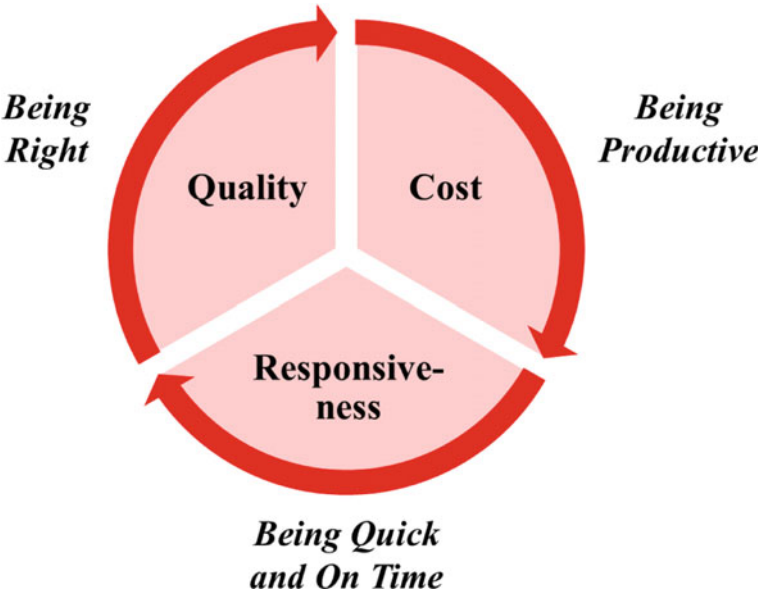

Fig. 3 Competitiveness factors in the fashion supply chain

ities, other Asian countries such as India, Bangladesh and Vietnam are increasingly promoting the textile and apparel industry in recent years (Berg and Hedrich 2014; Zhen 2015; Barrie 2016; Barth 2016). In this section, the industry conditions of the textile and apparel industry in China, India, Bangladesh and Vietnam are introduced and discussed. Additionally, it is investigated whether the logistics performance of each of these countries has an influence on the fashion supply chain efficiency of suppliers in these countries.

China

China is the world's largest textile and apparel producer and exporter. The industry plays a crucial role in the country's national economy. The output volume of China's textile and apparel industry accounts for more than half of the global one (Lu 2016a). China is the biggest apparel exporting country worldwide with an apparel export value of $175 billion in the year 2015 (Textile Outlook International 2017).

The Chinese textile and apparel industry is highly diverse, with companies and factories working on cotton, chemical fiber textile and printing, dyeing finishing, wool textile and dyeing finishing, linen textile, silk textile finishing as well knitted and woven products. China is known as one of the top apparel manufacturers worldwide with an advanced supply chain infrastructure (Lam and Postle 2006). For instance, its internal transportation network, as well as its world-class ports and power sources are the foundation for efficient operations of players in China's textile and apparel industry and drive the country's success. Furthermore, China can source all the natural materials (both plant and animal based) that are needed in textile and apparel production in its own country. China has a strong workforce with the required expertise and is thus able to produce a huge amount of good-quality goods at low cost. It is predicted that the large domestic market will continue to maintain its size in the next years (Lu 2016a).

In recent years, the rising costs of energy, land, and labor have weakened China's position in the international competitive environment. Seeing the Chinese textile industry in the long term, when producing low-end products, manufacturing capacity will continue to transfer to other Asian countries that are cheaper. In comparison to previous years, China's manufacturing strategy has changed and is still in a state of development. Increasingly, investments in technological innovation and quality upgrades are made. Furthermore, the focus is set on achieving higher profit margins by producing fewer units but increasing the value of the output instead. Achieving economies of scale through producing as many units as possible is not the ultimate goal of all manufacturers anymore. As a result, the image of China as a low-cost country is fading away, while the image of China as a medium to high-tech manufacturer is becoming more and more popular. Owing to the constant development and the modernization of production processes, China is facing a lot of new challenges. Chinese manufacturers have to deal with higher production costs at home and respond to competition from cheaper sourcing countries around. The global economic slowdown as well as increasingly strict environmental policies is driving China's fashion manufacturing sector under pressure (Young 2016). However, given the current climate in Asia's textile and apparel sector, China will remain the leading

textile and apparel sourcing country in the world in the foreseeable future. There is no other country that will be able to match China in terms of scale, manpower, infrastructure, speed, efficiency, expertise, flexibility and stability.

India

India's textile and apparel sector is one of the oldest industries in the country. The market size of India's textile and apparel industry amounted to approximately US$108 billion in 2015 and is expected to reach US$223 billion by 2021. Textile and apparel constitutes 14% of India's industrial production output and contributes about 5% to India's GDP, creating employment for about 105 million people, and making it the country's second largest employer after agriculture (India Brand Equity Foundation 2017). India's major apparel export markets are the USA, EU, and UAE. India is characterized by the coexistence of many big factories using power-looms, and a large number of small-scale, labor-intensive weaving, and knitting setups. With a large agricultural sector, India is one of the largest cotton and silk producers in the world (India Today 2015). By being able to tap its own raw materials, the country is less dependent on raw material supply from foreign countries and thus faces less constraints to the ongoing growth of its garment sector.

India's textile supply chain is complex and fragmented, ranging from material procurement to the shipping of finished products. Since India has many upstream suppliers for fabrics, accessories, trims, coloring substances, and replacement parts for machinery, the country does not depend so much on imports and can realize shorter lead times when it comes to apparel production. By being increasingly exposed to demanding clients from Europe and the USA, Indian factories gain experience in exports management, factory compliance, and sustainability topics.

India benefits from its geography as the country generally suffers fewer natural disasters than other manufacturing nations in Southeast Asia. Compared to China and many Southeast Asian countries, India—sitting on the Indian Ocean trade route—enjoys advantages in its trade with Europe, Africa, and the Central East in terms of less transportation days needed for shipping goods to major ports in these regions. In the fashion industry, the importance of speed to market continues to grow, and companies seek sources close to markets, with responsive supply and sustainable production. This opens the door wider for Indian textile and apparel production being closer to the EU and UAE markets.

Another reason why India is attractive for textile and apparel buyers is its large consumer market. India is the world's second largest population. Its large consumer base has great potential for steady economic growth in textile and apparel consumption. According to a 2015 UN study of global population trends, India is even expected to overtake China to become the world's most populous nation by 2022 (BBC 2015). Attracted by the potential of India's domestic market, apparel brands such as Tommy Hilfiger, Superdry, Hugo Boss, and Diesel have already started operations in India. These brands know that Indian middle-class consumers are more willing to buy good quality apparel products and develop great loyalty.

Bangladesh

When sourcing from Bangladesh, there are several challenges such as infrastructure, transportation system, working conditions, and safety, which buyers have to take into consideration. The Southeast Asian country Bangladesh has poor working condition but low wages, and excessive overtime (Safi 2016). In Bangladesh, workers in the textile and apparel sector only receive poor salaries (Textile Outlook International 2017). What is worse, they often cannot get their salary, bonus, and overtime bills in time. In many cases, workers in Bangladesh's textile and apparel industry receive the legal minimum wage, which does not provide enough money for them to sustain their families (Safi 2016).

Fire was a common hazard in Bangladeshi factories (Textile Outlook International 2017). For example, on April 24, 2013, an eight-story complex of clothing factories called Rana Plaza near the country's capital Dhaka collapsed with 1127 people being killed, mainly young women (Taplin 2014). This disaster immediately attracted huge media attention because it occurred due to the fact that many leading fast fashion brands miss out on imposing and enforcing binding safety rules and regulations on their Bangladeshi manufacturers. Moreover, Bangladeshi government had recently taken steps to improve workplace safety in response to a number of industrial accidents in the sector (Taplin 2014).

Despite industrial accidents, the economy of Bangladesh is prospering in the past few years. The main reason for this is the ready-made garment sector.

Vietnam

The Vietnamese textile and apparel industry grew quite fast over the last two decades (Le and Wang 2017). Many manufacturers have shifted their production facilities from China to Vietnam (BDG 2016). For example, the sportswear giant Nike sources 42% of its products from Vietnam but only 30% anymore from China (Harris 2015). Cheap labor, favorable demographic and geographic conditions, growing export rates, and free trade agreements attract a lot of manufacturers to produce in Vietnam (BDG 2016).

Costs are an important factor for buyers to select Vietnamese companies as their textile and apparel manufacturers (Textile Outlook International 2017). Vietnamese factory workers get on average only one-third of the wages of workers in China (Harris 2015). While the wages in China are rising due to constant innovation and specialization, wages in Vietnam remain relatively constant and cheap. Another beneficial factor for Vietnam is that its population consists to 65% of people who are younger than 40 years. Young people have a high motivation to learn and develop professional skills, and therefore create an advantage for manufacturing (BDG 2016).

Vietnam is engaged into several free trade agreements (FTA). Especially the involvement into the Association of Southeast Asian Nations (ASEAN) and the Trans Pacific Partnership (TPP) (now abolished by Donald Trump until April 2018) emphasizes the openness of Vietnam toward global trade and makes it a determined participant in the world's economy (BDG 2016). Whereas Vietnam benefits from its free trade agreement participation, it still experiences major negative effects because

of a lacking raw material supply in its own country. Vietnam does not farm cotton or produce other kinds of textile materials (no matter natural fiber and man-made fiber). This weakness leads to Vietnam's huge demand of imported raw materials from the USA, and significantly increases the country's dependence on external suppliers.

Vietnam's stable political environment attracts a lot of investors to shift their production facilities to the country (Lomas 2017). The Vietnamese government is continuing its efforts to create an attractive business environment and a comprehensive legal framework in order to increase the country's competitiveness to become the destination of textile and apparel manufacturing (Nguyen 2014).

In the year 2015, the export value of apparel in Vietnam increased by 10% while the export value in China declined by 6% (Lu 2016a). Vietnam's close geographic proximity to China makes it easier for manufacturers who want to move their production from China to Vietnam to integrate their existing supply chains into the new setup (Niggl 2015). Overall, Vietnam is seen as China's main rival in Asia for apparel and textile manufacturing in the long term (Jennings 2017).

Country-Specific Logistics Performance as Determinant of Supply Chain Efficiency

Logistics plays a key role in facilitating international and domestic trade, and is central to a country's competitiveness and economic growth. An indicator which reflects the logistics situation in each country is the Logistics Performance Index (LPI). The LPI measures a country's logistics performance throughout the entire logistics supply chain and indicates the ease of moving products into, inside, and out of a country (https://lpi.worldbank.org/about). Countries with high LPI scores provide a better environment for textile and apparel producers as these can make use of more sophisticated infrastructure and logistics services in that country. This is likely to decrease product lead time and increase efficiency in their supply chain. Textile and apparel manufacturers also take a country's logistics environment into consideration when it comes to choosing a factory location. Overall, logistics presents both opportunities and challenges for the Asian countries. If governments allocate enough financial resources to building and maintaining infrastructure, they can attract a larger number of manufacturers. On the contrary, if a country has many logistics shortfalls, it becomes more difficult to attract producers which rely on inbound and outbound logistics for their raw material supply and finished goods transport. Also, an underdeveloped logistics system is unlikely to attract a lot of Foreign Direct Investment (FDI). The LPI helps countries to detect the strengths and weaknesses of their logistics performance, and enables targeted government investments into logistics areas that need development. The LPI also helps countries to set the right priorities when a budget constraint exists.

Figure 4 compares the logistics performance of China, India, Vietnam and Bangladesh, the four countries which were introduced. It can be seen that for the latest numbers of 2016, China scores highest among these four countries in all the six dimensions customs, infrastructure, international shipments, logistics competence, tracking and tracing, and timeliness. This is an explanation why China has such a strong textile and apparel industry, and why China will remain the number one

textile and apparel producer for some time in the future. No other of the four countries has a higher LPI score than China (3.66 out of 5). India scores 3.42, Vietnam 2.98, and Bangladesh 2.66. The countries rank 27, 35, 64, and 87, respectively, in the global LPI ranking. Looking at the bigger picture, China's logistics performance is far better than the average in other Asian regions such as South Asia and East Asia & Pacific, as China scores much higher in the six LPI dimensions than the regions South Asia and East Asia & Pacific.

Figure 4 shows that China achieves an especially high score in infrastructure. This is due to the fact that in the past, the Chinese government focused on strategically building infrastructure. China still plans to invest aggressively across key infrastructure sectors in the future to support and stimulate further growth. China's continuous investment into infrastructure also benefited textile and apparel producers that operate in the country. For example, the share of logistics cost of total product price could be decreased, and the number of goods lost during transportation in the country was minimized. Overall, China's sound logistics performance served as foundation for the growth of the Chinese textile and apparel industry, and facilitates, accelerates, and cheapens the supply chain operations of Chinese suppliers. Hence, Chinese suppliers could gain and still possess a competitive advantage over their rivals in other Asian countries.

Fig. 4 Comparison of the 2016 logistics performance of China, India, Vietnam and Bangladesh. *Source* https://lpi.worldbank.org/international/scorecard

4 New Challenges and Opportunities for Asia's Fashion Supply Chain

Asia plays an important role in contributing to the global economy and satisfying the demand of consumers for textile and apparel products. Enhancing supply chain efficiency and at the same time accommodating the latest developments in politics and technology brings various new challenges for Asia's fashion supply chain, but also provides opportunities to be seized. In the following, three major developments are presented that will shape the fashion supply chain landscape in Asia in the future.

The Belt and Road Initiative

The Belt and Road Initiative (BRI), also named One Belt One Road (OBOR), is China's most ambitious economic and diplomatic program. It is a development strategy proposed by China's leader Xi Jinping in September/October 2013 that focuses on connectivity and cooperation between China and Eurasian countries. The BRI consists of the land-based Silk Road Economic Belt (SREB) and the oceangoing Maritime Silk Road (MSR). The 'Belt' is a series of six overland corridors connecting China with Europe, via Central Asia and the Middle East, including some countries situated on the ancient Silk Road. The initiative covers around 60 countries in Asia, Oceania, Northeast Africa, and Europe which make up 65% of the world's population, one-third of the world's GDP, and a quarter of all the goods and services the world moves. In 2017, projects with investments of $900bn were planned or underway.

The initiative aims at realizing China's ambition to play a larger role in global affairs with a China-centered trading network as base. The 'Chinese Dream' can be seen as renewal of an older order of overland and maritime relations that has been interrupted by European colonialism. The BRI fosters the extension of the infrastructure-driven economic development that China went through in the past decades. Whereas China currently faces sluggish growth in exports and weak internal demand, the BRI is set to pave the way for the Chinese economy's next growth step. The BRI might have the potential to reshape global trade. Developing infrastructural ties with neighboring countries will reduce physical and regulatory barriers to trade. This creates new markets for Chinese goods and technology. Until now, the BRI has proved successful in connecting China with developing countries and helped many countries to enhance their national economy through collaboration. The BRI has also demonstrated the power of China.

BRI strategy influences the layout of China's textile and apparel industry. China eliminated clothing import duties for 33 developing countries and less-developed countries, opened the import market, and encourages outgoing investment and inclusive development. Moreover, BRI strategy improves multilateral trade. In the textile and apparel industry, China has imported more raw materials and finished clothing, whereas exported more spinning machines and manufacturing equipment to less-developed countries. The Asian Infrastructure Investment Bank (AIIB) will contribute to the construction of infrastructure, which facilitates and accelerates moving

products and materials between different supply chain members. Furthermore, the AIIB will promote industrial development and create more opportunities in the global fashion supply chain. Overall, the Belt and Road Initiative strengthens the position of Chinese and Asian textile and apparel manufacturers in the global fashion supply chain network.

Sustainability Issues in Fashion Supply Chains

Sustainability is another topic that will dominate the future of fashion supply chains. Textile and apparel is one of the most polluting industries in the world, having a direct impact on the health of the world's ecosystems.

Cotton is the most commonly used natural fiber for making clothes and makes up approximately 33% of all fibers that are found in textiles. The problem is that cotton farming is very water-intensive. To produce one cotton shirt, 2700 L of water is required, which is enough for one person to drink for 2.5 years (National Geographic). Cotton production can be especially damaging in areas that already face water stress. Clothing production is also responsible for water use and pollution. Worldwide, 5 trillion liters of water is used every year solely for fabric dyeing, and 20% of industrial water pollution is caused by garment manufacturing.

Garment not only consumes and pollutes water, but also leaves a carbon footprint, which size depends on the material used. Synthetic fibers such as polyester impact water and land less than grown materials such as cotton, however, they emit more greenhouse gases per kilogram. A polyester shirt has more than double the carbon footprint of a cotton shirt (5.5 kg vs. 2.1 kg). In 2015, polyester production for textiles set about 706 billion kg of greenhouse gases free, which is equivalent to the annual emissions of 185 coal-fired power plants.

With the latest consumer behavior, water stress and carbon emissions become even more severe. Fast-changing fashion trends and low prices make people consume more than in the past. The average consumer is now buying 60% more clothing items compared to the year 2000, but each garment is only kept half as long. 'Fast fashion' shortens fashion cycles and gets a garment from the designer to the customer within weeks instead of months. The number of fashion seasons per year has increased from two—spring/summer and fall/winter—to as many as 50–100 microseasons.

Apparel spending is forecasted to grow tremendously over the next decades, spurred by Asia where hundreds of millions of people in China and India will enter the global middle class. By 2030, there will be 5.4 billion people in the global middle class, compared to 3 billion in 2015. Consequently, an increased demand for clothes that define middle-income lifestyle is expected. If consumption continues at its current rate in the future, the world would need three times as many natural resources by 2050 compared to what was used in 2000.

Whereas some apparel companies will ignore environmental concerns and keep on operating their traditional business models, others will become aware of the urgency of finding solutions for the world's resource problem and will tackle the issues in their supply chain. Every stage in the fashion supply chain, from raw material sourcing and textile production to apparel manufacturing and distribution, consumes a significant

amount of natural resources and owes for the release of emissions that do harm to the environment. This is why each and every part of a fashion supply chain offers potential for improving sustainability.

A first step for textile and apparel companies is to measure their environmental impacts throughout their entire supply chain and understand in which areas they can improve. One suitable tool is the 'Sustainable Apparel Coalition's Higg Index' that allows companies to measure their environmental, social, and labor impacts. There are already some companies that work on improving their resource efficiency. H&M and Zara, both pioneers of fast fashion, joined 33 other fashion companies pledging to increase their clothing recycling by 2020 and collecting and recycling used clothes at many of their stores. Other fashion companies publish water and emissions quantities on the webpage of each of their products. One important step for fashion firms is to realize that it is not only beneficial for the environment to improve the environmental impact of the garment produced, but also to produce less items overall. On the one hand, fashion companies want to produce enough quantity to satisfy demand and achieve economies of scale in production, on the other hand, they know that less production also consumes less resources and thus is more environmentally friendly. Obviously, especially low-price fashion firms face a significant trade-off between the ability to serve price-sensitive consumers and at the same time protect the environment. These companies are at the same time the ones which have the largest impact on the environment through their vast production volumes. Overall, in order to stay within planetary boundaries, consumers are required to consciously make apparel purchases, and the industry is called to return to 'slow fashion' (Drew and Yehounme 2017).

In Asia, the emerging countries all face sustainability issues. There are different ways that Asian textile and apparel manufacturers can use resources in a way that is not harmful to future generations. Possible measures they can take to achieve more sustainable fashion supply chains are eliminating chemicals in products and production processes which are hazardous to humans and the environment, promoting the ethical treatment of animals, and creating eco-friendly products that use materials from sustainable sources. Ideally, Asian suppliers voluntarily develop sustainable supply chain procedures and invest in clean technology in production. However, this is often not the case. Quick money is what many suppliers are looking for, not trying to lessen the impact of their activities on the environment. If manufacturers do not change their behavior themselves, one possible solution can be the enforcement of certain supplier behaviors in the legal way. National governments can become more active in introducing new rules and regulations that textile and apparel producers have to comply with. Moreover, international buyers can encourage and require their suppliers to adhere to environmental laws and improve their practices. Overall, it would be an essential step if Asian textile and apparel manufacturers initiated sustainable measures in the short-term future and committed to the reduction of their environmental impact and to the protection of ecosystems and biodiversity.

Sustainability does not only include topics related to nature and the environment, but also includes social dimensions such as respect for people. Corporate Social Responsibility (CSR) initiatives try to take into account the economic and social

interests of different stakeholders. It is known that employees of some Asian garment suppliers are exposed to inhuman working conditions. This is particularly true in the emerging countries such as Bangladesh. The poor and unsafe working conditions lead to challenges of managing social responsibility (Burke 2013). Truly sustainable fashion supply chains take care of workers' health and safety, respect their human rights and provide equal opportunities. To achieve that, Asian textile and apparel suppliers can assess risks related to their worker's health and safety and take steps to minimize these risks by providing a safe place to work in their factories. Furthermore, manufacturers can reject child labor, forced labor, and discrimination. Buyers can continuously raise their suppliers' awareness of workplace health and safety requirements, require them to comply with certain health and safety principles, and undertake unannounced visits and inspections. Supplier audits are an effective tool for buyers to check factory conditions and monitor suppliers' execution of sustainability policies.

Fashion brands that have implemented sustainable supply chains can communicate their efforts to consumers and revamp their brand image. This will attract conscious consumers and enable brands to set a price premium for apparel products that were produced in a sustainable way. As a result, brands investing in sustainability can expect monetary gains in terms of an increased willingness to pay from consumers.

The Impact of E-commerce on Fashion Supply Chains

E-commerce is becoming more and more popular among consumers in the world, who especially value the unrestricted accessibility and great convenience provided. Consumers are also purchasing fashion products online. For example, Chinese consumers may purchase a Ralph Lauren shirt from a US Web site, but actually that shirt may be produced in China. Thus, as matter of fact, to be able to respond more quickly to market demand, importers can allocate the apparel production to countries that are closer to that market. Asia is a big market for fashion. It is crucial for importers to manage transportation and warehousing in Asia, and connect online retailers with global consumers via efficient supply chain systems.

5 Conclusion

Textile and apparel is an important economic sector in Asia. Many emerging countries rely on their textile and apparel industry which creates jobs and raises living standards. Thus, gaining a better understanding of Asian fashion supply chains is critically important. Fashion supply chain management aims at fulfilling buyers' requests and maximizing the total supply chain benefits. Fashion supply chain management is a complex activity involving many different members and stages that have to collaborate and be gone through before the final product reaches the consumer. The typical fashion supply chain includes raw material farmers/producers, fiber and textile producers, apparel manufacturers, transporters, warehouses, and retailers. Each

stage of the supply chain has individual functions and objectives. Information (e.g., demand and supply information), products (e.g., fashionable and basic items), and payment (e.g., pay in advance, pay when the products arrived, and pay after the products are sold) are the three key elements that shape the interaction of supply chain parties.

With increasing production costs, it becomes gradually harder for China to maintain its competitive advantage in the textile and apparel sector. Other Asian nations such as India, Vietnam and Bangladesh are on the rise and take over more and more of the manufacturing share. The capabilities of their fashion supply chains show that they have caught up a lot and are legitimate competitors of China. However, due to the fact that these countries still lag behind China in regard to overall competitiveness and apparel manufacturing efficiency, China will remain the world's leading textile and apparel sourcing country and top choice for many buyers in the foreseeable future.

The diversification of textile and apparel sourcing challenges China's dominance heavily, but also provides a mass of unprecedented opportunities for importers and new production locations (Barrie 2016; Zhen 2015). Multinational brands have to evaluate their unique sourcing needs and sensitivity to certain factors when taking apparel sourcing decisions. Cost of labor, value-added tax, customs clearance, lead time, ease of entry, intellectual property protection, reliability, and political stability are only some criteria that need to be considered when choosing an apparel sourcing location. Whereas in the past, many buyers ended up sourcing their textile and apparel products from Chinese suppliers, they now have many other attractive sourcing alternatives. For textile and apparel buyers, it is now important to realize that apparel sourcing is not limited to China but that the increased number of sourcing options can be investigated and utilized. A balanced and diversified sourcing portfolio is the key for buyers because it minimizes supply chain risk and maximizes profit.

Newly emerged challenges and opportunities which Asian fashion supply chains face are presented by the Belt and Road Initiative, the development of sustainable supply chains, and the increasing popularity of e-commerce in fashion. The Belt and Road Initiative connects Chinese manufacturers better with many parts of the world and stimulates demand for Chinese goods through trade facilitation. Sustainable supply chain operations do not only decrease the environmental footprint of apparel companies, but also help them attract new customers and enhance their brand image, which will pay off financially in the end. As an increasing number of consumers prefer to buy apparel products via online channels, supply chain activities around distribution including transportation and warehousing are required to become more flexible to not only connect to physical but also to online retailers.

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Part I
Fashion Supply Chain Management Concepts

Chapter 2
Regional Comprehensive Economic Partnership (RCEP): Impact on the Integration of Textile and Apparel Supply Chain in the Asia-Pacific Region

Sheng Lu

1 Introduction

The Regional Comprehensive Economic Partnership (RCEP) is an ambitious free trade agreement (FTA) currently under negotiation between ten member states of the Association of Southeast Asian Nations (ASEAN) and other six large economies in the Asia-Pacific region (i.e., Australia, China, India, Japan, South Korea, and New Zealand) (Lee 2016). The RCEP is one of the most significant mega-FTAs in the world, both economically and politically. In 2015, the group of 16 RCEP members, which comprised more than 3 billion people, had a combined Gross Domestic Product (GDP) of about US$22.7 trillion and accounted for nearly 30% of the world trade volume (ASEAN 2015; WTO 2017). As a modern FTA, the RCEP deals with not only traditional trade policies such as tariff barriers but also some twenty-first century trade agendas, such as e-commerce, competition policy, and trade facilitation, that most existing FTAs in the region have never addressed (Lewis 2013; Wilson 2015). Regarded as China's strategic move in response to the pivot to Asia strategy proposed by the USA, the RCEP also has profound geopolitical implications for the future peace, prosperity, and development of the Asia-Pacific region (Rahman and Ara 2015; Kim 2016).

Textile and apparel (T&A) is a critical sector under the RCEP negotiation. In 2015, the sixteen RCEP members altogether exported US$405 billion worth of T&A (54% of the world share) and imported US$115 billion (31% of the world share) (WTO 2017). Notably, many of these T&A products are made through a collaborative supply chain in the Asia-Pacific region. For example, a clothing labeled "Made in Vietnam" often contains fabrics made in China from yarns spun in Japan (Lopez-Acevedo and Robertson 2016). Because the RCEP intends to eliminate existing trade barriers between its members substantially, implementation of the agreement has the potential

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to facilitate the integration of regional T&A supply chain further and significantly shift the current pattern of T&A trade in the Asia-Pacific region.

This study intends to quantitatively evaluate how the implementation of the RCEP will affect the integration of T&A supply chain in the Asia-Pacific region. While some studies have started to assess the macroeconomic impact of the RCEP, how might the agreement affect the T&A sector has been studied little (Lewis 2013; Rahman and Ara 2015). For the academia, findings of this study will make a significant contribution to our understanding of the T&A sectoral impact of the RCEP. Results of the study will also address the concerns of the T&A business community regarding the new market environment and the possible scenarios after the implementation of the RCEP. Moreover, for policymakers, findings of the study will provide valuable inputs that could support the T&A sectoral negotiation under the RCEP as well as related trade policy making in response to the implementation of the agreement.

The paper is composed of four parts. The second part provides an overview of related theories and literature that suggest the impact of the RCEP from a theoretical perspective. The third part is a detailed description of the research methods and data source of this study. The fourth part presents empirical results and discussion of them. Moreover, the last part includes key findings and the discussion of future research agendas.

2 Literature Review

To holistically evaluate how the RCEP might affect the integration of T&A supply chain in the Asia-Pacific region, we need to examine the following three questions critically: first, what is the development stage of RCEP members' T&A industry? Second, what is the pattern of T&A trade and supply chain that includes RCEP members? Third, how will the RCEP change "rules of the game" and consequentially affect related T&A trade flows and supply chains in the Asia-Pacific region. The following sections will address each question respectively.

2.1 The Development Stage of RCEP Members' Textile and Apparel Industry

While T&A is often treated as one single industry, textile manufacturing and apparel manufacturing are heterogeneous in nature (Dickerson 1999). In general, textile manufacturing, which mainly involves the spinning, weaving, and fabric finishing processes, is primarily based on sophisticated machinery for production. In comparison, apparel manufacturing, which includes the cloth cutting and sewing operations, primarily relies on labor inputs (Dickerson 1999). Even today in the twenty-first

century, manufacturing of apparel is still highly labor intensive and has a relatively low requirement for technology and capital (Lu and Dickerson 2012).

Because of the heterogeneous nature of T&A production regarding capital and labor intensity, the stage of development theory proposed by Toyne et al. (1984) argues that T&A industry in a country generally will go through six development stages. As shown in Table 1, each development stage can be observed with distinct production structure and trade patterns (Jin et al. 2013). Specifically, from the process moving from the stage of embryonic to the stage of significant decline, textile products will gradually account for an increasing share of a country's total T&A industry output while the share of apparel products will fall. The evolution process of a country's T&A industry is also in parallel with that country's overall economic advancement level. While many developing countries are capable of producing apparel, they are unable to produce textiles, especially made-made fiber products, until their national economies reach a certain advancement level with sufficient cumulation of capital and technology (Toyne et al. 1984).

Empirical studies show that the state of RCEP members' T&A industry, in general, follows the pattern suggested by the stage of development theory. For example,

Table 1 Development stage of RCEP members' textile and apparel industry

Development state	T&A output structure	Pattern of trade	Typical RCEP members
Embryonic	Natural fiber raw material	Net importer of textiles; Net exporter of apparel	Some ASEAN members such as Myanmar
Early export of apparel	Natural fiber apparel articles		
More advanced production of fabric and apparel	Natural fiber apparel and fabrics; beginning stage of producing manufactured fibers		Some ASEAN members such as Vietnam
Golden age	Sophisticated apparel articles; increased share of textiles in total industry output		China, India
Full maturity	Textiles exceed apparel in total industry output, mostly are manufactured fiber products	Net exporter of textiles; Net importer of apparel	South Korea
Significant decline	Most industry outputs are manufactured fiber textiles		Japan, New Zealand, Australia

References Compiled based on Toyne et al. (1984), Dickerson (1999), Jin et al. (2013) and Lopez-Acevedo and Robertson (2012)

based on a comprehensive review of official government statistics, Lopez-Acevedo and Robertson (2012), Fukunishi and Yamagata (2014), and Lopez-Acevedo and Robertson (2016) found that the T&A industry in many developing members of the RCEP was still at the early stages of development. Specifically, restrained by the availability of capital and technology skills, developing countries such as Cambodia, Vietnam, and Myanmar mostly undertook labor-intensive and low-skill level functions like fabric cutting, garment sewing, and packing. Related, because of the nascent stage of development, apparel production in these three countries also had a high concentration on limited categories of products that only require simple to moderate skill sets, such as men's and boys' shirts, trousers, and skirts (WTO 2017). Meanwhile, these developing countries relied heavily on imports for textile inputs, such as yarns, threads, and fabrics due to the lack of local manufacturing capability (Lopez-Acevedo and Robertson 2012).

In comparison, the T&A industry in the developed RCEP members, such as Japan and South Korea, has mostly reached the development stage of "full maturity" or "significant decline" (Dickerson 1999). On the one hand, these developed countries are the world's most competitive textile producers and exporters today (WTO 2017). The advantages of Japan and South Korea's textile production, for example, are especially visible for high-tech and capital-intensive categories, such as synthetic fibers, functional fabrics, and industrial textiles (Japan Textile Federation 2017; Textile Outlook International 2017). However, because of the high labor cost, both Japan and South Korea have substantially move apparel manufacturing overseas in the past decades and rely on imports to meet the domestic demand for apparel consumption (Dickerson 1999; Rasiah and Ofreneo 2009).

2.2 Regional T&A Supply Chain in the Asia-Pacific

The regional supply chain or regional production and trade network refers to a vertical industry collaboration system between countries that are geographically close to each other (Ando and Kimura 2005; Dicken 2015). Within a regional supply chain, each country specializes in certain portions of supply chain activities based on its respective comparative advantages so as to maximize the efficiency of the whole supply chain (Lu and Ha-Brookshire 2009).

The regional supply chain is a distinct pattern of T&A trade in the Asia-Pacific, particularly among RECP members located in East and Southeast Asia. As illustrated in Fig. 1, within this regional T&A supply chain, more economically advanced Asian countries (such as Japan, South Korea, and China) supply textile raw material to the less economically developed countries in the region (such as Myanmar, Cambodia, and Vietnam) (Dicken 2015; Lopez-Acevedo and Robertson 2016). Based on relatively lower wages, the less-developed countries typically undertake the most labor-intensive processes of apparel manufacturing and then export finished apparel to major consumption markets around the world. Meanwhile, because of the particular stage of development (see Table 1) and size of the country, mega emerging

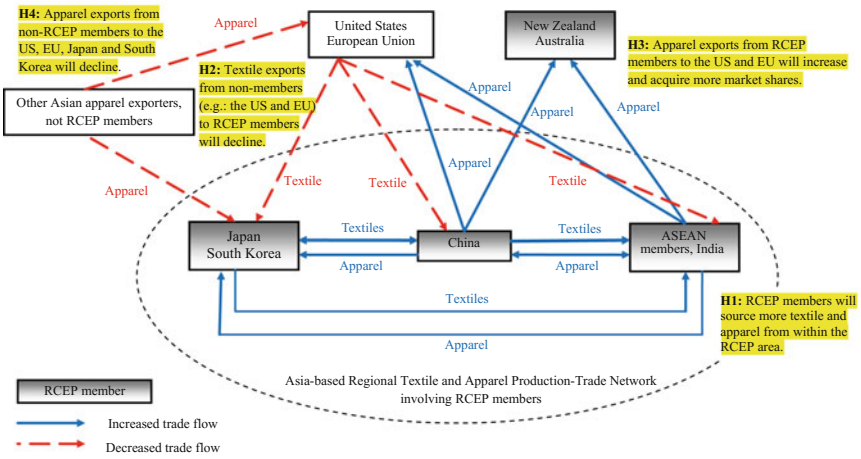

Fig. 1 Potential impact of the RCEP on the textile and apparel supply chain in the Asia-Pacific

economies in the region such as China may produce some T&A products primarily based on its domestic supply chain (Zhu and Pickles 2014). Nevertheless, as a developing country, China still had to import US$2.3 billion and US$1.8 billion worth of textiles from Japan and South Korea, respectively, in 2015 for some high-quality or technologically-advanced products it could not produce (Textile Outlook International 2017; WTO 2017).

Related trade flows also indicate the existence of this unique regional T&A supply chain among RCEP members. As shown in Tables 2 and 3, most East and Southeast Asian RCEP members import a substantial share of textiles and apparel from other RCEP members rather than trading with countries outside the region. For example, as much as 80.3% of textiles imported by ASEAN members, 39.9% in China, 75.2% in India, 86.5% in Japan, and 77.7% in South Korea came from other RCEP members in 2015 measured by value (GTAP 2016; WTO 2017). Similarly, as much as 81.0% of ASEAN members' apparel imports, 40.6% in India, 88.5% in Japan, and 78.3% in South Korea also came from RCEP members in 2015 measured by value (GTAP 2016; WTO 2017). Moreover, 65.4 and 53.1% of textile exports from Japan and South Korea went to other RCEP members in 2015, respectively. Meanwhile, apparel made by RCEP members are both consumed within the region and exported to other key consumption markets in the world, particularly the USA and the European Union (EU).

Several factors may have contributed to the formation of the regional T&A supply chain among RCEP members. First, East and Southeast Asian countries have a long history of forming a regional division of labor in manufacturing through a so-called flying geese model (Kojima 2000; Goto 2017). Specifically, based on the hierarchy of economic development in the region, more advanced economies undertake relatively more capital and technology-intensive production process whereas

Table 2 Source of RCEP members' textile and apparel imports in 2015 (by value) Unit: %

Exporters/Importers	ASEAN	Australia	China	India	Japan	South Korea	New Zealand
Textile							
ASEAN	11.0	6.0	7.5	8.1	11.5	17.6	4.9
Australia	/	/	0.2	1.1	0.2	0.7	12.6
China	46.5	53.2	/	58.9	70.3	49.7	43.7
India	2.2	5.6	3.1	/	1.3	4.4	4.4
Japan	5.9	0.8	16.8	3.0	/	5.2	0.5
South Korea	14.2	2.6	11.7	3.2	3.1	/	3.1
New Zealand	0.1	5.3	0.5	1.0	0.1	<0.1	/
RCEP total	80.3	73.5	39.9	75.2	86.5	77.7	69.2
Apparel							
ASEAN	11.2	5.5	5.3	5.3	9.2	19.3	4.4
Australia	0.2	/	0.3	0.2	<0.1	0.1	11.4
China	60.6	70.8	/	33.9	77.2	57.4	65.1
India	2.3	2.9	1.5	/	1.0	0.4	2.2
Japan	1.6	0.1	1.9	0.3	/	1.0	0.1
South Korea	4.9	0.3	4.5	0.7	1.1	/	0.2
New Zealand	0.2	1.2	<0.1	0.3	<0.1	<0.1	/
RCEP total	81.0	80.7	13.5	40.6	88.5	78.3	83.3

Data source GTAP (2016), WTO (2017)
Note Rows are exporters and columns are importers; figures in the table = value of imports from a particular source/total value of imports

the less advanced economies engage in relatively more labor-intensive productions (Dickerson 1999). Further, when a more advanced economy shifts to more capital and technology-intensive industries (such as textile fiber production), it will relocate the production of labor-intensive products (such as apparel) to the less-developed economy in the region. The flying geese model explains how apparel manufacturing gradually moved from Japan to newly industrialized economies (like South Korea, Hong Kong, and Taiwan), to China and more recently to even less-developed ASEAN members (Kojima 2000; Dicken 2015). Second, investment and sourcing strategies of T&A multinationals have also contributed to the creation of the regional T&A supply chain in the Asia-Pacific. Gereffi (1999) and Lopez-Acevedo and Robertson (2012) found that many apparel factories in low-wage Asian countries were wholly-owned subsidiaries or joint ventures invested by Japanese, South Korean, and Chinese T&A firms. These T&A multinationals mostly dispatch production orders to their overseas subsidiaries and supply needed textile raw material in the format of intra-firm trade. Additionally, free trade agreements (FTAs) have further strengthened the regional T&A supply chain in the Asia-Pacific. By the end of September 2016, there were 168 FTAs in force between Asian countries (Solís and Wilson 2017). Through lowered

Table 3 Destination of RCEP members' textile and apparel exports in 2015 (by value) Unit: %

Exporters/Importers	ASEAN	Australia	China	India	Japan	South Korea	New Zealand	RCEP total	USA	EU
Textile										
ASEAN	12.7	0.9	6.6	1.7	7.7	4.9	0.2	34.7	21.9	15.4
Australia	14.0	/	7.9	8.8	4.8	7.3	14.2	57.0	6.9	12.3
China	10.7	1.6	/	2.5	9.4	2.8	0.3	27.4	15.1	17.3
India	3.2	1.1	3.4	/	1.1	1.6	0.2	10.6	19.3	25.7
Japan	18.6	0.4	40.7	1.8	/	4.0	0.0	65.4	6.6	9.3
South Korea	29.1	0.7	18.2	1.2	3.7	/	0.2	53.1	8.0	8.5
New Zealand	3.5	29.7	17.2	7.6	2.0	0.4	/	60.4	5.4	21.9
Apparel										
ASEAN	2.3	0.7	1.1	0.1	6.7	3.6	0.1	14.6	52.1	21.9
Australia	4.1	/	6.0	0.3	1.1	2.8	25.6	39.9	7.9	15.5
China	2.8	2.2	/	0.1	12.8	2.4	0.3	20.6	20.9	29.4
India	1.1	0.9	0.6	/	1.6	0.2	0.1	4.5	23.2	48.4
Japan	16.4	0.5	19.1	0.2	/	9.2	0.1	45.5	6.5	13.1
South Korea	21.6	0.9	19.0	0.2	16.8	/	0.1	58.7	11.5	12.8
New Zealand	12.1	46.5	1.7	1.3	3.1	0.8	/	65.6	5.2	11.3

Data source GTAP (2016), WTO (2017)

Note Rows are exporters and columns are importers; figures in the table = value of imports from a particular source/total value of imports; EU refers to 28 members of the European Union

tariff and non-tariff barriers, these FTAs significantly decreased the cost of trade between related countries and facilitated the integration of T&A supply chain in the region, (Lewis 2013; Kawasaki 2015).

2.3 *Potential Impact of the RCEP on the T&A Supply Chain in the Asia-Pacific*

Based on the computable general equilibrium (CGE) models, some studies have quantitatively evaluated the potential economic impact of the RCEP. Consistent with the prediction of standard trade theories, most of these studies suggest that the implementation of the RCEP will benefit the overall economic welfare of its members and promote the economic integration in the Asia-Pacific region (Cheong and Tongzon 2013; Itakura 2014; Rahman and Ara 2015). However, because of different research design and source of data, researchers could not reach a consensus about the potential winners and losers of the agreement. For example, Itakura (2014), Cheong and Tongzon (2013), and Kawasaki (2015) contended that the substantial trade diversion effect of the RCEP would affect exports from the non-RCEP countries in the Asia-Pacific region negatively and make them big losers of the agreement. However, Mikic and Jetin (2016) estimated that the potential trade diversion effect of the RCEP on Asian countries that are not members of the agreement would be minimal because of the highly integrated regional supply chain already formed and other regional trade agreements currently in force. Some other studies suggest that winners and losers of the RCEP could vary from sector to sector. For example, Thuy Anh and Minh Ngoc (2016) found that among all industries in Vietnam, its agriculture exports would benefit mostly from the trade creation effect of the RCEP. In comparison, Yuh et al. (2015) argued that the RCEP could make ASEAN T&A producers more vulnerable to the increasing imports from China after losing the tariff protection.

Despite the fruitful research outcomes, very few studies have empirically investigated the T&A-specific economic impact of the RCEP. However, most existing studies agree that the implementation of a mega free trade agreement like the RCEP would affect trade patterns of related countries as well as economic integration in the region to a great extent (Cheong and Tongzon 2013; Das 2013). Specifically, as shown in Table 4, T&A imports currently are subject to a relatively high tariff rate in most RCEP members, with the applied simple average tariff rate in 2015 up to 12.0% for textiles and as high as 29.6% for apparel. While the RCEP intends to eliminate the import tariff (i.e., the rates listed in Table 4) for T&A products traded between RCEP members, the tariff will remain unchanged for T&A products traded between RCEP members and countries that are not members of the agreement (ASEAN 2015). Because T&A products are with a relatively high price elasticity of substitution (Dickerson 1999), the proposed tariff cut under the RCEP would directly affect the cost competitiveness of T&A products from a particular source and result

Table 4 Applied simple average tariff rate of RCEP members in 2015 Unit: %

	Textile	Apparel
Brunei[a]	0.82	0.00
Cambodia[a]	5.36	14.14
Indonesia[a]	9.24	14.40
Lao[a]	8.84	9.98
Malaysia[a]	8.82	0.20
Myanmar[a]	8.31	16.88
Philippines[a]	9.08	14.84
Singapore[a]	0.00	0.00
Thailand[a]	8.66	29.56
Vietnam[a]	9.59	19.81
Australia	4.31	8.84
New Zealand	1.88	9.68
China	9.52	15.99
India	12.03	12.54
Japan	5.39	9.02
South Korea	9.03	12.47

Data source WTO (2016)
[a]ASEAN members

in several critical changes to the existing trade patterns and T&A supply chains in the region (Fig. 1).

First, as the tariff on T&A traded between members of the RCEP falls, some domestic T&A production in an RCEP member would be replaced by more efficient products from other RCEP partners, resulting in expanded T&A trade flows between RCEP members or the so-called trade creation effect (Baldwin and Wyplosz 2006). The lowered cost of trade could encourage RCEP members to use more textile inputs locally made in the RCEP area and strengthen the existing regional T&A supply chain. With that, this study proposes that:

H1: RCEP members will source more textile and apparel from within the RCEP area after the implementation of the agreement.

Second, since the RCEP discriminates against non-members of the agreement, T&A imports from RCEP partners would replace products from outside producers, resulting in declined T&A trade flows between RCEP members and their non-RCEP trading partners or the so-called trade diversion effect (Fukao et al. 2003). RCEP's trade diversion effect could particularly affect US and EU textile producers, which are the primary source of textile inputs from outside the Asia region for RCEP members (WTO 2017). With that, this study proposes:

H2: Textile exports from non-RCEP members (e.g., the USA and the EU) to RCEP members will decline after the implementation of the agreement.

Further, based on a more integrated and efficient T&A supply chain facilitated by RCEP's trade creation effect, apparel exports from RCEP members could demon-

strate even more cost competitiveness and acquire more market shares in leading apparel import markets such as the USA, EU, Japan, and South Korea (Dicken 2015). In comparison, other apparel suppliers for these markets but are not members of the RCEP, such as Bangladesh, could see a decline of their exports because of the intensified competition. With that, this study proposes that:

H3: Apparel exports from RCEP members to the USA and EU would increase and acquire more market shares after the implementation of the RCEP.

H4: Apparel exports from non-RCEP members to the USA, the EU, Japan, and South Korea would decline and lose market shares to RCEP members after the implementation of the RCEP.

3 Methods and Data

3.1 Measuring the Economic Impact of the RCEP

The computable general equilibrium (CGE) model developed by the Global Trade Analysis Project (GTAP) was adopted in this study to evaluate the potential impact of the RCEP. The GTAP CGE model is one of the most popular analysis tools for assessing the economic effects of free trade agreements (Dixon and Jorgenson 2012). Compared with a single-equation econometric model or the partial equilibrium analysis method, the CGE model has the advantage of capturing the input–output relationship between the T&A industry and other sectors in the setting of an open global economy and thus improve the robustness of the estimation (Adams 2005). Many quantitative studies that assess the macroeconomic impact of the RCEP also adopted the CGE method (such as Cheong and Tongzon 2013; Itakura 2014; Rahman and Ara 2015).

Specifically, the GTAP CGE model assumes that in a perfectly competitive market, the production follows the principle of constant returns of scale (Hertel and Hertel 1997). The model establishes a multi-country and multi-sector framework of production, trade, and consumption by using a series of behavioral equations and parameters. The values of the endogenous variables are determined when both the product and factor markets across all sectors in all countries covered by the model reach their equilibrium status (i.e., the status of market clearance) based on the aggregate demand and supply (Burfisher 2016).

To provide a linearized representation of equations, behavioral components of the GTAP CGE model are expressed as a percentage change (Hertel and Hertel 1997). Regarding trade flows, on the supply side, the value of industry output of product i in country r[qo(i, r)] can be expressed as:

$$\mathrm{qo}(i,r) = \mathrm{SHRDM}(i,r) \times \mathrm{qds}(i,r) + \sum_{k \in r} \mathrm{SHRXMD}(i,k,s) \times \mathrm{qxs}(i,k,s) \quad (1)$$

where SHRDM(i, r) denotes the share of domestic sales of product i in country r; qds(i, r) denotes the value of domestic sale of product i produced in country r; SHRXMD(i, k, s) denotes the proportion of export sale of product i supplied by country k to region s and there are r number of regions in total; qxs(i, k, s) denotes the value of export sale of product i provided by country k to region$s$; r refers to the set of regions.

On the demand side, we can express the import demand for product i supplied by country r to region s as:

$$\text{qxs}(i, r, s) = \text{qim}(i, s) - \sigma_M(i) \times [\text{pms}(i, r, s) - \text{ams}(i, r, s) - \text{pim}(i, s)] \quad (2)$$

where in Eq. 2, qxs(i, r, s)denotes the import value of product i supplied by country r to region s; qim(i, s) denotes the value of aggregate import demand for product i in region s; ams(i, r, s) denotes the external price reduction factor for product i supplied by country r to region s; pim(i, s) denotes the composite price of imports for product i in region s;

$$\text{pim}(i, s) = \sum_{k \in r} \text{MSHRS}(i, k, s) \times \text{pms}(i, k, s) \quad (3)$$

Moreover, as expressed in Eq. 3, pim(i, s) in Eq. 2 mathematically equals the weighted average price of imports from all import sources for product i. MSHRS(i, k, s) denotes the share of product i supplied by country k to region s, and pms(i, k, s) denotes the import price of product i supplied by country k to region s. r refers to the set of region s. $\sigma_M(i)$ denotes the elasticity of substitution between imports and domestically made commodity for product i in region s. The value of $\sigma_M(i)$ is usually positive, suggesting a competing relationship between imports and the domestically made commodity in an importing country (Burfisher 2016).

$$\text{pms}(i, r, s) = \text{tms}(i, r, s) + \text{pcif}(i, r, s) \quad (4)$$

Additionally, as illustrated in Eq. 4, pms(i, r, s) in Eq. 3 is affected by the tariff rate applied to product i supplied by country r to region s[tms(i, r, s)] and the cost, insurance, and freight (CIF) price of product i supplied by country r in region s[pcif(i, r, s)].

When using the CGE model to assess the economic impact of a policy shock (such as the elimination of tariff) under the framework of a multi-country and multi-sector open economy, the exogenous variable representing the policy shock [such as tms(i, r, s)] will be assigned a corresponding new value. Specifically, to quantify RCEP's tariff elimination effect, we followed the practices of similar studies (such as Narayanan and Sharma 2016; Burfisher 2016) and reduced the tariff on T&A traded between RCEP members from their current rates (as shown in Table 4) to zero for the exogenous variable tms(i, r, s) in Eq. 4. The CGE model then calculated the new equilibrium status for the product and factor markets by solving Eqs. 1–4 simultaneously. The economic impact of the policy shock is reflected by the value

change of the endogenous variables pms(i, r, s), qxs(i, r, s), qo(i, r), qds(i, r), and pim (i, s) at their initial and the new equilibrium status (Hertel and Hertel 1997; Dixon and Jorgenson 2012).

3.2 Data Source

We used data from the latest GTAP9 database to run the CGE model in this study (Aguiar et al. 2016; GTAP 2016). To assess the T&A-specific sectoral impact of the RCEP, we categorized the 57 industry sectors included in the GTAP9 database into three groups: *Textile* (International Standard Industry Classification System, ISIC code 17 and code 243), *Apparel* (ISIC code 18), and *Others* (including all other 55 sectors). We further categorized the 140 countries included in the GTAP9 database into twelve groups: *ASEAN, Australia, China, India, Japan, South Korea, New Zealand, USA*, *EU* (refers to 28 members of the European Union), *Bangladesh*, *Rest of Asia* (refers to Asian countries other than RCEP members and Bangladesh), and *ROW* (refers to rest of the world). The categorization allowed us to compare winners and losers of the RCEP at the country level, including both RCEP members and other critical stakeholders that are not members of the trade agreement (Das 2013).

4 Results and Discussions

First, results of the CGE model estimation support *H1* that the implementation of the RCEP would significantly encourage its members to source more textile and apparel from within the RCEP area. Regarding textiles, RCEP members, particularly those located in East or Southeast Asia, will increasingly use more regional textile inputs because of RCEP's tariff elimination effect. Specifically, as shown in Table 5, when other factors remain constant, the implementation of the RCEP will result in an increase in the value of ASEAN's annual textile imports from the RCEP area by US$4905 million compared with the base-year level in 2015. The increase will be US$5235.7 million in China, US$2729.9 million in India, US$2163.5 million in Japan, and US$1805.8 million in South Korea. Understandably, Japanese, South Korean, and Chinese textile suppliers will be among the biggest winners of the RCEP and enjoy a notable increase in their exports to other developing RCEP partners that have no capacity for making textiles, such as ASEAN countries (Lopez-Acevedo and Robertson 2012) (Table 6). Further, as shown in Table 7, RCEP members will raise the proportion of their textile imports from the RCEP area by 8.1 percentage points on average, after the implementation of the trade agreement.

Similarly, RCEP members would also place more apparel sourcing orders from within the RCEP area because of the trade creation effect of the agreement (Lewis 2013). As shown in Table 6, when other factors remain constant, the implementation

Table 5 Impacts of the RCEP: volume change of textile imports (base year = 2015) Unit: $million

Exporters/Importers	ASEAN	Australia	China	India	Japan	South Korea	New Zealand
RCEP total	$4095.5	$554.6	$5,235.7	$2729.9	$2163.5	$1805.8	$95.0
ASEAN	−$186.0	−$18.5	−$7.8	$251.8	−$394.2	$251.1	$6.2
Australia	−$6.1	/	$149.3	$1.1	−$8.5	−$8.3	−$21.7
China	$2625.9	$589.6	/	$2226.3	$2494.2	$1279.8	$109.3
India	$120.3	$30.9	$187.3	/	−$57.0	$105.4	<$0.1
Japan	$521.2	−$6.8	$2924.6	$95.8	/	$177.9	$0.3
South Korea	$1016.7	$11.8	$1994.4	$157.2	$131.7	/	$0.9
New Zealand	$3.5	−$52.4	−$12.1	−$2.3	−$2.7	−$0.1	/
Non-RCEP total	−$1533.9	−$265.8	−$1611.2	−$490.6	−$600.5	−$418.9	−$55.8
USA	−$112.3	−$46.0	−$142.8	−$48.5	−$89.5	−$84.1	−$11.3
EU(28)	−$246.4	−$93.7	−$261.3	−$154.3	−$229.4	−$148.9	−$17.7
ROW	−$1175.2	−$126.1	−$1207.1	−$287.8	−$281.6	−$185.9	−$26.8

Note Rows are exporters and columns are importers

Table 6 Impacts of the RCEP: volume change of apparel imports (base year = 2015) Unit: $million

Exporters/Importers	ASEAN	Australia	China	India	Japan	South Korea	New Zealand	USA	EU
RCEP total	$1714.4	$764.2	$729.7	$183.5	$3453.5	$1402.3	$134.3	$1267.8	$837.5
ASEAN	−$84.7	$19.0	$18.0	$29.4	−$551.1	$366.2	$11.2	$1443.1	$741.3
Australia	−$1.0	/	$28.1	$0.8	−$0.9	$5.8	−$29.1	$0.7	$2.0
China	$1381.8	$738.6	/	$147.2	$3987.6	$982.5	$146.8	−$209.5	−$56.9
India	$15.3	$23.4	$101.4	/	−$69.1	$7.3	$4.7	$18.8	$126.9
Japan	$49.2	−$0.8	$200.7	$1.6	/	$39.9	$0.2	$2.6	$6.1
South Korea	$357.5	−$0.6	$381.2	$3.5	$85.1	/	$0.5	$12.0	$17.7
New Zealand	−$3.7	−$15.4	$0.3	$1.0	$1.9	$0.6	/	$0.1	$0.4
Non-RCEP total	−$420.5	−$260.8	−$329.3	−$67.1	−$846.8	−$371.8	−$43.3	−$429.0	−$501.4
Bangladesh	−$12.5	−$46.7	−$3.6	−$8.3	−$74.3	−$25.1	−$6.1	−$24.5	−$14.5
Rest of Asia	−$81.5	−$29.2	−$235.7	−$9.8	−$163.9	−$94.4	−$3.1	−$89.3	−$390.5
ROW	−$326.5	−$184.9	−$90.0	−$49.0	−$608.6	−$252.3	−$34.1	−$315.2	−$96.4

Note Rows are exporters and columns are importers. EU refers to 28 members of the European Union

Table 7 Impacts of the RCEP: share of textile and apparel imports from RCEP members (by value) Unit: %

Scenario/Importers	ASEAN	Australia	China	India	Japan	South Korea	New Zealand		
Textile									
Base year = 2015	80.3	73.5	39.9	75.2	86.5	77.7	69.2		
After RCEP	85.9	80.5	52.4	87.9	90.2	85.2	76.3		
After RCEP versus base year	5.7	7.1	12.5	12.7	3.8	7.6	7.1		
Apparel									
Scenario/importers	ASEAN	Australia	China	India	Japan	South Korea	New Zealand	U.S.	EU
Base year = 2015	81.0	80.7	13.5	40.6	88.5	78.3	83.3	65.4	40.7
After RCEP	89.4	87.9	22.9	60.9	92.8	86.7	90.7	66.3	41.2
After RCEP versus base year	8.4	7.2	9.4	20.3	4.3	8.4	7.4	0.8	0.5

Note EU refers to 28 members of the European Union

of the RCEP will result in an increase in the value of Japan's annual apparel imports from the RCEP area by US$3453.5 million compared with the base-year level in 2015. The increase will be US$1714.4 million in ASEAN, US$1402.3 million in South Korea, US$764.2 million in Australia, US$729.7 million in China, US$1835 million in India, and US$134.3 million in New Zealand. Further, as shown in Table 7, RCEP members will raise the proportion of their apparel imports from the RCEP area by 9.3 percentage points on average as a result of the RCEP.

However, it does not seem apparel producers in all RCEP member countries will benefit from the agreement equally. For example, while China's annual apparel exports to Japan and ASEAN will increase by US$3987.6 million and US$1381.8 million, respectively, because of the RCEP, ASEAN members will suffer a decline in their apparel exports to Japan (down US$551.1 million) and other ASEAN partners (down US$84.7 million). The result echoes some previous studies that were worried about ASEAN apparel exporters being negatively affected by China's competition after the two regions form a free trade agreement (Yuh et al. 2015).

Second, results of the CGE model estimation support *H2* that textile exports from non-members to RCEP members will decline after the implementation of the agreement. As shown in Table 5, when other factors remain constant, implementation of the RCEP will result in a substantial fall in the value of ASEAN's annual textile imports from non-RCEP members by US$1533.9 million compared with the base-year level in 2015. The decrease will be US$1611.2 million in China, US$600.5 million in Japan, US$490.6 million in India, and US$418.9 million in South Korea. Moreover, results indicate that US and EU textile suppliers could be among the stakeholders most adversely affected by RCEP's trade diversion effect (Thuy Anh and Minh Ngoc 2016). For example, China's annual textile imports from the USA and the EU altogether will be US$404.1 million less than otherwise because of the RCEP (or 25% of China's total decline of textile imports from non-RCEP members). US and EU textile suppliers will face a similar drop in their exports to Japan (US$318.9 million less), ASEAN (US$358.7 million less), South Korea (US$233.0 million less), and India (US$202.8 million less) after the implementation of the trade agreement. Consequently, only around 6.5% of RCEP members' textile imports will come from the USA and the EU after the RCEP, down from 9.4% in 2015 measured by value (GTAP 2016; WTO 2017).

Third, results of the CGE model estimation support *H3* that apparel exports from RCEP members would benefit from a more integrated regional T&A supply chain facilitated by the RCEP and demonstrate more competitiveness in the world's leading apparel import markets, such as the USA and the EU (WTO 2017). Specifically, as shown in Table 6, when other factors remain constant, implementation of the RCEP will result in an increase in the value of annual US and EU apparel imports from RCEP members by US$1267.8 million and US$837.5 million, respectively, compared with the base-year level in 2015. Thanks to the RCEP, market shares of RCEP members will also jump from 65.4 to 66.3% in the USA and from 40.7 to 41.2% in the EU.

Among RCEP members, apparel exports from ASEAN countries to the USA and EU notably will enjoy the largest expansion. Related, compared to the base-year level in 2015, implementation of the RCEP will reduce the unit price of apparel

exports from ASEAN countries to the USA and EU by 1.15% on average, versus only 0.58% for other RCEP members [i.e., the value of pcif(i, r, s) in Eq. 4]. Not like those RCEP members at a more advanced stage of economic development such as China, apparel producers in ASEAN countries rely heavily on imported textile inputs (Zhu and Pickles 2014; Lopez-Acevedo and Robertson 2016). The results suggest that the RCEP will particularly help ASEAN countries more easily get access to needed textile inputs locally made by Asian-based RCEP suppliers such as China, South Korea, and Japan and consequently improve the overall cost competitiveness of ASEAN's apparel exports through a more efficient regional T&A supply chain (Goto 2017).

Additionally, results of the CGE model estimation support *H4* that apparel exports from non-RCEP members will somewhat suffer a decline and lose market shares to their RCEP competitors in the world's leading apparel import markets. As shown in Table 6, when other factors remain constant, implementation of the RCEP will result in a decrease in the value of annual US apparel imports from non-RCEP members by US$429.0 million compared with the base-year level in 2015. The decline will be US$501.4 million in the EU, US$846.8 million in Japan, and US$371.8 million in South Korea.

Not surprisingly, results suggest that Asian apparel suppliers in non-RCEP member countries would be negatively affected the most by the implementation of the agreement. For example, when other factors remain constant, implementation of the RCEP will result in a decrease in the total value of annual US apparel imports from Bangladesh and *Rest of Asia* by US$113.8 million (or market shares down 0.5 percentage points) compared with the base-year level in 2015. The decline will be US$405.0 million in the EU (or market shares down 0.1 percentage points), US$238.2 million in Japan (or market shares down 1.2 percentage points), and US$119.5 million in South Korea (or market shares down 3.0 percentage points). The results reflect the fact that apparel made by these Asian countries that are not members of the RCEP, such as Bangladesh and Sri Lanka, are mostly basic items with a high price elasticity of substitution (Dickerson 1999; Saxena 2014). Without additional support, apparel producers in these countries would be vulnerable to the intensified competition from RCEP members that make the similar products and target the same export markets.

5 Conclusions and Future Research Agenda

This study provides a quantitative evaluation of how the implementation of the RCEP will affect the integration of T&A supply chain in the Asia-Pacific region. By adopting the GTAP CGE model based on the GTAP9 database and focusing on the effect of tariff elimination, key findings of the study include:

First, the trade creation effect of the RCEP will significantly encourage its members to source more textile and apparel from within the RCEP area and form an ever more integrated regional T&A supply chain. Second, the trade diversion effect of the RCEP will affect textile exports from non-RCEP members, particularly the

USA and the EU, to RCEP members negatively. Third, apparel exports from RCEP members would benefit from a more integrated regional T&A supply chain facilitated by the RCEP and demonstrate more competitiveness in the world's leading apparel import markets, including the USA and the EU. Meanwhile, apparel exports from non-RCEP member countries to these markets would suffer a decline and lose market shares because of the intensified competition from RCEP members.

Findings of this study augment our understanding of the T&A-specific sectoral impact of the RCEP and shed light on the new market environment after the implementation of the agreement. For policymakers, findings of this study also provide valuable inputs that could support the T&A sectoral negotiation under the RCEP and related policy making in response to the implementation of the agreement. The findings have two additional important implications:

First, results of the study confirm that the RCEP will lead to a more integrated T&A supply chain among its members. When other factors remain constant, after the implementation of the agreement, as much as 78.5% of RCEP members' textile imports measured by value will come from within the RCEP area, up from 70.0% in 2015 (GTAP 2016). The RCEP will particularly strengthen the role of Japan, South Korea, and China as the primary textile suppliers in the regional T&A supply chain that involves RCEP members. Measured by value, approximately 65.8% of textiles imported by RCEP members will come from these three countries, up from 56.4% in 2015 (GTAP 2016). The RCEP will also enlarge the role of ASEAN, India, and China as the leading apparel producers in the regional T&A supply chain. Measured by value, approximately 68.1% of apparel imported by RCEP members will come from these three members, up from 61.0% in 2015 (WTO 2017). Considering the positive impacts of expanded investment and other trade facilitation provisions of the agreement, we can expect a further integration of the regional T&A supply chain among RCEP members in the long-term (Lee 2016; Kim 2016).

Second, findings of the study suggest that as a trading bloc, the RCEP will make it even harder for non-RCEP members to get involved in the regional T&A supply chain in the Asia-Pacific. Because an entire regional T&A supply chain already exists in the Asia-Pacific, plus the factor of speed to market, few incentives are out there for RCEP members to partner with suppliers from outside the region in T&A production (Ando and Kimura 2005). The discriminatory tariff elimination under the RCEP will put T&A producers that are not members of the agreement at a greater disadvantage in the competition (Baldwin and Wyplosz 2006). Not surprisingly, measured by value, only around 21.5% of RCEP members' textile imports will come from outside the area after the implementation of the agreement, down from the base-year level of 29.9% in 2015. Likewise, the RCEP will make its members source less apparel from outside the region, with the proportion of imports down from the base-year level of 25.1% in 2015 to approximately 17.4% measured by value (GTAP 2016; WTO 2017).

Despite the meaningful results, this study also has several limitations that future research might overcome. First, although this study applies the latest GTAP9 database to assess the impact of the RCEP, the fast-changing economic landscape in the RCEP area could affect the accuracy of some parameters used in the GTAP model, such as

the elasticity of substitution. Future studies might update values of these parameters based on more recent data available from other sources or adopt a dynamic GTAP model to include data of multiple years in the analysis. Second, assessment of the impact of the RCEP is limited to trade patterns in this study. Given the labor-intensive nature of the apparel sector, future studies can continue to investigate the employment impact of the RCEP, particularly in those developing Asian countries that are not members of the agreement, such as Bangladesh and Sri Lanka. Third, several new free trade agreements that involve RCEP members might take effect in the coming years, such as the EU-Vietnam free trade agreement (EVFTA) and the updated version of the Trans-Pacific Partnership that excludes the USA (TPP11) (William and Fergusson 2017). It could be interesting to investigate further how EVFTA, TPP11, and RCEP jointly might affect the current pattern of T&A trade and regional T&A supply chain collaboration on a broader global scale.

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Chapter 3
Sustainability Issues in Asian Fashion Supply Chains: Retailers Versus Suppliers

Ceren Altuntas Vural

1 Introduction

Since its wide recognition after the Brundtland Report (WCED 1987), sustainability has become a both international and national policy that is reflected to business world being the engine of growth in many economies today (Altuntas 2013). Sustainability has proved to be a necessity more than a trend for especially global business. Today, organizations from a diverse set of industries try to tackle with sustainability problems, analyze their existing unsustainable operations, make efforts to develop sustainable ones, and also extend this effort both upstream and downstream in their supply chains. Stakeholders become more and more aware of the sustainability issues prevalent in these chains, and mostly focal organizations are under spotlight for unsustainable practices in their supply chains (Meixell and Luoma 2015).

Stakeholder interest to fashion focal companies is even more intense. Fashion brands face a lot of challenges in terms of decreasing their negative impacts to the environment due to their production processes like beaching, washing, dying (Nagurney and Yu 2012). Furthermore, there are a lot of fashion brand owners like Nike (Spar and Burns 2000), H&M, GAP, Levi's (Ray and Peepercamp 2018) have been and still are under suspicion in terms of poor working conditions, child labor, and forced labor at their suppliers. Especially after the Rana Plaza crash in Bangladesh, it became so widely recognized that majority of the fashion business is now associated with these poor labor practices and negative societal outcomes.

From an economic perspective, fashion industry has a labor-intensive character where production and consumption are both geographically dispersed and segmented

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(Abernathy et al. 2004; Battaglia et al. 2014). Demand has increased significantly due to the population increase and fast fashion trend (Bhardwaj and Fairhurst 2010) that boosted production and consumption volumes by influencing the consumption frequency. Together with the globalization of supply chains, textiles manufacturing has moved to low-wage countries where environmental and social standards are also low (Khurana and Ricchetti 2016). Despite this segmented and dispersed structure, it is a tendency of fashion product customers like all others, to define the value of market offerings without differentiating between focal companies or suppliers (Seuring and Gold 2013). Consequently, customers perceive focal companies and brand owners as the responsible party for supply chain sustainability.

Although it is a widely acknowledged necessity that fashion supply chains should transform toward sustainability, it is not an easy task. Managing complex supply chains with high demand uncertainty and intense competition is already a challenge for sustainability (Perry and Towers 2013). In addition to that, different industries have different characteristics resulting in different sustainability priorities (Turker and Altuntas 2014). Even within the same industry, separate production segments might have different sustainability requirements. Fashion industry can be divided into two large segments composed of market-facing end with fashion retailers and upstream end with fashion suppliers ranging from raw materials to contract manufacturing. It might be of importance for better collaboration in the supply chain, to understand how supply chain sustainability is practiced by these two large segments in the industry. Such an effort might be especially important for the management of sustainability in the upper tiers and echelons (Wilhelm et al. 2016) of fashion supply chains.

Despite the interest in scholarly literature on sustainability in fashion and textiles, a specific focus on the differentiated sustainability demands of the industry is lacking. This chapter makes an attempt to address this void by exploring sustainable supply chain management (SSCM) practices in fashion retailers and fashion suppliers. The empirical evidence is collected from Turkey, a country that used to be one of the main textiles exporters prior to the release of China's quotas in 2005. Textiles and fashion products are still one of the most important export items of the country that tries to position itself also in the fashion retailing business. With its population of 80 million people, the country can make a good example for both a fashion demand and supply market from Asia.

The chapter starts with a literature review on SSCM with a special focus on the triple bottom line (3BL) approach. A framework is developed to reflect the existing sustainability issues in supply chains to fashion supply chains. Then, examples from fashion retailers and fashion suppliers are analyzed with respect to their sustainability practices related with supply chains. The results are discussed and recommendations for further scholarly research and practice are generated.

2 Literature Review

2.1 Sustainability in SCM Research

SSCM concept emerged from a perspective that introduced environmental and societal considerations into traditional supply chain management (SCM) that focuses solely on economic performance. This was a natural result of the diffusion of sustainability policies to business world that is responsible from the growth in many economies today. Corporate sustainability started to gain importance and individual organizations undertook initiatives to become sustainable. However, as organizations moved from vertically integrated forms that perform all processes internally to multi-organizational networks working with many suppliers and customers to deliver value, sustainability implications diffused to a larger extent (Andersen and Skjoett-Larsen 2009). In a world where all businesses are connected to others for the successful production, delivery or collection of their market offerings it was soon acknowledged that true sustainability could only be achieved by the alignment of sustainability goals and practices through supply chains.

Although there are different definitions of SSCM, the common notion in many of those is the integration of environmental, social, and economic goals in a harmony with the existing business processes among the coordinated parties in supply chains. In particular, SSCM covers processes associated with procurement, production, distribution (Ahi and Searcy 2013), and even return (Halldórsson et al. 2009) of material, information and capital flows among supply chain members (Seuring and Müller 2008). It requires managing risks to avoid disruptions, achieving transparency for better supplier management and integrating sustainability into supply chain organization's culture and strategic approach (Carter and Rogers 2008).

The scope of SSCM is considered to be twofold, and the first part focuses on sustainable products and the second part focuses on risk avoidance and performance management (Seuring and Müller 2008; Turker and Altuntas 2014). It is essential to manage the products' life cycle in order to produce sustainable market offerings together with the members in the supply chain. For avoiding risks and managing the performance, it is essential to focus on processes and find out ways for performing them in a more sustainable way.

Part of the existing SSCM literature focuses on how to produce sustainable products throughout the supply chain (Maxwell and van der Vorst 2003; Maxwell et al. 2006; Seuring 2011). Another part studies on supplier selection for SSCM (Reuter et al. 2012; Bai and Sarkis 2010; Govindan et al. 2013) and management of these suppliers (Foerstl et al. 2010; Reuter et al. 2010) especially with the help of codes of conduct (Ciliberti et al. 2008; Egels-Zandén 2014; Porteous et al. 2015). With the motivation to understand the impact of sustainability on supply chain performance, there are studies focusing on metric development and performance measurement (e.g., Hassini et al. 2012; Hutchins and Sutherland 2008; Schaltegger and Burritt 2014) where another part of the literature focuses on the antecedents of SSCM such

as drivers (Seuring and Müller 2008), enablers (Diabat et al. 2014), barriers (Seuring and Müller 2008), resources and capabilities (Gold et al. 2010; Beske 2012).

Besides these efforts, a significant part of the literature conducts case analyses (e.g., Pagell and Wu 2009) or in-depth analyses in specific industries like food (e.g., Beske et al. 2014); automotive (e.g., Koplin et al. 2007); electrics and electronics (e.g., Wittstruck and Teuteberg 2012), fashion and textiles (e.g., Turker and Altuntas 2014). The reason to look into specific industries is that the sustainability requirements may differ with respect to the supply chains they integrate with. One can observe this with the wide diversification of codes of conduct and standards among different industries. Therefore, an industrial focus could be considered useful in analyzing sustainability issues in supply chains. This study focuses in fashion industry and divides the industry even further in itself. The study acknowledges differences between the market-end of the industry and the raw material-end and tries to explore sustainability issues in those two ends with a 3BL approach.

2.2 SSCM with a 3BL Approach

Supply chains are conceptualized in the form of vertically integrated organizations that work under obligatory contracts (Ellram 1991) or networks of organizations that take part in value production activities in upstream and downstream linkages (Christopher 2005) that aim business process integration (Cooper et al. 1997) and increased performance of the supply chain as a whole (Mentzer et al. 2001). SSCM requires taking goals from three dimensions of sustainability, namely economy, environment, and society while achieving the coordination and flow through supply chains (Seuring and Müller 2008). These three dimensions are referred as 3BL (Elkington 1998) and are required to be managed in a balanced way in order to achieve sustainability.

Economic dimension of sustainability refers to an organization's ability to continue profiting in the long-term while managing its financial, tangible, and intangible capital in an effective manner (Dyllick and Hockerts 2002). Economic sustainability is defined as "an organisation's impacts on the economic circumstances of its stakeholders and on economic systems at the local, national and global levels" (GRI 201 2016) so its focus is not solely on the shareholders but stakeholders at a larger extent. Furthermore, it is about the economic health and viability of organizations and supply chain so economic sustainability indicators have an internal focus but the economic activity has external results which affect the socioeconomic environment that are considered as indicators for social sustainability (Labuschagne et al. 2005).

Environmental sustainability is a widely studied part of the literature especially due to institutional pressures from government bodies and also cost-saving opportunities as a result of environmentally efficient operations management. Environmentally sustainable supply chains (or green supply chains) are studied by integrating environmental thinking into different stages of SCM like product design, material selection and sourcing, production, distribution and end of life management (Srivastava 2007).

At all these stages, supply chains are required to focus on reducing resource consumption, minimizing waste and emission production, avoiding negative impacts on eco-systems (Dyllick and Hockerts 2002), and minimizing the footprint of their operations (Gimenez et al. 2012).

Social sustainability refers to the businesses' impacts on social systems and their relationships with stakeholders (Labuschagne et al. 2005). Among these stakeholders there are employees, customers, suppliers, external community, and society at large. Among the most frequently mentioned social sustainability issues are working, health and safety conditions, respect to diversity and human rights, social responsibility, community development and investment in employees (Wang and Lin 2007). These issues should be managed through all life cycle stages of market offerings (Hutchins and Sutherland 2008) which requires a supply chain focus both upstream and downstream.

Managing the facets of 3BL is not an easy task though, especially for organizations that are used to perform with economic goals and with competitiveness considerations. Therefore, a considerable amount of scholarly research focuses on the economic outcomes of sustainability or, in other words, if it pays to be sustainable (Golicic and Smith 2013). Also there are important studies that underline the primacy of profits before the other dimensions of sustainability like the corporate social responsibility (CSR) pyramid of Carroll (1979) or SSCM review of Carter and Rogers (2008). The dominant approach in SSCM tries to emphasize that focusing on environmental and social goals won't result in loss of profits (Walley and Whitehead 1994); oppositely it will increase the economic performance.

Gaining their importance after the economic pillar, environmental and social pillars are generally treated as issues to be aligned with (Halldórsson et al. 2009) existing SCM practices focusing on economic performance. Managing the supply chains in a sustainable way requires the minimization of environmental impact and maximization of social welfare while maximizing supply chain's profitability (Hassini et al. 2012). Or at best, supply chains that maximize performance at all three pillars of sustainability will be better of in economic terms with respect to supply chains that focus on only one or two of the pillars (Carter and Rogers 2008).

Majority of the 3BL conceptualizations with respect to supply chains configure these three pillars in the form of Venn diagrams and point the intersection of all three sets as the optimum area for successful SSCM. An alternative perspective takes a subset approach to the three pillars and points the environment as an inclusive set that covers both pillars and society as an inclusive set that covers the economy (Giddings et al. 2002). Such an approach triggers the thoughts about how critical are the environment and society for the long-term survival of the economy. In addition to that, SSCM requires attention to a multiple set of stakeholders whose interest in the supply chain's actions are not only related with its economic performance but more with environmental or social performance (Pagell and Shevchenko 2014). Also there are examples of supply chains that try to define their performance beyond economic success but on social and environmental success (Wu and Pagell 2011). Therefore, it is considered that a holistic perspective to the 3BL approach should require a balanced sustainability performance for supply chains.

Furthermore, a significant part of the SSCM literature is focusing on the environmental pillar (Seuring and Müller 2008) or green supply chain management (GSCM) (Srivastava 2007). Research on the social dimension lacks the required attention (Hutchins and Sutherland 2008) creating a biased distribution of scientific interest toward either the economic or environmental pillars. However, a true and successful adoption of 3BL approach would require intention from the supply chain to keep the traditional business goal of making profits and avoiding loss but also performing high on the dimensions of society and the environment (Pagell and Wu 2009).

Research on fashion supply chains is mostly focused on the social dimension of 3BL due to the industry's labor-intensive nature, but environmental pillar is gaining importance recently due to the industry's consumption of non-renewable resources and focus on organic raw materials. The economic pillar has always been important especially after the transfer of production to low-wage countries but recognition of high profits at advanced economies. Therefore, analyzing sustainability issues in fashion supply chains with a 3BL focus could point out main topic areas to deal with in the industry's sustainability journey.

2.3 3BL Framework for Fashion Supply Chains

Sustainability issues in fashion supply chains are highly dependent on certain characteristics of the industry. The sourcing and manufacturing part of the industry is blamed significantly because of poor working conditions, lack of workplace safety, issues like child labor or forced labor (Ichimura 2011; Viederman 2014) and majority of this manufacturing takes place in Asia. Also the industry is dependent on chemical materials and non-renewable resources like land and water (Lakhal et al. 2008). Furthermore, the industry has a quick time-to-market character where delivery times are frequent and order batches are small (De Brito et al. 2008) which causes a high demand on fast transportation services.

Although there are efforts to develop metrics for measuring sustainability in the supply chain, achieving a holistic and generic list is quite challenging. However, 3BL approach provides a useful framework to differentiate between different areas to focus and manage sustainability in different parts. Table 3.1 tries to list sustainability issues in the supply chain with a 3BL framework based on the existing literature (the first column) and reflects these issues on fashion supply chains. The reflection is based on a compilation of literature, practice (like NGO reports, news), and previous research. Such a reflection is assumed to answer how current sustainability issues in SCM are reflected in fashion supply chains.

Fashion supply chains were one of the first industries facing sustainability challenges since the child labor scandal that was revealed in Nike's supply chain in 1990s (Spar and Burns 2000). Since then, the industry kept being criticized because of poor working conditions and lack of environmental measures at suppliers particularly located in Asian emerging economies. According to Eurostat (2012), Bangladesh, China and India are the world's largest three textile and apparel exporting nations to

Table 3.1 Sustainability issues in supply chains

	Supply chains	Fashion supply chains
Economy (GRI 200; Wang and Lin 2007; Harms et al. 2013; Gimenez et al. 2012; Govindan et al. 2013; Taticchi et al. 2015)	Supplier reliability Quality assurance Cost reduction Customer loyalty Innovation potential Financial capital Shareholder value Increased returns Tangible assets Intangible assets Reuse, recycle, return Anti-corruption	Relocation of labor Valuable brand names High innovation potential Highly competitive market Labor-intensive Quick turnover
Environment (Srivastava 2007; Harms et al. 2013; Gimenez et al. 2012; Govindan et al. 2013; Taticchi et al. 2015)	Waste reduction and management Pollution prevention Eco-design Reduction of negative impacts on the environment Use of materials and resources Biodiversity Product stewardship Reuse, recycle, return	Cotton production Water pollution Chemical dependence Land pollution Toxic waste production By product-related waste High transportation and logistics demands Reuse, recycle, return opportunities
Society (Harms et al. 2013; Gimenez et al. 2012; Govindan et al. 2013; Taticchi et al. 2015; GRI 400)	Working conditions Diversity in work force Freedom of association Human rights Increased positive impact on society Customer health, safety, and privacy	Child labor Forced labor Lack of unionization rights Lack of workplace safety Social responsibility campaigns Consumer influence

Europe and the industry was shocked once again in 2013 with the collapse of Rana Plaza in Bangladesh, the deadliest accident in fashion industry. The common setting in these scandals and many more that have been revealed during the last decades were the supplier or subcontractor facilities located in Asian countries that produce for well-known Western fashion brands. One can't ignore that sustainability in fashion industry is not possible without assuring sustainability in the industry's supply chain.

The social issues in the fashion supply chains are mostly attributed to their long, complex, and highly segmented nature. The suppliers of main fashion brands are composed of multiple tiers (Jacobs 2006), and the manufacturing processes of finished garments are divided between multi-tier subcontractors that are in charge of weaving, knitting, dying, stitching, ironing, printing, or embroidering (Caniato et al. 2012). These subcontractors are generally composed of small-scale organizations that can conduct business with unrecorded economic activities and without complying with many regulations. They are hard to trace, unlikely to be visible in many

fashion supply chains which are highly globalized. Such a structure leaves room for mispractice in labor management, safety issues, and human rights.

The most frequently observed social sustainability issues in fashion industry are related with child labor and forced labor (Smestadt 2010; Winter and Lasch 2016; Diabat et al. 2014). Such an outcome is related with both the characteristics of the work force that is composed of mostly low-educated women from rural areas that lack the required bargaining power against employers (Khurana and Ricchetti 2016) and the institutional structure that lacks the regulations to protect workers' rights in emerging nations where majority of production takes place (Howard-Hassmann 2005). In addition to that, the industry is associated with a lot of unethical working practices at production sites (Barnes and Lea-Greenwood 2006) like poor wage levels that are frequently disrupted, lack of respect to unionization rights, lack of workplace safety, and negative impacts of production processes on worker health.

Although the social aspect of sustainability is highly linked with one category of stakeholders, i.e., employees, the industry is also blamed for its negative impact on fashion consumers. The creation and communication of an ideal beauty image causing eating disorders (Khurana and Ricchetti 2016) and the encouragement of continuous consumption especially with the fast fashion wave (Turker and Altuntas 2014) are criticized by consumer societies and non-governmental organizations (NGOs).

Together with the increased consumption of especially fast fashion products, questions started to be raised about the waste production, resource consumption, and impact on pollution by the industry. The ultimate fashion supply chain is composed of chemical industry, textiles industry composed of fiber, thread, fabric, apparel industry, retail industry, recycling industry, service providers, and other non-conventional textiles applications (EURATEX 2014). The environmental impact of the fashion supply chain is mostly attributed to the textiles sector due to land pollution, natural resource consumption, use of toxic chemicals (Kant 2012). The impact of the retailing sector is mostly due to (i) geographically dispersed nature of the industry (Bonacich et al. 1994) and (ii) short lead times and small batch sizes of fast fashion segment and their impact on the transportation demand (Saicheua et al. 2012). In order to deliver within the fastest time possible, fashion products are mostly transported by air causing high CO_2 emissions (Turker and Altuntas 2014).

The industry's environmental impact is also significant after retailing. Most of the water consumption and pollution takes place during the maintenance processes of these products by consumers. In addition, the effort of fast fashion producers to lead consumer preferences and change them frequently results in an increased amount of textiles waste to be reused, returned, or recycled (Khurana and Ricchetti 2016).

From an economic perspective, the industry caused loss of many jobs in Europe to Asia due to relocation of manufacturing (Bonacich et al. 1994) and is a significant source of employment in Asian emerging economies. However, with the exception of the luxury segment, the fashion industry is considered to be a low-value manufacturing industry (Ho and Choi 2012) especially due to the intense price-based competition in fast fashion segment. But still the innovation potential is high and European fashion producers try to seize the technology and innovation side of the

industry with new techniques, design and high-skilled labor (De Brito et al. 2008). There are many valuable brand names that have strong intangible assets which they need to protect against unsustainable practices in their supply chains.

Issues on the economic pillar of sustainability for fashion industry also focus on the economic impacts of the other two pillars. There are contradicting views and research results about the direction of the relationship between social and environmental sustainability and economic performance. But for the fashion industry where brand names are very valuable, it is suggested that if sustainability efforts can be used for innovation, better quality products, and ethical manufacturing practices, then the stakeholder value is expected to increase (Khurana and Ricchetti 2016). The cost dimension and where its burden is passed on in the supply chain are important questions.

There are some organizations that externalize sustainability issues and claim the responsibility to others, but other groups of fashion companies internalize and try to find better ways of doing business (De Brito et al. 2008). Passing the sustainability burden onto suppliers is a short-term measure which in practice does not seem to achieve the ultimate aim of SSCM. In fashion industry, there are many failure examples about supplier compliance to buyer-led standards and programs (Perry and Towers 2013). This might be due to the perceived lack of distributive justice in sustainability requirements, rewards, and costs as many suppliers see audits, training, sustainability investments as costs which the buyers don't accept to reflect in the traditional exchange (Normann et al. 2017). Such a situation causes sustainability a burden or a fad for fashion suppliers and causes ignorance, lack of attention, compliance with minimums, and a barrier for a truly sustainable fashion supply chain. Inability to build a sustainable supply chain might cause bad reputation, brand name deterioration, and loss in market share and potential revenues as evidence shows that fashion customers are eager to buy sustainable products and ready to pay a premium if the quality level is satisfying (Shen et al. 2012).

Organizations located at different sectors of the fashion industry try to tackle with sustainability problems in various ways. The most common tools used by fashion brands are international standards, codes of conduct, or third-party audits (Aßländer et al. 2016) but these tools haven't proved to be effective for achieving good sustainability results (Welford and Frost 2006). Even if they produce positive results for the first-tier suppliers, the visibility diminishes at the upper tiers where most of the misconduct is observed. The suppliers of the industry try to compete under strong price pressure and at the same time comply with required sustainability norms. However, research shows that although sustainability compliance is an important criterion in fashion supplier evaluation, it is not significant in supplier selection (Winter and Lasch 2016). Bearing on costs rising from sustainability demands result in loss of business for many Asian companies (Chi 2011).

While the sustainability of an organization cannot be more than the sustainability of its supply chain (Krause et al. 2009), the sustainability practices focused and communicated by different tiers in the fashion supply chains vary. Fashion retailers are mostly the brand owners that are exposed to unsustainability claims by consumer markets. Textiles organizations are the suppliers of fiber, fabric and apparels who

work between upper tier suppliers and fashion brand retailers. For a sustainable supply chain a harmony is expected among the SSCM practices undertaken by these organizations as they operate in the same supply chains most of the time. Next chapter seeks response to the harmony question and tries to explore the SSCM practices by fashion brand retailers and fashion product suppliers by investigating corporate reports of companies from Turkey.

3 Sustainability in Fashion Retailing Versus Fashion Supply: Examples from Turkey

Turkey, a country that used to be one of the major textiles exporters to Europe, has lost its competitiveness after the removal of trade barriers in the industry. However, geographical proximity of the country to Europe still acts as an advantage and Turkish textiles industry is still one of the most important industries for the country. Besides the export-oriented textiles and apparel manufacturing, a strong fashion brand retailing industry has been developed to seize the demand from a large and young population of consumers. So the country is both a supplier of textiles and apparels for Western fashion brands and a buyer for Asian textiles exporters.

Sustainability has been labeled as one of the main strategies for the fashion industry by the Ministry of Science, Industry and Technology in the strategy document and action plan for 2015–2018 (MSIT 2018). The document underlines the role of sustainability that could enhance competitiveness for Turkish fashion product exporters in world fashion markets. The industry acknowledges the importance of sustainability trends gaining pace in consumer markets together with the recognition of slow fashion movements (TCMA 2016). Sensitivity to climate change, substitution of cotton with new technologies, reduction of water dependent raw materials, carbon footprint monitoring are among the sustainability issues for supply markets. Trends like recycling, development of second-hand markets, local design and distribution, circular economy collection sharing in the fashion consumer markets will be influential on shaping the sustainability actions of fashion retailers.

Fortune Turkey 500 list is used for selecting a sample to explore sustainability initiatives. A total of 37 fashion companies of which 8 were fashion retailers and 29 were textiles producers were listed. For a comparison, highest ranking 8 companies from the second group were selected. Their corporate Web sites were visited for sustainability reports. If there were no sustainability reports or any other related document, then the Web site content was analyzed. The corporate sustainability efforts were not analyzed in-depth to keep the focus on supply chain. The main purpose was to identify sustainability issues related with supply chains. Table 3.2 exhibits the results of the analysis.

The results provide some examples for the differences between sustainability practices of fashion retailers and textiles suppliers in Turkey. All the listed companies have an international orientation. Retailers, having a wide network in the domestic

Table 3.2 Fashion Retailers versus Textiles Suppliers

	R/W[a]	Sust. issues	General notes		R/W	Sust. issues	General notes
R1	R	*Economic* contribution to employment, risk management, capacity utilization monitoring *Environment* recycled paper in labels, water reduction at supplier processes, using fabric waste for manufacturing, organic cotton *Social* business ethics, workplace safety, human rights, child labor, forced labor, illegal employment of immigrant labor, customer health	GC principles, Global Supplier Commitment document, focus on second-tier suppliers, explicit responsibility of SCM on supplier sustainability, supplier evaluation, supplier training and development, supplier satisfaction, SEDEX auditing for suppliers, supply management school, supplier development portal, trainings for subcontractors at second tier	T1	W	Supplier evaluation Availability of international standards ISO 18001 and ISO 14001	Corporate sustainability oriented, focused on own production and materials, SSCM based on supplier evaluation on quality basis. Social and environmental issues are monitored through standards
R2	W	N/A	Emphasis on employees, freedom of association, CSR Campaigns on reuse and redistribution	T2	R	Human rights Labor Environment Anti-corruption	Corporate sustainability oriented, suppliers are indirectly mentioned, supplier monitoring, main suppliers also signed GC, subject to SEDEX or BSCI audits
R3	W	N/A	Emphasis on employees and customer expectations CSR Campaigns Emphasis on business ethics, respect to environment and social responsibility consciousness	T3	R	Human rights Labor Environment Anti-corruption	
R4	R	N/A	Emphasis on the close cooperation of suppliers, distributors, and the company	T4	N/A	N/A	N/A

(continued)

Table 3.2 (continued)

	R/W[a]	Sust. issues	General notes		R/W	Sust. issues	General notes
R5	R	*Economic* Transparency, payments, working hours (compliance to local regulations), documentation *Environment* Waste management, resource reduction, calculation of water, carbon and chemical footprint, compliance to local regulations *Social* Child labor, forced labor, workplace safety for buildings, fire, electricity and machinery, discrimination, human rights, right of association, employee health, customer health		T5	R	Better Cotton Initiative and supplier contribution	Externally dependent on raw material supply. Corporate sustainability oriented
R6	N/A			T6	R	Supplier monitoring and evaluation based on SA 8000 requirements	SA 8000, supplier to Nike Tommy Hilfiger and Inditex
R7	N/A			T7	W	Slight focus on value chain	Corporate sustainability focus, waste, recycling and CSR campaigns
R8	N/A			T8	W	Supplier compliance to company quality and environment requirements	Corporate sustainability focus Single pillar: environment

[a]Report or Web site

market, sell also to foreign markets through various distribution channels but with own brands. Suppliers produce both for domestic and international markets, but their major markets are the latter.

In most of the examples, the reports or Web sites contained general statements about suppliers and supply chain which comply to international standards and certification. Such statements are required to be documented in order to get an internationally recognized certificate. Majority of the companies are focused on their corporate sustainability and CSR campaigns. Even if they conduct highly sophisticated sustainability practices, for their supply chains their efforts are limited with supplier evaluation and monitoring in general. There are few examples that work in-depth on supply chain sustainability and even with a TBL perspective.

Transparency in the supply chain and especially compliance with local regulations to working hours, payments are among important economic sustainability issues indicated by retailers. Besides these, capacity utilization at supplier facilities, managing sustainability risks at suppliers, and contribution to employment by the whole supply chain are also mentioned as the indicators for economic sustainability.

Water usage in the production processes of textiles products is one of the frequently mentioned environmental sustainability problems for the supply chains. Also, the water discharge that takes place after specific processes is causing pollution and needs to be controlled. One of the retailers developed a process innovation for dry finishing of garments and introduced the new process at supplier facilities. Such activities decrease the environmental impact of the whole supply chain.

Recycling of old clothes or scrap products for new products, organic cotton initiatives in the supply chain are among other environmental practices. In addition to these, the production processes of fashion products cause a significant amount of fabric waste. One of the companies started to use fabric waste as an input for new products and encouraged suppliers to use fabric waste while producing their orders.

Social issues mentioned in the reports or Web sites are congruent with the sensitive issues in fashion markets such as child labor, workplace conditions, human rights and rights to association at suppliers. One interesting issue is about the forced and illegal immigrant labor at suppliers. Turkey has been affected significantly from the war at its borders which caused a lot of migration to the country. One of the social consequences was the illegal employment of this population and this is also a social risk for the fashion industry.

Despite it was only two examples, a TBL approach to SSCM could be observed at fashion retailers. However, such an approach was missing at textiles suppliers. Although some of them adopted a TBL approach to sustainability, this was only at the corporate level. Supply chain sustainability for the sourcing market is mostly about evaluating and monitoring suppliers as the codes of conducts that they have to comply require them to do.

All of the textiles suppliers are working with global brands and their communications focused on innovation and quality. Environmental and social issues are listed and addressed thoroughly in several examples but again at the corporate level. Practices related with the supply chain are audits and evaluation principles. Companies who have signed Global Compact use the four main principles to underline

the criteria for supplier evaluation but don't provide specific information on SSCM practices.

The findings show that retailers are focused on design, sales, and reputation most of the time. However, a few of them have started to diffuse corporate sustainability to their supply chains and try to adopt SSCM practices. One of the examples have extended the scope to second tier suppliers and try to monitor, train, and improve their sustainability practices as well. But such an approach is lacking at textiles suppliers. Their basic relationship with sustainability is compliance which is understandable because they are the suppliers of many global fashion supply chains. In order to maintain their position, they have to comply with the sustainability rules imposed by their customers. But if they can extend these practices to their supply chains, the sustainability performance of the whole chain is expected to increase.

One other important finding is the lack of logistics component in the SSCM practices of selected companies. None of the selected organizations referred to sustainability in transportation, warehousing, or handling processes. However, especially transportation is a significant aspect of fashion supply chains where time to market is always critical. The lack of focus indicates that SSCM is defined with a manufacturing perspective. Logistics perspective is one of the areas that require improvement.

4 Conclusion

To summarize, sustainability is no longer a luxury for fashion supply chains but it is more of a requirement. Asian fashion supply chains operate as the sourcing markets for Western brands but recently fashion retailers born in these markets started to gain international visibility. Selling to an international customer base, fashion retailers in Asia need to focus on sustainability practices as consumers might have a significant impact on profits through their sustainability consciousness and favor more sustainable rivals (Nagurney and Yu 2012). Nevertheless, they can't be more sustainable than their supply chains.

Besides fashion retailers, the textiles producers in Asia have an important role in assuring and monitoring sustainability in the supply chain. They are the intermediaries between focal organizations and second, third, or nth tier of suppliers. Adopting a SSCM approach would ease the monitoring process of the whole chain by the focal organization and increase the sustainability for all.

The most critical sustainability issues for fashion supply chains are developing new production processes to reduce the industry's dependence on land and water, redesigning the supply chains with a circular perspective, innovating for better use of resources, monitoring to eliminate child labor, forced labor, poor treatment, and poor workplace conditions at suppliers. There is a growing customer segment composed of eco-conscious consumers who don't focus only on design and price but more on the materials, manufacturing processes and the supply chains of products they buy (Cervellon and Wernerfelt 2012). The more organizations know and control their supply chains, the more they can satisfy the knowledge demands of these customer

segments. But this is not the task of a single organization, so-called the focal company. Adopting and diffusing SSCM practices are duties of all parties in fashion supply chains.

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Chapter 4
Cashmere Value Chain in China

Qingliang Gu and Bin Shen

1 Introduction

Cashmere products were worn by the rich customers, but now are much more accpeted by mass consumers. As a result, the market demand of cashmere products is much larger than before. China, the largest producer of cashmere in the world, has greatly contributed to enlarging supply and meeting the customer demand (Waldron et al. 2014).

Cashmere is an important sector in the textile and apparel industry in China (Waldron et al. 2014). The cashmere fiber and products show unique attributes and have great values in the world market. China is the largest producer and exporter of cashmere products, and a big potential consumer in the world (Brown et al. 2005). The production of raw cashmere in China is about 15,000–16,000 t, 72% of the world total, and the import is 6500 t annually (Waldron et al. 2014).

The cashmere industry is driven by both supply and demand. China is the largest producer of cashmere yarns, fabrics, and fashion goods. The industry imported large percentage of world raw and semi-processed cashmere as shown in Tables 4.1 and 4.2. Both tables show that the total net consumption is increasing during the period of 2006–2014, which implies that the capacity of cashmere industry is gradually expanding. Furthermore, less export of raw cashmere means that the industry has focused on the value-added sector of production chain in China.

This paper is based on the first author's project "Pashmina enhancement and trade support project" for International Trade Center.

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Table 4.1 China net consumption of cashmere in weight in 2006–2014

Year	World imp. (t)	China imp. (t)	Proportion (%)	China production (t)	China exp. (t)	China net consumption (t)
2006	27,536	6278	23	16,395	7003	19,418
2007	25,692	7245	28	18,483	6315	22,653
2008	24,220	6225	26	17,184	5066	20,988
2009	25,966	8932	34	16,964	4086	23,771
2010	31,055	12,981	42	18,518	5624	28,759
2011	29,857	11,107	37	17,989	6007	26,604
2012	23,226	9941	43	18,021	4814	25,620
2013	25,900	10,645	41	18,114	4919	25,915
2014	28,060	12,178	43	19,278	4323	29,082

Source UN International Trade Database
HS Code: 510211; 510219; 510531; 510539
The total industry consumption for the purpose of producing cashmere goods (industry for yarns, fabrics, sweaters, scarves, etc.) could be calculated according to the following equation
Net consumption = domestic production + import − export

Table 4.2 China net consumption of cashmere in value and weight in 2006–2014

Year	Net consumption in value ($)	Net consumption in weight (t)	Average price ($/t)	Growth rate in value (%)	Growth rate in weight (%)
2006	501,077,883	19,418	25,804	/	/
2007	610,472,234	22,653	26,949	22	17
2008	533,560,377	20,988	25,423	−13	−7
2009	397,438,290	23,771	16,719	−26	13
2010	626,102,506	28,759	21,771	58	21
2011	729,830,432	26,604	27,433	17	−7
2012	758,457,025	25,620	29,604	4	−4
2013	811,820,887	25,915	31,327	7	1
2014	883,032,329	29,082	30,364	9	12

Source UN International Trade Database
HS Code: 510211; 510219; 510531; 510539

China is the giant producer and exporter of cashmere in the world. According to the latest data from National Bureau of Statistics of China, there are about 2600 cashmere related firms and produces 75% of the world's cashere products (Towers et al. 2013). To satisfy the international market, Chinese processors used to keep close eyes on international cashmere trend, but now domestic market as well, which has rapid growth at present.

In this paper, the Chinese cashmere value chain is examined. The value chain structure of cashmere sourcing and processing of raw material, spinning, weaving, knitting, and sewing is discussed. The objectives of this study are (1) to understand the Chinese cashmere value chain structure, (2) to identify the industry structure from supply of raw material to production of finished goods, and (3) to introduce the successful cashmere retailers in China and identify how Chinese retailers develop, design, and produce the premium cashmere products.

The rest of this study is organized as follows: Section 2 reviews the cashmere value chain structure in China. Section 3 conducts the case discussion on Chinese cashmere brands. Section 4 proposes challenges and problems in Chinese cashmere industry. Section 5 concludes our study.

2 The Cashmere Value Chain Structure in China

The value chain of the cashmere is quite complex. The value chain of cashmere can be generally classified into the following steps: (1) The cashmere material is collected from goats which are raised by farmer; (2) After collection, cashmere materials need to be selected according to the various quality and standards; (3) The selected cashmere is sold to the dealers who would resell it to the processors (it may be relevant to various parties with informal/formal contracts); (4) After the cashmere is delivered to the factories of processors, it firstly has a preliminary processing which includes abstersion, carding, and dehair; (5) Designers design cashmere products and merchandizing planning; (6) It goes through processing, including spinning, knitting and tatting, and sewing; (7) The cashmere sweaters arrive at stores and are sold by retailers to the final consumers; and (8) If cashmere products are difficult to wash and maintain, after-sales services help retailers to enhance consumer satisfaction (Fig. 4.1).

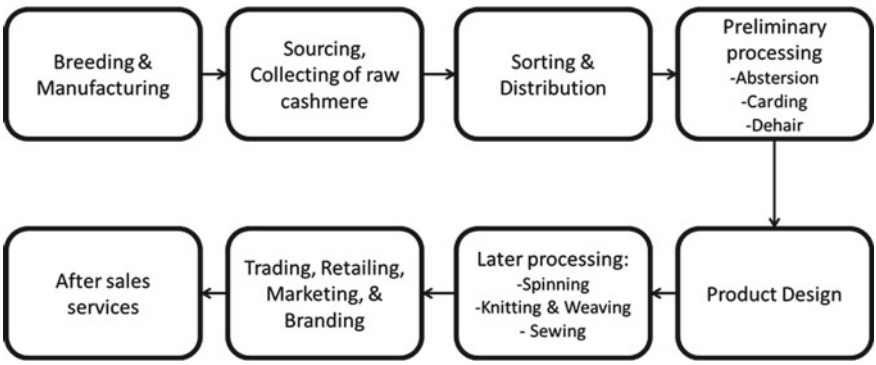

Fig. 4.1 Cashmere value chain

Many Chinese cashmere companies have responded to the Chinese government's "One Belt One Road" intiative. For example, in 2009, Zhongyin, the major player of cashmere in China bought Todd & Duncan, the cashmere spinning subsidiary of the mainstay in Scotland, UK. Moreover, Zhongyin moves out of mass production capacity and sets up factories overseas.

China's cashmere industry plays an important role in the world market. However, as world economy recesses, the export declines consequently, and selling cashmere products in domestic market is also increasingly tough. Besides Erdos, many Chinese cashmere companies have registered brands such as Luwang (King Deer), Weixin (Viction), Shengxuerong (St. Edenw), Xuelian (Snow Lotus). At present, the China cashmere industry not only holds the international market tightly, but also takes the domestic market very seriously (Lightfoot and Cohen 2008). Many firms claimed that the domestic market is more lucrative than the international one (Hume 2014).

Selling cashmere products is a good business and many fashion retailers start to sell cashmere products (Lightfoot and Cohen 2008). For example, Erdos has 1500 retail stores in China[1] (even in the train station such as Shanghai Hongqiao railway station). The price range of Erdos for pure cashmere products is from RMB 600 to more than RMB 5000 targeting segments with different sub-brands. Erdos used to be the medium-high cashmere brand in China, now it tends to extend its product line. Erdos now develops a high product line, called 1436. 1436 sells premium quality products with high prices.

However, it is important to note that the China domestic market is highly segmented. There are a lot of low-value cashmere products in market (Siegle 2014). Moreover, many products are claimed as cashmere one, but they are not exactly. Therefore, Chinese consumers are always concerned with the low quality cashmere which sometimes mislabeled as "cashmere" products (Waldron et al. 2014). In order to develop the cashmere industry to be healthy and sustainable, it is important to regulate the market, set up quality standard, and build brand image, industry reputation, and intellectual properties.

Cashmere industry is unique and special in China. Cashmere firms are located in western China, instead of eastern places. It is becasue western China is close to the raw materials. In central Inner Mongolia, there are a number of large, stand-long enterprises in Erdos (i.e., Erdos and Dongda), Linhe city (Viction), Hohhot, and Baotou (King Deer). In Ningxia, there is Cashmere Industrial Park Lingwu, which is on the outskirts of the capital city of Yinchuan, Ningxia (InvestHK 2015). However, the fine wool woven fabrics finished goods, especially the high-end fashion, are produced and assembled in southeast coastal area in China, for example, Ruyi Group, the largest suits and dress producer by fine worsted and woolen fabric located in Shandong; Youngor, the China's No. 1 menswear producer with vertically integration from spinning, weaving to sewing in Zhejiang province. Moreover, most giant companies and international brands have their departments of designing, marketing distribution, and trading in Shanghai. The domestic brands' headquarter may locate in Shenzhen, Hangzhou, Beijing, the regional fashion center in East China.

[1] In Erdos financial report, it shows there are 20 retail stores which are located out of China.

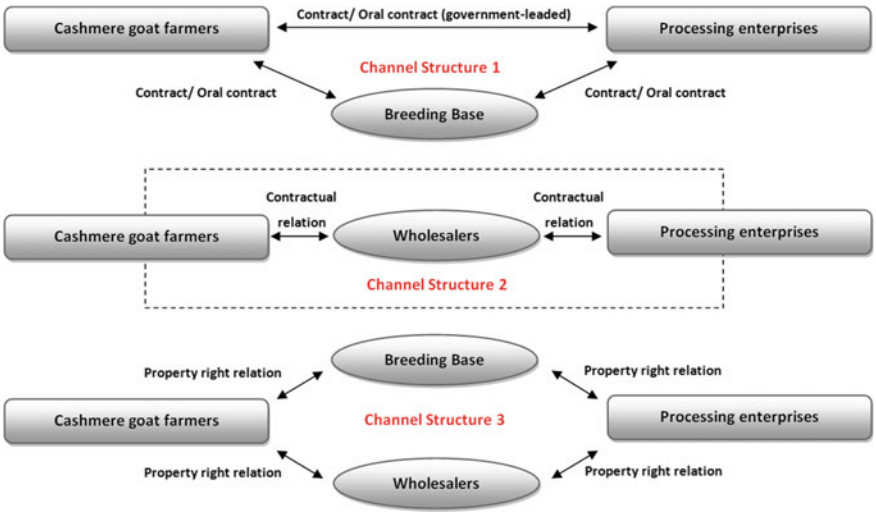

Fig. 4.2 Channel structure of cashmere supply

Cashmere processing is one of the few industries in which western China dominates the production in volume over the more developed and industrialized eastern regions. The most important advantages for mills in western China are their proximity to and familiarity with high-quality cashmere supplies. This contrasts with the worsted and woolen fabric sector that has almost entirely moved to eastern China because of buyers demands.

Clustering is the typical phenomenon of China textile industry. China cashmere industry can be classified into three types:

(1) The raw material market and manufacturing clusters developed from raw cashmere origin and distribution center, such as Erdos in Inner Mongolia, Qinghe in Hebei, and Lingwu in Ningxia, usually led by large cashmere companies.
(2) Industrial zones and wholesale markets gathered by many manufacturing SMEs in the form of "stores backed by factories," such as Puyuan sweater industrial park and Tongxiang sweater market in Jiaxing, Zhejiang province.
(3) Fashionable metropolises grouped by cashmere brand companies' fashion marketing, designing, trading, and retailing, such as Shanghai and Beijing.

There are three kinds of channel in China's cashmere distribution. For small-scale suppliers (Channel Structure 1), goat farmers are part of breeding base and then sell cashmere to processing enterprises. For medium-scale supplier (Channel Structure 2), goat farmers sell the cashmere to wholesalers, and then wholesalers sell to processing enterprises. For large-scale manufacturers, the processing enterprises lead the whole channel. The processing enterprises own breeding base, wholesalers, and farmers (Channel Structure 3) (Fig. 4.2).

Table 4.3 Key cashmere retailers in China

Brand and Company	Categories	Description
Erdos, King Deer, Zhenbei, Snow Lotus, Tianshan, Tuhuang	Cashmere sweaters and accessories	Top local manufacture brands specialized in cashmere
Cerruti 1881, Zegna, Armani, Hugo Boss, Burberry, Gieves & Hawkes	Sweater, coat, dress, suits of fashion brand	Overseas brands imported or local made
Cashmere Yung, Ducan	High-end brands	High-end brands, cooperate with local cashmere companies
Zara, Uniqlo, H&M	Casual and sweaters	Overseas retailers brands, fast fashion, local sourcing retailers
Ruyi, Youngor	Fabrics and menswear	Local manufacturer brands
Woo, Premium good	Scarves and accessories, tailored designand made	National brand boutique special VIP
Tongxiang wool sweater market	Low-end products; sweaters	Wholesale market

3 Cases Discussions

This case study was conducted using multiple research methods. First, the secondary data such as the publicly available statistics from the government and companies' annual reports were collected. Second, the administration of China National Textile and Apparel Council (CNTAC) was introduced and the clear picture of Chinese cashmere industry was gained. Third, investigation of the cashmere industry zones and the case study of key players in China were conducted. Furthermore, the factories and market conditions based on the information were summarized. Notice that the materials from these multiple sources were used for triangulation purpose which helped enhance the reliability of the findings. The case study discusses Chinese cashmere brands.

In this case study section, Chinese cashmere brands can be mainly classified into three categories in the domestic cashmere market, namely manufacturer brands, private retailers' brands, and luxury designer brands. In the Chinese cashmere market, the key players specialized in cashmere and wool sweaters and accessories include Erdos, King Deer, and Tianshan. These companies started their business with OEM, and exports usually account for a large proportion of their total revenue. Erdos is the No. 1 cashmere producer in China with better quality and higher price (Table 4.3).

Case 1 Woo: A High-End Customized Brand with Chinese Culture

Woo is a high-end brand founded by a Chinese intellectual using silk and cashmere as raw materials. The main products of Woo are scarves. The products are customized cashmere and silk accessories with price ranges from 2000 to 4000 RMB. Its target

customers are high-end elite female customers. The products are produced with China's top manufacturing techniques and special design, patterns, and color. The brand highlights customization, Chinese culture, or customer demand. The products are also used as diplomacy gifts and national marketing. The main sale channel of Woo is boutique. Woo has been the domestic high-end brand without any question.

Case 2 Jiayuan: The Upgrading Road of Cashmere Enterprises

Jiayuan is one of the largest cashmere manufacturers in China. It is an Original Equipment Manufacturer (OEM), producing for international brands. With the increase of labor cost in the manufacturing industry and decrease of international orders, RMB appreciation, and homogeneous competition at home, profitability of Jiayuan is also shrinking. To address the challenges and difficulties, on the one hand, Jiayuan Group carries out technological innovation by introducing advanced equipment and increasing R&D investment; on the other hand, Jiayuan Group makes an acquisition of European high-end brand Cashmere Yung (CY) to improve design intelligence, channel network, and brand reputation in market. Jiayuan Group not only consolidates and expands the international market, but also moves its strategic target to domestic market, and opens up the domestic outlets in high-end department stores in the central business district in Beijing and other first-tier cities.

4 Challenges and Problems in Chinese Cashmere Industry

To maintain its competitiveness in the world market, there are challenges and problems in the cashmere industry including quality and price stability, financing of SMEs, excessive inventory and capacity, and labor cost in the value chain.

– **Quality of Cashmere Products**

Product quality and adulterated products are crucial in cashmere industry. Cashmere products are expensive and selling cashmere products are profitable. To ensure product quality, the government has to launch the restrict grades, standards, laws to improve product quality and detect the adulterated products. Moreover, some organizations could launch the quality certifications in retailing.

– **Financing**

The cashmere industry is both capital and labor intensive. Large amount of money is needed for raw materials, work in process, and working capital. Firms have greatly financial pressure in recent years due to the low export prices, unstable RMB currency prices, and the intensive competition in domestic market. Most importantly, the price of cashmere is quite expensive. With unstable price of cashmere and higher risks in running business, it is important to manage the firms' cash flow, predict, and act to deal with uncertainties. The government should try to build up the supporting system to help the firms.

– **Heavy Inventory and Overcapacity**

Seasonal over-stock and markdown is the big problem in the cashmere industry. Cashmere products have long lead time due to its production process. Long lead time could lead to the high risk in product delay, overstocking, and overcapacity. Moreover, cashmere product is very seasonal. Only cold weather needs cashmere products. Thus, product seasonablity leads to the risk of high inventory and overcapacity. To better manage product inventory, the systematic inventory management is highly needed and critically important.

5 Conclusion

Cashmere is an important natural material in textile and apparel. Its high raw material cost lifts the price of cashmere products and naturally identifies the processors who must have sufficient capital. China is the largest producer and exporter of cashmere products, and a big potential consumer in the world. This paper provides a picture of cashmere value chain in China. Specifically, in this paper, cashmere value chain in China is discussed. Moreover, two famous Chinese cashmere brands Woo and Jiayuan are introduced. Both retailers are successful in designing, manufacturing and selling cashmere products. We can identify how these two brands develop their value chain. Last but not least, we propose challenges and problems in Chinese cashmere industry.

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Part II
Fashion Supply Chain Management Models

Chapter 5
Existence and Causes of Bullwhip Effect: An Empirical Study on a Designer Footwear Supply Chain

Hau-Ling Chan, Tsan-Ming Choi, Shuyun Ren, Bin Shen and Wing-Yee Wong

1 Introduction

Bullwhip effect relates to "demand amplification" and "variance amplification" in which the order variance to the supplier is larger than that of the buyer and the distortion is amplified from the downstream to the upstream in the supply chain context (Lee et al. 1997). This phenomenon has been identified in many different supply chains, such as Procter and Gamble's Pampers, Campbell's chicken noodle soup, and Barilla's pasta which create operational instability (Wang and Disney 2016). The existence of Bullwhip effect increases supply chain costs and reduces supply chain efficiency (Bray and Mendelson 2012).

It is well-known that bullwhip effect exists, particularly in the high demand variance industry such as fashion. Fashion industry is very important in terms of its high

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volume and sales figures. Demand and variance amplification plays an important role as lead time, order batch, and product types are critical in the fashion industry. In the designer fashion industry, lead time of time-to-market is about four months (Kuksov and Wang 2013). The question is whether the lead time influences the demand amplification in the supply chain context. In addition, order batching is another practical rule in the fashion supply chain. The suppliers usually require a minimum order quantity to guarantee that the buyer will order a quantity that can ensure its minimum profit. This order batch may influence demand amplification. Last but not the least, fashionable products have a higher degree of demand uncertainty (Fisher 1997), which leads to a higher chance of demand amplification. High heel shoes are one kind of fashionable products in the fashion industry (Guéguen 2015). The higher-height shoes are usually more fashionable. A natural question is raised: Whether the heights of shoes affect the demand amplification. In this paper, we aim to evaluate the impact of lead time, order batch, and product types on the bullwhip effect in the fashion industry.

Motivated by the fact that the bullwhip effect may exist in different markets and the fashion company may overlook this problem, this paper is developed to statistically identify the existence of this effect and the internal causes of bullwhip effect by changing the inventory classification decision. To be specific, this paper examines the existence and the causes of the bullwhip effect in the designer fashion supply chain. The real POS data was collected from a famous real designer footwear brand, artificially named as Brand Z. To the best of our knowledge, it is the first paper to investigate the bullwhip effect in fashion industry. Our major findings are as follows. First, we find that in the designer fashion supply chain, minimum order quantity is not significantly related to the bullwhip effect. Second, the statistical result shows that a longer lead time implies a larger degree of bullwhip effect (i.e. larger variance of demand variability). Third, the heights of shoes are positively related to bullwhip effect between the manufacturer and the Brand Z only. This implies that more fashionable products have a higher degree of bullwhip effect.

This paper is organized as follows. In Sect. 1, we introduce our study. We then review the relevant literature and develop the corresponding hypotheses in Sect. 2. In Sect. 3, we indicate the sampling process and present the data analysis. In Sect. 4, we reveal our findings and statistical testing results. Finally, we draw the conclusion and highlight the implication in Sect. 5.

2 Literature Review and Hypotheses Development

Bullwhip effect is no longer a new phenomenon. It has been well explored in the existing literature. The prior literature includes the existence, causes, and mitigation of the bullwhip effects. Sterman (1989) conducts an experiment called “Beer Distribution Game” to test the bullwhip effect phenomenon. The experiment is used to measure the change of order variances when it moves up in the supply chain. The result shows that the order variances are amplified when it moves up in the supply

chain which is caused by the irrational decision making of the player. Another early article about the bullwhip effect is Lee et al. (1997). They use an analytical approach to identify that demand signaling, order batching, fluctuating prices, and shortage game are the four major causes of bullwhip effect. Wang and Disney (2016) conduct a comprehensive review in the bullwhip effect in supply chain. The bullwhip effect has been examined by empirical, analytical, and experimental approaches. In this paper, we use the empirical approach to identify the existence and causes of bullwhip effect in the designer shoe brand.

This effect affects a company's profitability since demand fluctuations could hinder demand forecasting and inventory management of the upstream supplier. In addition, it also jeopardizes the inventory service level in which the designer brand should maintain a high level to satisfy the customer. Therefore, supply chain members will try to increase the inventory quantity by keeping more safety stocks to ensure there is sufficient supply to deal with the customer demand. Higher manufacturing cost, storage cost, and delivery cost are then incurred (Zotteri 2013). As a result, identifying bullwhip effect is critically important.

2.1 Effect of Order Lead Time

Lead time is defined as the duration between the time an order is placed and the time the order is available for satisfying customer demands (Stevenson 2017). It consists of different components such as order preparation time, order transiting time to supplier, supplier lead time (i.e., length of time when the supplier receives the order and ready for shipping the products), items transiting time from the supplier, and preparation time for availability. However, lead time is an uncontrollable factor and it requires the firm to pay additional costs to shorten it (Hua et al. 2015).

Chen et al. (2000) find that lead time is directly related to variability amplification, which means that a longer lead time will induce a bigger bullwhip effect. Therefore, shortening the lead time could reduce the variability amplification as well as the quantity of safety stock needed. By reviewing the historical demand data, a more accurate demand forecast could be generated. Order decision could be made by considering the lead time required to produce and to deliver the merchandise so as to support the forecasted sales. On the other hand, Li and O'brien (1999) study the bullwhip effect on a multi-stage supply chain and propose that a long lead time at the upstream activities can increase bullwhip effect at the next stage. Oppositely, a long lead time at the downstream activities can alleviate the bullwhip effect. Chatfield et al. (2004) further study the effect of lead times under different information sharing policies on bullwhip effect. Based on the reviewed literature related to lead time and bullwhip effect, we present a hypothesis as below:

Hypothesis 1 A longer order lead time yield a higher level of bullwhip effect.

2.2 Effect of Minimum Order Quantity

Apart from lead time, order batching is another major cause of bullwhip effect (Lee et al. 1997). It refers to the situation that the downstream supply chain member places orders to upstream member in batches (Hussain and Drake 2011). Because of the high inventory holding costs and high backlog costs, companies prefer to place orders at a specific time point rather than when needed. In addition, Hussain and Drake (2011) also comment that order batching can help achieve economic order quantity and transportation economies. Economic order quantity refers to the production of a larger batch of merchandise where the manufacturer can enjoy the benefits of facility set-up cost reduction and manufacturing efficiency improvement. Transportation economies represent the optimization of transportation costs by fully utilizing the capacity in transportation. For example, retailers can attain a quantity discount from wholesaler and enjoy a full truck-load rate when they place in bigger lot sizes. From inventory managers' point of view, the order batching strategy can help meet the forecasted demand with minimal inventory, which in turns help them to achieve the sales target and gain profit.

Minimum order quantity (MOQ) is a policy derived from the order batching practice, which is adopted due to the concern of economies of scale in the fashion industry (Chow et al. 2012). Most of the fashion companies use minimum order quantity policy to achieve the economies of scale in production and distribution. It has been proved that a small batch size could reduce the operational cost and enhance order stability (Wangphanich et al. 2010). The constraint of minimum order quantity could be applied to a particular item or a group of items, such as all colors of a particular style. The minimum order quantity may be contributed to the demand variation since it affects the accuracy of demand forecasting. Based on the above review related to order batching and bullwhip effect, a hypothesis is formulated below:

Hypothesis 2 A larger minimum order quantity leads to a higher level of bullwhip effect.

2.3 Effect of Product Types

The prior literature has examined the effects of product types on bullwhip effect in supply chains. Pastore et al. (2018) examine the bullwhip effect in automotive spare parts supply chain with more than 30,000 products, characterized by different technical characteristics, demand classes, and planning parameters. They find that bullwhip effect is more significant for fast moving products than slow movers. Duan et al. (2015) use daily and product level data to test the existence of bullwhip effect among substitutable products in supply chain. They find that the bullwhip effect is not only from the individual product, but also the substitutable ones. Raghunathan

et al. (2017) analyze the bullwhip effect in multi-products by the analytical approach. They find that the various product types have different level of bullwhip effect.

In this paper, we use the data of a designer fashion brand's high heel shoes. The height of shoe heel can refer to the various product types. For example, 10 cm is high heel shoes, 65 mm is so-called middle heel shoes, and 10 mm is flat shoes. From the psychology perspective, high heel shoes increase women's attractiveness (Guéguen 2015). Because of the difficulty and the appearance of wearing, it is believed that high heel shoes are more fashionable products than flat ones (Graff et al. 2013; Johnson et al. 2014). Fashionable products have a higher degree of demand uncertainty (Fisher 1997; Selldin and Olhager 2007), which may lead to demand amplification because of enlarged demand variance. In this paper, we use product level data from designer shoe brand and evaluate the relationship between product types (i.e., different height of shoes) and bullwhip effect.

Hypothesis 3 Shoes with a higher height lead to a higher level of bullwhip effect.

3 Sampling and Data Analysis

3.1 Background of Brand Z

Brand Z is a British designer footwear brand selling luxury shoes, bags, and accessories all over the world. Apart from having direct sales to the final customers in the market, Brand Z is also a wholesaler selling products to various fashion retailers (e.g., department store). In this study, we consider the role of Brand Z as a wholesaler and focus on the shoe products to evaluate its bullwhip effect. The shoe products can be divided into two different types; they are flats and pumps. To be specific, the heel height of the flats is 10 mm while the heel height of the pumps ranges from 65 to 100 mm. On the other hand, the production time (as a result of the lead time) of each shoe type is different. It ranges from 4 to 8 months depending on the design complexity and the raw material availability. In real-world practice, minimum ordering quantity (MOQ) requirement is well observed in which the manufacturers impose the order quantity constraint on the downstream wholesaler. It is also the case in Brand Z in which some manufacturers have the MOQ requirement of 50, 75, 100, or even 200 units so as to guarantee their profits.

In this study, we consider a three-echelon supply chain which consists of a group of manufacturers, a wholesaler (Brand Z), and a retailer. Figure 1 presents the supply chain structure of Brand Z in Hong Kong. To be specific, the echelon at the downstream supply chain represents the Hong Kong fashion retailer who sells the shoe products to the final customers in the Hong Kong market. They can place an order to the wholesaler every month based on their market demand information. The middle echelon represents the Hong Kong wholesaler who receives and processes the orders from the fashion retailer and then makes an order request to the manufacturers according to the fashion retailer's order quantity as well as the manufacturer's MOQ

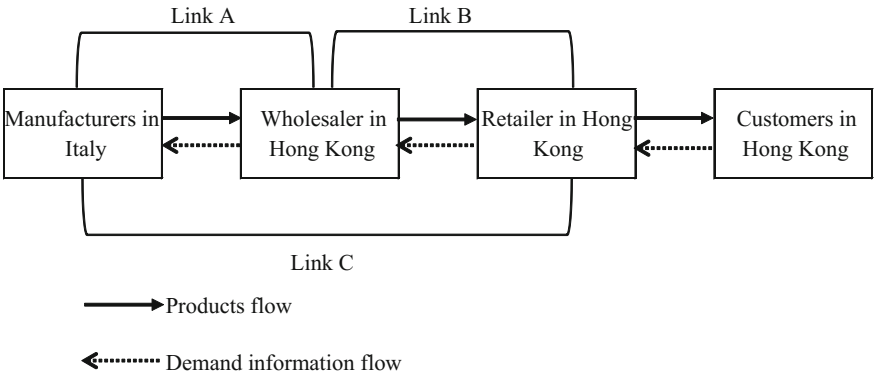

Fig. 1 Supply chain structure in this study

requirements. Finally, the echelon at the upstream supply chain is the manufacturers. There are totally four manufacturers and all of them are located in Italy. Each of them is responsible to produce the shoes with different styles and materials.

3.2 Methodology

3.2.1 Data Sets and Sampling

In this study, we collected the real order quantity data of each supply chain member in the period from June 2015–March 2016. To be specific, we collected (i) the order quantity of the retailer, (ii) the order quantity of the wholesaler (Brand Z), (iii) the production quantity of the manufacturers toward each shoe product. There are 25 shoe products in total. In addition, we also collected and specified the (iv) MOQ requirement, (v) lead time, and (vi) heel heights toward each shoe product. Overall, 825 data were collected. To provide a better explanation on various important parameters clearly, we have the following definition:

1. *Coefficient of variation (CV)*: Measured by the ratio of standard deviation of demand s to mean demand $\overline{x}$ (Fransoo and Wouters 2000; McCullen and Towill 2002), i.e., $CV = \frac{s}{\overline{x}}$.
2. *Bullwhip effect (BE)*: Determines the demand amplification level between two supply chain members and is quantified by the ratio of coefficient of variation of upstream echelon to downstream echelon. Specifically, BE at Link A, Link B, and Link C is denoted as $BE_A = \frac{CV_{Manufacturer}}{CV_{Wholesaler}}$, $BE_B = \frac{CV_{Wholesaler}}{CV_{Retailer}}$, and $BE_C = \frac{CV_{Manufacturer}}{CV_{Retailer}}$, respectively.
3. *Link A*: Consists of the manufacturer and the wholesaler.

4. *Link B*: Consists of the wholesaler and the fashion retailer.
5. *Link C*: Consists of the manufacturer and the fashion retailer.

3.3 Data Analysis

We first analyze the existence of the bullwhip effect of each shoe product according to the definitions. In addition, not all the manufacturers have imposed the MOQ requirement and we code the MOQ as "1" when there is no MOQ constraint imposed by the manufacturer. In other words, the manufacturer is willing to trade with the wholesaler when it orders at least one unit. Next, we conduct the statistical analysis using the SPSS software. A correlation test was employed to test the developed hypotheses.

4 Results

4.1 Analysis of the Bullwhip Effect

To determine the existence of bullwhip effect of each shoe product, we first measure the bullwhip effect at each link and of each shoe product. Table 1 summarizes the bullwhip effect, the MOQ requirement, the lead time and the heel heights of each shoe product.

4.2 Statistical Analysis of the Causes of Bullwhip Effect

Table 2 presents the correlation between MOQ, lead time, heel heights, and bullwhip effect at each link of each shoe product. First, we find that lead time is positively correlated with the heel heights with the p value <0.01. In addition, lead time is also positively correlated with the bullwhip effect with p value <0.05 with the Link A, p value <0.01 with the Link B and Link C. Therefore, H1 is supported and a longer order lead time yields a higher level of bullwhip effect.

On the other hand, the statistical correlation analysis demonstrates that the MOQ does not have a significant correlation with the bullwhip effect at the 0.05 significance level. Therefore, H2 is rejected and we cannot reveal that a larger minimum order quantity leads to a higher level of bullwhip effect.

Table 1 Summary of the bullwhip effect, MOQ, lead time, and heel heights of each shoe product

Product	BE at Link A	BE at Link B	BE at Link C	MOQ (units)	Lead time (months)	Heel heights (mm)
1	1.1567	1.3273	1.5352	1	8	100
2	1.3901	1.4713	2.0452	1	8	85
3	0.8108	0.7568	0.6136	1	6	65
4	1.0417	1.0254	1.0682	150	8	85
5	1.0277	1.0023	1.0301	250	8	85
6	0.9226	0.9058	0.8357	100	4	65
7	1.0803	0.6026	0.6510	100	4	65
8	1.1199	1.0043	1.1247	100	6	85
9	0.9670	0.9183	0.8881	1	4	10
10	1.1459	1.0403	1.1921	100	6	85
11	0.9758	0.9184	0.8962	75	4	10
12	0.9652	0.9639	0.9304	200	4	10
13	0.9868	0.9726	0.9598	200	4	65
14	1.1247	1.1496	1.2930	1	6	85
15	1.0087	0.9993	1.0081	75	4	10
16	1.0279	1.0260	1.0547	1	6	100
17	0.9676	1.0417	1.0079	1	6	85
18	1.0591	0.9781	1.0358	1	6	85
19	0.9860	0.9741	0.9604	75	4	10
20	0.9706	0.9694	0.9408	50	4	10
21	1.0038	1.0184	1.0223	75	8	85
22	0.9988	0.9999	0.9988	100	4	10
23	0.7569	1.4201	1.0749	50	6	10
24	0.8981	0.9060	0.8137	1	4	10
25	1.0644	1.0928	1.1631	1	8	10

Finally, we find that the heel height and the bullwhip effect are positively correlated at Link A only with p value <0.05. However, there is no significant correlation between the MOQ and the bullwhip effect at Link B and at Link C. Therefore, H3 is partially supported and the shoes with a higher height lead to a higher level of bullwhip effect between the manufacturers and the wholesaler only.

Table 3 summarizes the statistical results for the proposed hypotheses.

Table 2 Correlation between MOQ, lead time, heel heights, and bullwhip effect at each link of each shoe product

	MOQ	Lead time	Heel height	BE at Link A	BE at Link B	BE at Link C
MOQ	1	−0.110	0.001	−0.076	−0.233	−0.224
Lead time	−0.110	1	0.608**	0.427*	0.537**	0.586**
Heel height	0.001	0.608**	1	0.484*	0.149	0.358
BE at Link A	−0.076	0.427*	0.484*	1	0.366	0.784**
BE at Link B	−0.233	0.537**	0.149	0.366	1	0.855**
BE at Link C	−0.224	0.586**	0.358	0.784**	0.855**	1

*Correlation is significant at the 0.05 level (two-tailed)
**Correlation is significant at the 0.01 level (two-tailed)

Table 3 Summary of the statistical test result

Hypothesis	Result
Hypothesis 1: A longer order lead time yields a higher level of bullwhip effect	Supported
Hypothesis 2: A larger minimum order quantity leads to a higher level of bullwhip effect	Rejected
Hypothesis 3: Shoes with a higher height lead to a higher level of bullwhip effect	Partially supported

5 Discussion

5.1 Causes of Bullwhip Effect

In this paper, we find that the order lead time and the height of the shoes have a significantly positive correlation with the bullwhip effect at all links and at Link A, respectively. Therefore, lead time and heel heights are critical causes of the bullwhip effect in the Brand Z supply chain.

5.1.1 Lead Time

According to the statistical result of H1, it shows that a longer order lead time leads to a higher level of bullwhip effect. Lead time, therefore, is a crucial factor which will affect the operations efficiency in a supply chain context because the upstream supply chain members are not able to keep track of the real demand at the downstream side with a long lead time (Liao and Shyu 1991).

5.1.2 Heel Heights

From the statistical result of H3, it reveals that the shoes with a higher height lead to a higher level of bullwhip effect between the manufacturers and the wholesaler only. Our results show that the bullwhip effect due to the heel height exists in the linkage between the manufacturer and the wholesaler only. From Table 1, it indicates that a type of high heel shoes has a longer lead time between the manufacturer and the wholesaler. In addition, the high heel shoes are perceived as fashionable products with higher level of demand uncertainty (Fisher 1997; Selldin and Olhager 2007). Since the brand Z has its own physical stores in which it can also collect the demand information, this demand uncertainty of the fashionable shoe products can be reduced between downstream retailer and the wholesaler (brand Z).

5.2 Mitigate the Bullwhip Effect

5.2.1 Information Sharing

Information sharing between the downstream retailer and upstream supply chain members is an effective measure to mitigate the bullwhip effect in the supply chain context (Yang et al. 2011). According to Lee et al. (1997), information sharing includes sharing of inventory status, sales data, sales forecast, production quantity or even delivery schedule. For example, the downstream retailer possesess the market demand information in which it should be shared with the upstream manufactures for the production planning. Lee et al. (1997), Raghunathan (2001), Gaur et al. (2005) find that no one particular information sharing policy is perfect in all situations and they suggest to apply the hybrid policy for the information sharing. Despite the bullwhip effect cannot be fully eliminated through information sharing, it can help avoid the variance amplification at the upstream supply chain (Dejonckheere et al. 2004). In the exiting literature, it is stated that information sharing can significantly improve the supply chain efficiency as well as reduce the excess quantity of inventory (Bourland et al. 1996; Lee et al. 1997; Cachon 1999; Barut et al. 2002). By sharing the true demand information along the supply chain, it helps the retailer establish a relationship with upstream manufacturer. As Brand Z is a designer fashion brand in which they are famous for its craftsmanship, Brand Z should develop a long term strategic partnership with its manufacturers. In addition, it can help the supply chain members improve their operations management with a better inventory planning.

5.2.2 Quick Response Strategy

As suggested by Disney and Towill (2003), reducing the lead time can help mitigate the bullwhip effect in the supply chains. In fashion industry, quick response (QR) is a strategy that can shorten the lead time for the replenishment in response to the

market changes (Choi and Sethi 2010). Under the QR strategy, the retailer can adjust the initial forecast quantity and then postpone the order decision closer to the selling season (Iyer and Bergen 1997). On the other hand, the retailer will conduct information updating by collecting the demand information of the correlated products to improve the forecasting accuracy (Choi et al. 2003, 2006, 2017, 2015). In the existing literature, it is found that both the supplier and the retailer are better off if an appropriate contract is adopted. To implement the QR strategy, Brand Z has to consider the degree of supplier and buyer relationship. This is because the supplier and buyer relationship will affect the quality of the information shared, the forecasting policy, the supply chain contract adopted, and the technology being used (Choi and Sethi 2010). Recently, many fashion retailers have adopted the radio frequency identification (RFID) technology for inventory management (Chan 2016; Chow et al. 2010). It can enhance the transparency of the inventory and achieve a quicker replenishment. It is an effective technology to handling the short shelf-life products (Karkkainen 2003) such as trendy fashionable products.

6 Conclusion Remarks

This study focuses on a targeted designer footwear brand and statistically examines the existence and the causes of the bullwhip effect in the designer fashion supply chain. We collected 825 data including the real order quantity of each supply chain member, MOQ requirement, lead time, and heel heights, and conducted the empirical tests. Our findings show that the degree of bullwhip effect in our targeted brand is significantly correlated with the lead time and the shoe height only but not the minimum order quantity requested by the manufacturers. In addition, we discuss the measures to mitigate the bullwhip effect in the Brand Z supply chain.

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Chapter 6
Application of Human Rights Due Diligence and the LeanIn Concept for Addressing Pregnancy-Related Discrimination in Cambodia's Garment Sector

Bai Li and Marsha A. Dickson

Sheryl Sandberg is the chief operating officer (COO) of Facebook now, and used to be the vice president of global sales and operations of Google. She mentioned an incident from her first pregnancy in her book *Lean In: Women, Work, and the Will to Lead* (2013). One morning, Sandberg found a far away parking spot. As a pregnant woman, she struggled to get into the office and suddenly felt nauseous. The next day she met with Google' s founders and proposed an idea: pregnancy parking, which would be designed to give expecting mothers priority to park in front of each building. She felt embarrassed that she never thought of these pregnancy-related human rights issues until her own pregnancy (Sandberg 2013). Human rights are universal and inalienable; indivisible; interdependent and interrelated. They are "universal because everyone is born with and possesses the same rights, regardless of where they live, their gender or race, or their religious, cultural or ethnic background" (UNFPA 2005). As such, it is worth paying attention to pregnancy-related human rights issues in the workplace.

Compared to 30 years before, the American gender pay gap has dropped by 30% (Hegewisch et al. 2012) and a higher number of women, such as Sheryl Sandberg, have become top managers in companies and earn higher salaries than before (Sandberg 2013). As a result, pregnancy-related human rights issues have been attracting significant attention in developed countries. However, the gender income disparities were growing in most Asian developing countries over the past years (OECD 2017) and pregnancy-related human rights issues appear to have received little attention. With the global garment industry, from upstream to downstream, dispersed around the world, apparel factories play a critical role in many developing countries' economies, such as Cambodia, Bangladesh, and Vietnam (Berik and Rodgers 2010). Human rights and labor abuse issues are not new topics in apparel

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factories, however, ingrained prejudices mean the status of female labor in these developing countries is lower than in western countries (Robertson et al. 2016).

The global policy agenda has included the issue of human rights for decades (Ruggie 2011). However, workers in some Asian countries still suffer from human rights and labor abuses, and they lack the awareness, seniority, and confidence to solve these problems (Heintz 2007). To remain competitive, both export-oriented factories and subcontractor factories squeeze workers with long working hours, low salaries, and working on weekends (Kashyap and Tiv 2015). Kashyap and Tiv (2015) explain that labor rights abuses, as one type of human rights issue, includes "forced overtime and retaliation against those who sought exemption from overtime, lack of rest breaks, denial of sick leave, use of underage child labor, and the use of union-busting strategies to thwart independent unions" (p. 7). It is difficult for pregnant women to survive sleepless nights and long hours of backbreaking work, because of their special physical condition. Therefore, they are especially vulnerable to pregnancy-related human rights abuses, like lack of rest breaks. Recently, in Cambodia, episodes of workers fainting on the job has drawn considerable public attention (Kashyap and Tiv 2015).

The understanding related to pregnancy-related human rights and labor abuse for female laborers is more novel and exceptional in developing countries as mentioned before. Correctly, in Cambodia, some rural girls see garment factories as saving themselves from the control of their families and village, even if, as asserted by Homlong (2016), the cheating and discrimination of garment factories appears limitless. Most female workers in Cambodian garment factories lack awareness to resist abuses and struggle against human rights issues. To solve these issues, it is critical to gain support from different stakeholders, such as brands, governments, factories, and consumers (Rullo 2017). Garment brands gain most of the profits in the supply chain, and they are most often located in developed countries. Therefore, brands are stronger than other stakeholders in the garment industry and should take a leading role in addressing pregnancy-related human rights and labor abuse for female labors in Cambodia's garment industry.

This paper considers how companies can implement the due diligence recommendations for responsible supply chains in the garment and footwear sector. We draw on guidance from the Organisation for Economic Co-operation and Development (OECD) to propose ways to address pregnancy-related human rights and labor abuse issues for female workers in Cambodia's garment industry.

1 Cambodia's Apparel Industry: Double-Edged Sword

As one of the main sources of non-agrarian employment, the apparel industry plays a critical role in Cambodia's economy. Specifically, 75% of value-added in manufacturing and 17% of all economic activity in Cambodia comes from the garment industry (Heintz 2007). In 2016, 45% of Cambodia's Gross Domestic Product (GDP) was driven by merchandise exports including footwear and garment exports (World

Bank 2017). Designs are provided by international buyers, such as GAP, Levi Strauss, and Nike, and then they are manufactured (cut-make-trim) by the garment factories in Cambodia with imported textiles (ILO 2012).

The growth of the garment industry in Cambodia started in 1994 (Oka 2016), with the average annual growth rate during the following decade at 45% (Heintz 2007). Nowadays, garment exports, as the prominent industrial sector, have further pushed Cambodia's economic growth in a short period. World Bank (2017) indicates that Cambodia's rapidly improved international status is due to its competitive productivity.

At the same time, the garment industry in Cambodia has created job opportunities for poor workers from rural areas, and the industry hires a majority of low-skilled female laborers. One study shows that women make up 90–92% of the industry's 700,000 workers (Kashyap and Tiv 2015). In 2013, 412 export garment factories hired almost 400,000 workers. Counting the workers in subcontracting factories would most likely bring the number of female laborers even higher (Kashyap and Tiv 2015).

Because apparel and textile supply chains are spread across many different countries, it is challenging for apparel brands to control their supply chains and meet their social responsibilities. The Cambodian garment industry is mainly dependent on international markets, foreign investors, and foreign aid. Brands in the United States, the European Union, and Canada are core consumers for the garments made by Cambodian factories. Also, about 95% of exporting garment factories are owned by foreign investors from China, Malaysia, and Singapore (Oka 2016). Although the garment industry has a positive contribution to the employment rate, the impact on human rights is complex and may be far-reaching. Most of the laborers who worked in Cambodian garment factories are in low skill jobs. Workers in Cambodian garment factories often suffer from human rights and labor abuse issues.

2 Effects of Human Rights Issues and Discrimination on Efficient Supply Chains

Efficiency of production is vital to brands and retailers in the extremely competitive global garment industry (Robertson et al. 2016). This competition leads international manufacturers to cut all possible costs by outsourcing production to lower-wage economies (Hurley 2005). Heintz (2007) asserts that big brands also prefer to choose smaller subcontracted units than larger factories, because garments can be produced faster and cheaper. This competition also leads to increasing pressure on several fronts, especially time and price. In absence of a technological reformation, most garment factories put pressures on their workers, increasing their working time, adding to their workload, and reducing their salary (Kashyap and Tiv 2015). Labor abuse becomes a detriment to an effective Cambodian garment industry.

Some workers in Cambodian garment factories have complained that "management pressure to meet production targets undermined their ability to take breaks to use washrooms, rest, or drink water" (Kashyap and Tiv 2015). Most of the factories in Cambodia rarely care about the human rights and labor abuse issues, and follow the labor standard (Berik and Rodgers 2010). To make itself more competitive, Cambodia's export garment industry has lost its ethics.

3 Pregnancy Discrimination: A Human Rights and Labor Abuse Issue

Different from other industries, the garment industry in Cambodia is dominated by female laborers, because women can frequently be paid less and are perceived to be easier to control (Kashyap and Tiv 2015). Compared to the higher salary they offer to male laborers, some factories only pay about half of the lowest salary to female laborers (Berik and Rodgers 2010). Hurley (2005) identifies seven key issues faced by laborers in the apparel industry: "the employment of vulnerable workers; insecurity of work; underpayment of wages and social welfare; overwork and underwork; health and safety issues; harassment; and the challenges facing trade union organization" (p. 96).

Kashyap and Tiv (2015) pointed out that pregnancy-related discrimination and sexual harassment are two key human rights and labor abuse issues that female laborers faced in their workplace. Pregnancy-related discrimination existed in different stages of the employment lifecycle, including "during hiring, promotion, and dismissal, and included failure to make reasonable workplace accommodations to address the needs of pregnant workers" (Kashyap and Tiv 2015, p. 8). Pregnancy and motherhood are hard to cope with during daily work and are at odds with efficiency of production. Pregnancy-related human rights issues have occured widely in at least 30 factories in Cambodia (Kashyap and Tiv 2015). Although Cambodia's Constitution and labor laws forbid dismissals based on pregnancy, Human Right Watch (Kashyap and Tiv 2015) found that legal protection was weakly enforced.

Workers from Cambodian garment factories have revealed that it is a general situation that factories' managers reject hiring pregnant workers (ILO 2012). When females who already work in the factories become pregnant, it is difficult for them to renew their contracts. This discrimination is thought to occur because maternity benefits would raise production costs of factories. Interviews with workers show that factories prefer to hire unmarried female workers rather than married female workers. Furthermore, they prefer not to recruit pregnant women or women with babies because the babies are often sick and mothers have to take leave from work to care for them (ILO 2012).

Those pregnant workers who are employed explained that it is difficult for pregnancy to be accommodated in factories because pregnancy needs adequate time to rest or use washrooms. Kashyap and Tiv (2015) have found that the real situation in

Table 1 Three pillars of the "Protect, Respect, and Remedy" Framework (Ruggie 2011, p. 4)

The State Duty	To protect against human rights abuses by third parties, including business enterprises, through appropriate policies, regulation, and adjudication
The Corporate Responsibility	To respect human rights, which means that business enterprises should act with due diligence to avoid infringing on the rights of others and to address adverse impacts with which they are involved
The Need for Greater Access by Victims	To effective remedy, both judicial and non-judicial

Cambodia is many factories do not offer these necessary frequent bathroom breaks or lighter workload without reducing pay. Also, factories do not offer enough time for prenatal health checks (ILO 2012). One factory in Cambodia required workers to make up time lost because of health visits affiliated with pregnancy (Kashyap and Tiv 2015).

Under Cambodian law, the payment system should include the basic salary and benefits, such as the payment for seniority, attendance, or other bonuses. Also, the pregnant women should receive half of their payment during their 90 days' maternity leave. However, most workers interviewed by the ILO, as part of a study on gender equality and the working and living conditions in Cambodia, reported that they only received half of the minimum basic salary without any benefits including the maternity benefit (ILO 2012). The report shows that women who worked at the garment factory in Cambodia for more than a year never got their maternity pay. Furthermore, because of the lack of childcare and difficulties in continuing breastfeeding while working, it is difficult for pregnant women to return to the workplace within the limit of 90 days (ILO 2012).

4 Using Human Rights Due Diligence to Address Pregnancy-Related Human Rights Issues and Discrimination

As part of globalization of the fashion industry, awareness of businesses and governments' impact on human rights has started to increase (Ruggie 2011). In 2005, the United Nations established a mandate for a Special Representative, which focuses on human rights issues for business enterprises (Ruggie 2011). One phase of the Special Representative's work was a recommendation for the "Protect, Respect, and Remedy" Framework. The Special Representative hoped this framework would provide a coherent system detailing the expectations and actions of relevant stakeholders for addressing human rights issues (Ruggie 2011). The three pillars outlined within the framework are shown in Table 1.

An important element of the corporate responsibility to respect human rights outlines that companies should carry out human rights due diligence, to "identify, prevent, mitigate and account for how they address their adverse human rights impacts" (Ruggie 2011, p. 10). This framework has been endorsed by many institutions, such as OECD. In 2017, the OECD published *OECD Due Diligence Guidance for Responsible Supply Chains in the Garment and Footwear Sector* (2017), which provides guidance on how to carry out due diligence and account for a company's actual and potential adverse impacts (OECD 2017). More specifically, this guidance aims to ensure that the enterprises' operations are aligned with government policies, therefore strengthening mutual confidence between enterprises and public societies in which they "operate, and lessening the negative impacts of business activities" (OECD 2017).

Due diligence can fit into solving the pregnancy-related human rights and labor abuse issues. This process can improve enterprises' reputation of participating enterprises and other stakeholders, and increase the ability to manage global operations consistently (OECD 2017). The OECD guidance has a module providing information on how enterprises may apply due diligence recommendations to sector sexual harassment and sexual and gender-based violence in the workplace (OECD 2017). However, this module lacks information related to pregnancy-related human rights and labor abuse.

The following sections suggest ways that companies can implement the due diligence recommendations to address pregnancy-related human rights and labor abuse. The guideline has six core elements as follows. We explore application of the first four elements.

> (1) embed responsible business conduct in enterprise policy and management systems; (2) identify actual and potential harms in the enterprise's own operations and in its supply chain; (3) prevent or mitigate harm in the enterprise's own operations and in its supply chain; (4) track; (5) communicate; (6) and provide for or co-operate in remediation when appropriate. (OECD 2017, p. 20)

4.1 Policy and Management of Responsible Business Conduct

The first recommendation in the OECD guideline is that companies should make policy commitments related to human rights and embed those throughout the company. These policies need to be approved at the senior level, and draw on internal or external expertise and publicly available information (OECD 2017). As mentioned before, the Cambodian economy is mainly dependent on foreign aid and international markets. International brands and retailers who have products manufactured in garment factories in Cambodia should move toward a zero-tolerance policy on pregnancy-related human rights and labor abuses issues in their operations. Based on the material in the OECD guideline, we derived the following policies related to pregnancy-related

human rights and labor abuse issues. Specifically, the foreign brands and retailers should be encouraged to add the following policies (OECD 2017):

No.	Policies
1	A workplace free of pregnancy-related human rights and labor abuse issues
2	Worker understanding of pregnancy-related human rights and labor abuse issues and related international labor standard
3	A process to hear grievances, which maintains confidentiality of workers who make complaints
4	A commitment to uphold international standards rather than less stringent national legislation

4.2 Risk Assessment

The actual and potential harms in the company's supply chain includes adverse impacts from both internal and external activities, either directly or indirectly related to their operations (OECD 2017). Pregnant women are exposed to risks of human rights and labor abuse issues in the workplace. After endorsing the Beijing Platform for Action (BPFA) at Fourth World Conference on Women in 1995, Cambodia has made gender equality a top priority in its development agenda, with significant political commitment, and has taken firm measures to achieve the goals set out in the BPFA (Nakagawa 2015). The Ministry of Women's Affairs created many laws and mechanisms, but the resources to enforce and advocate those is lacking, thus these policies have not been fully implemented. One report shows about 70% of employed female laborers, compared to 59% of male laborers, remain in vulnerable employment (Nakagawa 2015).

Brands and retailers should encourage Cambodian factories to understand the extent of pregnancy-related human rights and labor abuse issues in the garment industry. However, the lack of related material and data makes it difficult to identify the pregnancy-related human rights and labor abuse issues (OECD 2017). As such, the company might help factories to consult stakeholders and workers directly instead of relying on secondary data. By having conversations with the big brands more directly, stakeholders who cooperate with Cambodian garment factories can share useful information related to pregnancy-related human rights and labor abuse issues, making companies pay more attention to these issues than before (OECD 2017). Also, based on these conversations, feedback can be given to workers who are interviewed so they can learn about these risks. Some examples of possible risk factors for pregnant women who work in Cambodian garment factories are shown in Table 2. Brands and factories might be inspired by this table of ideas derived from the OECD (2017) Guidelines.

Table 2 Possible pregnancy-related human rights and labor abuse issues in Cambodian garment factories

	Risk factor
1	Inadequate labor laws and labor law enforcement to protect pregnant workers
2	Lack of access to education and low quality of education leading to poor school attendance of females in Cambodia
3	Wages that do not cover basic needs of pregnant women and their families. Wage non-compliance is also a risk in Cambodia's garment factories
4	Presence of production quotas and order fluctuation that leads to excessive overtime in Cambodia's garment factories

4.3 Prevent Harm

The necessary next step after identifying actual and potential harms is to stop or prevent the impact. Once factories have found harms in their operations and supply chain, they should not simply push the responsibility to other stakeholders, such as garment factory (OECD 2017). Grievance mechanisms are key to preventing and mitigating harm in the company's operation (OECD 2017).

Higher rates of unionization may help with solving pregnancy-related discrimination issues (OECD 2017). Becoming part of a trade union allows female laborers to be educated of what true rights they deserve in order to better protect themselves. Although a report shows that 97% of the 371 factories in Cambodia had one union (Kashyap and Tiv 2015), there is no information about whether these unions address pregnancy-related discrimination issues. Generating awareness about the problem is the most important thing to do first; let female laborers in Cambodia's garment industry who suffer from pregnancy-related human rights and labor abuse issues realize their mistreatment tis out of step with international standards.

4.4 Track

After companies consider and attempt to solve issues, they still need to determine whether their work results in actual changes. "Track" means enterprises should examine all the impacts, ensuring their changes have been effective. It is important for enterprises to track their due diligence progress (OECD 2017). Specifically, enterprises can collect information from factories, laborers, and unions. For example, workers in factories can report data through telephones; data can be updated directly to the audits (Roman et al. 2014). Then the stakeholders, such as brands, factories, and consumers can easily gain the growing database about the factories.

One example would be a story "dream" mentioned by Roman et al. (2014) a young Indian woman, coming from a rural area in southeastern India, worked in a large factory in Bangalore, India. She accessed Labor Voices-Connect on her mobile,

and filed a complaint about her rights being exploited during work. Even though she speaks everything in her native language, the app was able to recognize it, and send everything back to the database. A few hours later, a report was generated, and sent back to brand that works with this Indian factory. Just like the end of this story, in Sweden, an employee in one of the global retailer's offices of corporate social responsibility received the report and started dealing with the issue (Roman et al. 2014). This type of mobile technology is a great tool for gathering all the complaints and hidden issues from the workers. Without being punished, or scared of being found out in front of their bosses, workers can file all the complains through the app, making their voices heard (Roman et al. 2014).

5 LeanIn.Org Approach and Human Rights Due Diligence

In addition to carrying out aspects of human rights due diligence, companies could adopt concepts from LeanIn to address pregnancy-related human rights issues. LeanIn.org is an initiative of Sheryl Sandberg and Dave Goldberg Family Foundation and aims at helping an increasing number of women take the lead and talk openly about gender issues (Leanin.Org 2017). Partners can "participate in LeanIn.org public awareness campaigns, share education materials with employees, and run successful Circles programs" (Leanin.Org 2017, p. 1). Specifically, LeanIn.org has a study, Women in the Workplace that is promoting gender diversity in the workplace (LeanIn.Org 2017). This study is related to women who work in American companies and is conducted annually by LeanIn.Org and McKinsey & Company. We suggest that garment factories in Cambodia also can work with LeanIn.Org, become the partner of Work in the Workplace, and try to solve the pregnancy-related human rights issues together to accomplish desired changes. Also, as a nonprofit organization and online community dedicated to helping all women achieve their ambitions, LeanIn.org already has three ways to solve gender equality issues (leanIn.Org 2017):

- Annual campaigns: focused on raising awareness about topics that are critical to female workers. A campaign could be carried out in Cambodia, inviting popular celebrity lecturers who could give speeches relative to pregnancy-related discrimination issues. Yang Sophorn would be an ideal candidate since she is the president of the Cambodian Alliance of Trade Union (CATU), an independent union federation that promotes garment worker's right.
- Education: LeanIn.org offers an online library, which provides recommendations for human rights issues. The pregnancy-related issues should be a special column for this online resourses. In this case, there may have a language barrier for Cambodian women who want to use this information. One possible solution would be make some provocative brochures and videos in the Khmer language that relate to pregnancy-related human rights and labor abuse. These informational materials could be aimed at raising workers' awareness about these issues.

- Lean in Circles, are peer groups, that women can meet together per week or per month. Research shows that in the group discussion, people would be likely to feel self-confident. Specially, in Cambodian garment factories, workers can discuss the brochures and videos, which mentioned before, discuss some pregnancy-related human rights and labor abuse issues, and share good practices on how to combat these.
- Lean in Circles, are small groups that meet regularly to learn and grow together. Research shows that people feel more confident and are able to accomplish more in the groups.

Companies can hold events like lectures, lean in circles, and educational forums, helping female workers become aware of the pregnancy-related human rights and labor abuse issues they are facing now. The process is similar as identifying current and potential harms in the enterprise's operations and its supply chain in OECD Due Diligence Guidance. Also, the human rights related education materials showed on LeanIn.org website, will increase other stakeholders' (factories, brands, consumers) awareness.

By applying common strategies of LeanIn.org, companies can increase the awareness of female labors related to pregnancy-related discrimination issues. The United Nations has created a sense of urgency for companies to respect human rights of workers in global supply chains and how to tackle due diligence has been outlined by the *OECD Due Diligence Guidance for Responsible Supply Chains in the Garment and Footwear Sector* (OECD 2017). Companies can be the true leaders in this change. Brands may ask their suppliers to cooperate with LeanIn to build up an organization (LeanInFactory) focused on pregnancy-related issues. Well-known brands should lead this charge, by taking the first step in the OECD Due Diligence Guidance and embedding responsible business conduct in enterprise policy and management systems. If it works well, making mutual benefits for both upstream manufacturers, and downstream brands, other companies may follow this approach.

Moreover, the LeanInFactory could collect feedback from women workers and then discuss that with factories and government to improve policies. The LeanInFactory should share change plans immediately with workers. For this change action, workers should be the leaders of the trade union (LeanInFactory). Brands, factories, and governments can be the promoters and also be the organizers of the events or build up the library. Over the short-term, it would be important for workers to increase awareness of the idea that pregnancy-related discrimination issues exist and it needs to be addressed as fast as possible. Events like lectures and LeanIn Circle should regularly be held for factories in Cambodia. Then as part of building the complete system, the organization's next step should focus on remediation. Victims of pregnancy-related human rights and labor abuse issue should be consulted and helped so that the victims can get back to work being treated equally.

6 Conclusion

This chapter has outlined how companies can use the OECD's due diligence recommendations for responsible supply chains in the garment and footwear sector to address pregnancy-related human rights and labor abuse for female workers in Cambodia's garment industry. Also, we have offered some suggestions related to LeanIn.org that could help raise worker awareness of the issues. For Cambodia, staying at the forefront of the promise of improved human rights in the garment industry, it is vital for them to solve the pregnancy-related human rights and labor abuse issues. This kind of change related to human rights should not be limited to developed countries or large tech companies like Facebook or Google where Sheryl Sandberg has been fortunate to build her career. In a time of such radical and rapid change, no one should suffer human rights and labor abuse in silence. In closing, we are inspired by this statement from the book *Lean In: Women, Work, and the Will to Lead* (2013, p. 11): "We can reignite the revolution by internalizing the revolution. The shift to a more equal world will happen person by person. We move to the larger goal of true equality with each woman who leans in."

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Chapter 7
RFID-Embedded Smart Washing Machine Systems in the Big Data Era: Value Creation in Fashion Supply Chain

Bin Shen, Xuemei Ding, Yanyan Wang and Shuyun Ren

1 Introduction

Home appliance brands such as LG, Samsung, and Whirlpool have all launched smart washing machines on Wi-Fi with special smart feature (Griffin 2015). Washing machine has been well developed to connect with database and internet. For example, Kobus et al. (2013) discuss the smart washing machine with a new sustainable technology, which can collect the real-time electricity consumption and production data from the washing machines and the solar panels. Washing machine now is able to access Internet. A natural question arises: How can we develop smart washing machine with Internet of things and better use of the collected data?

The new version of smart washing machine with radio frequency identification (RFID) sensor has been developed, which is able to detect what clothes in the laundry and adjust the washing settings automatically based on the weight and materials of clothes. This technology has received great supports from fashion retailers. For example, global fast fashion brand Zara has built their business around RFID technology (Bjork 2014), global sports fashion retailer Decathlon implemented RIFD

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tags into their products (Swedberg 2015). Both Zara's and Decathlon's use of RFID are to improve operation efficiency and inventory accuracy.

Fashion has a wide assortment of products, short life cycles, and high seasonality. Companies adopt forecasting methods to predict market demand. However, it may still have bias when companies use the statistical and intelligent algorithm based on the previous sales data (Ren et al. 2015). RFID is a critical enabler to enrich the customer experience and market information. It is desirable to collect information in regard to what consumers are wearing and their wearing frequency because this could imply real-time consumer behavior at the apparel use stage (i.e., real-time consumer preference). In this paper, an innovative RFID-embedded smart washing machine (RFID+SWM) system is proposed, in which RFID sensor is able to read tags in clothes (which have been inserted by RFID tags), and detect what washing cycle they should go on. This new system could collect, store, and analyze data from households' washing machines and is capable to overcome a wide range of obstacles such as monitoring real-time fashion preference and optimizing operations system.

Availability of such washing information will grow exponentially when this smart washing machine is getting popular in households. Collected data becomes extremely large and complex and is difficult to process them by using traditional data processing applications. Data has the potential to change business model design and decision making based on data analysis. The embedded RFID smart washing machine will produce greatly large amount of real-time data associated with what color, textile, style, brands of clothes the consumers are washing, and when and where they are washing. This real-time information can partially reflect what consumers are wearing. Given the information of what consumers are wearing, fashion companies can derive optimal solutions in terms of consumer preference and use analytics to improve operations performance in design, manufacturing, and retailing. Much of the existing research focuses on physical applications and hardware development. It is unknown that what exactly values and challenges in the development of such a RFID+SWM and its corresponding business analytics.

To the best of our knowledge, it is the first study to explore business values of RFID-embedded smart washing machine. It is worth discussing that how this business analytics of such management systems transform fashion business. It is concluded that the data collected via RFID+SWM can help manage fashion business from product design, production planning, and retailing management. The benefits include the apparel production process optimization from perspectives of quality enhancement (quality for shorten or extend product life cycle), sustainability (carbon emission and water use management), and operation strategies management (help meet supply and demand). More specifically, this study aims to answer the following questions.

(1) How the RFID+SWM system is developed to guarantee users' and relevant firm's benefits?
(2) What are the motivating factors that drive users to adopt the RFID+SWM system?
(3) What are the business values of the RFID+SWM system in the fashion industry?

This paper is organized as follows. The related literature is reviewed in Sect. 2. Section 3 describes development of RFID+SWM and Sect. 4 details the discussion in regard to adoption intention and business value. The implication and recommendation are given in Sect. 5. Section 6 concludes the paper with general remarks and potential future research.

2 Literature Review

Two streams of research relevant to this study are briefly reviewed below.

2.1 RFID Implementation in Fashion

RFID technology has been widely employed in the various industries (Ngai et al. 2008a; Zhu et al. 2012; Laosirihongthong et al. 2013), such as aircraft engineering industry (Ngai et al 2007), food industry (Ngai et al. 2008b), and healthcare sectors (Wamba and Ngai 2015). RFID infrastructure consists of a transponder, a reader, and a data collection application (i.e., a software solution and an antenna). The data collection application connects with Internet and transfers the collected data to center servers for further data analysis.

RFID is also widely adopted in fashion supply chain (Quetti et al. 2012). Loebbecke and Palmer (2006) examined the benefits of the fashion merchandise manufacturer (i.e., Gerry Weber) who implemented RFID on fashion item, carton, and palette levels when trading with the leading fashion retailer (i.e., Kaufhof department store). They found that RFID is acceptable to consumers when embedding in the clothes and both parties enjoyed the substantial benefits in reducing operation time and labor cost when using RFID in the supply chain. Moon and Ngai (2008) provided five cases to describe the benefits of RFID in the fashion retailing. They proposed that RFID could enhance efficiencies of the customer relationship management, shop floor management, marketing and promotion, and logistics and inventory management in fashion retailing. Bertolini et al. (2012) examined the values of implementing RFID in the fashion supply chain. They claimed that the successful design and implementation of RFID in the fashion supply chain requires a close cooperation between users and developers. Zhou and Piramuthu (2013) studied the security property of RFID in fashion retailing. They proposed the authentication protocols to address the challenges in ticket-switching of RFID-tagged items in apparel retail stores. As high implementation cost is one of the main barriers in supply chain for RFID, Chan et al. (2012) compared the conventional bar code system and RFID in healthcare apparel inventory system. They found that supplier maybe worse off if the healthcare organization changes its scanning system from barcode to RFID or vice

verse. Ngai et al. (2012) summarized the business of RFID in fashion manufacturing operation. This paper is innovative and different from previous literature of RFID implementation in fashion production and operation management. It takes a forward step to discuss the value creation from the RFID+SWM in the fashion business.

2.2 Business Analytics in Fashion

Data provides new prospects to apply a variety of statistical and artificial intelligence techniques to measure business process management (Zhang 2012). Fashion industry is quite unique. Fashion trend is difficult to follow, monitor, and forecast. Effectively monitoring fashion trend and managing supply chain are challenging and not easily achieved using traditional approaches such as someone's experience and observation. Caro and Gallien (2010) investigated the fast fashion retailing assortment planning problem by using an optimization approach based on the data of Zara in retailing and supply chain. They found the optimal inventory allocation within the fast fashion supply chain network.

Business analytics represent a new era in large and complex data utilization. In the fashion industry, applications of business analytic are well explored in areas of social media with the growing popularity of Internet of things and availability of information (Ngai et al. 2015). It can analyze consumer postings, gauge the immediate impact of marketing, and understand the consumer's sentiment about brands and products. Social media is a platform to share personal perception and discuss what is happening. Data from social media can monitor the real-time perception that what people are talking (thinking) about the specific products or present fashion trend. However, thoughts and actions are not always consistent, and actions are more likely meaningful to future decisions (Hannah et al. 2011). Hu et al. (2016) studied the impact of social media's "liking and following" functions on operations and marketing policies. They found that recruiting influencers can help diminish sales' unpredictability. Fundamentally different from social media, the proposed approach in this paper traces and examines consumers' actions, the real-time data that what, when, and where people are washing (wearing) is captured. This data analysis can surely trace and monitor the consumers' actions on fashion.

3 Development of RFID+SWM System

In this section, we develop the architectural framework of RFID+SWM system. Figure 1 shows the overview of the proposed system. This figure helps to understand the maturity level of RFID technology in fashion and washing machine, and get the clear picture of the structure of the proposed system. As shown in Fig. 1, we describe the various stages in designing and developing the proposed system: (1) data capturing system, (2) data analytical center, and (3) big data and business analytics.

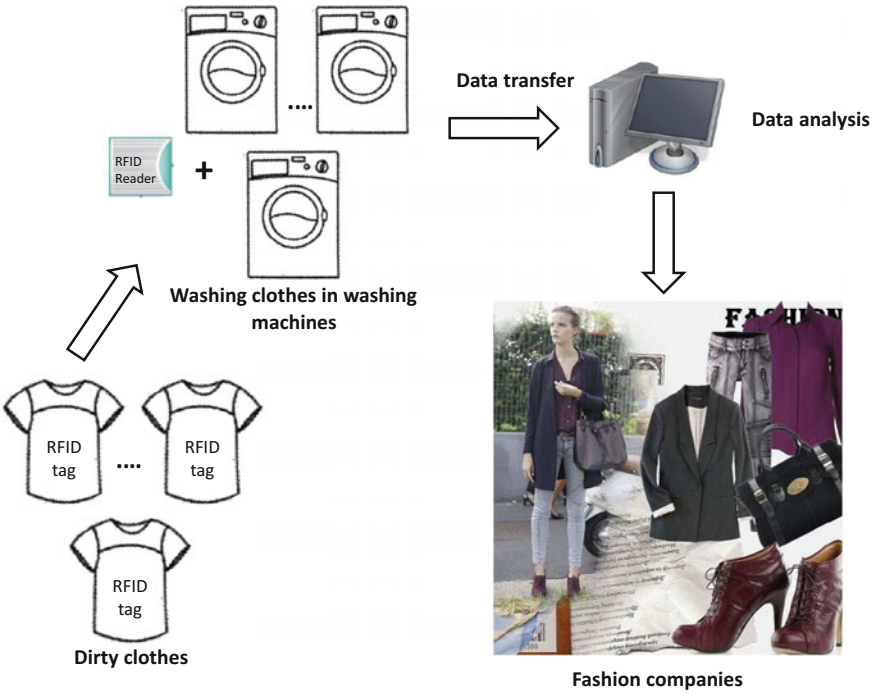

Fig. 1 Overview of RFID+SWM system

3.1 Stage 1: Data Capturing System

Data capturing system requires the installation of RFID tags and readers. To be tractable, all clothes are launched with RFID tags, in which some asset specific data including color, textile, style, brands of clothes, and when and where they are washing, are all collected. As all clothes will be washed by water, RFID tags must be waterproof. Moreover, the RFID readers are installed in the smart washing machine. RFID reader automatically detects clothes information (e.g., fabric type and colors) before starting the washing cycle. The RFID+SWM system captures digital processing of the tag content. Then, there is the hardware and software combination, which aggregates and filters the raw data for further processing. Afterward, data structure is formed, wirelessly transferred, and stored in data analytical center.

To develop the data capturing system, many fashion companies have inserted the RFID tags into the clothes (Loebbecke and Palmer 2006). Smart washing machine installs the RFID sensor with the strong IT application deployment, which gives the ability to process, store, and integrate the additional data from RFID. The data capturing system is the first step of RFID+SWM system.

3.2 Stage 2: Data Analytical Center

Based on the data collection from data capturing system, the data analytical center carries out some basic filtering, aggregation, and processing operations for data analysis. The basic rules of washing with regard to energy efficiency and sustainability are built into the data analytical center, which enables to capture what clothes are about to be washed, and provide the most suitable washing mode selection in consideration of best treatment of washing, minimization of carbon emission, water, and energy usage. To support the data analytical center online, the IT infrastructure integrates with RFID deployment and aims at supporting real-time operations associated with fashion supply chain management. Two aspects are emphasized regarding fashion supply chain as follows. First, the sustainability of entire fashion supply chain, including carbon emission, water footprint, and energy usage can be measured. Second, based on the frequency of washing, product quality can be better managed (if one type of products is more frequently washed, to extend the life cycle, its product quality should be better designed in production process with consideration of potential frequent washing in use). Afterward, the data analytical center uploads the data to cloud computing platform via Internet for storage and further analysis. This Web-based platform is built to enable company managers and supply chain specialists to retrieve relevant information.

3.3 Stage 3: Big Data and Business Analytics

Based on the data uploaded from heterogeneous household's washing machines, it needs to process online analytics, data mining, and automating decision system. A variety of statistical and artificial intelligence techniques based on real-time consumer behavior in washing are applied to measure business process management. After data mining, the implications to fashion and textile-related industry are able to be provided. Such business analytics from the proposed system helps industrialists to evaluate what, when, and where clothes are currently washing, as a result predict the consumer wearing behavior, and provide managerial insights to fashion supply chain. Moreover, from supply chain perspective, it can measure product's carbon emission and water footprint in both manufacturing and usage processes. This fundamentally changes the assessment of sustainability and reduces negative impact on environment. Figure 2 shows three steps in the architecture framework of the RFID+SWM system.

3.4 Example of Color Trend Forecasting

As mentioned above, some asset specific data including color, textile, style, brands of clothes, and when and where they are washing can be collected from RFID tags and

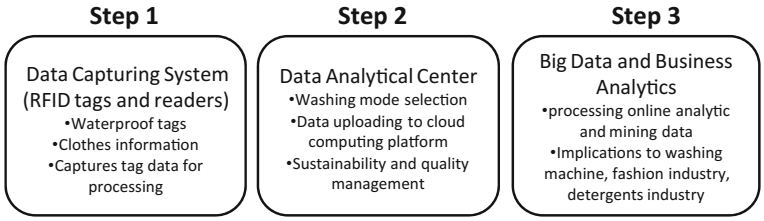

Fig. 2 Architecture framework of the RFID+SWM system

readers. In this subsection, we take color forecast as example to show the forecasting procedure based on the data collected from RFID+SWM system. The quantity of clothes in specific color presents the popularity degree of a specific color. In other words, more quantity of textile in specific color in the future indicates much more popular of a specific color. We build up the extreme learning machine (ELM) forecasting model and evaluate the impact factors including style, material, size, weight, and gender on color trend forecasting by the ELM algorithm. The output of ELM model is the quantity of specific color.

Define the input variables as $x_i = (x_{i1}, x_{i2}, x_{i3}, x_{i4}, x_{i5})$, where $i = 1, 2 \ldots N$ denotes the number of samples and $x_{i1}, x_{i2}, x_{i3}, x_{i4}, x_{i5}$ represents the input variables style, material, size, weight, and gender, respectively, at each observation time period. The forecasting steps of our proposed color trend forecasting model based on ELM algorithm are illustrated as follows:

- Step 1: Extract the quantity data of clothes in one kind of color from raw data according to its color code.
- Step 2: Select the impact factors that have a significant effect on the color trend forecasting as the inputs variables of ELM algorithm.
- Step 3: Divide the input datasets into training, testing, predicting sets. Please note that the inputs of different variables are in the different ranges. Thus, the training and testing data are normalized before training and testing process, so that the inputs fall into a specific range. The normalization method for input datasets and the unnormalization method for output datasets follow the work of Huang and Babri (1998) and Frank et al. (2003).
- Step 4: Select the activation function of hidden neuron and the neuron number of hidden layer of ELM. The input weights matrix W_i and hidden biases K are randomly chosen in ELM algorithm, while the output weight matrix β_i is determined analytically.
- Step 5: Compute the outputs of ELM forecasting model according to input training data and testing data and unnormalized the outputs. The predicted series of training data and testing data can be obtained.
- Step 6: Compute the predicted sales series of predicting data according to the input weights W_i and output weights β_i obtained by Steps 4 and Step 5.

With the above six steps based on ELM algorithm, the color trend forecasting can be identified by using data from RFID+SWM system.

4 Value Creation from RFID+SWM

4.1 Value of Users

Individuals are not willing to adopt a new technology if they cannot receive benefits after using it. It is thus significantly important to discuss adoption intention and ensure all involved individuals to implement a new system. In this subsection, the benefits of all involved individuals are discussed as follows.

First, fashion companies receive tremendous benefits from editing clothes information into RFID tags and inserting them into products. If the clothes with RFID tags are washed in the proposed smart washing machine, then what, when and where consumers wash are stored, traced, and analyzed. This analyzed result provides insights into consumer wearing behavior and helps re-engineer the fashion business processes in order to increase operational efficiency, and let match supply and demand. To remain competitive, re-engineering the business process achieves productivity gains and accesses to understanding consumers' preference and behavior. Moreover, after implementing the proposed system, product sustainability is measured in the use process. Thus, the sustainable fashion companies should carefully design product quality and manage sustainability in the consumer use.

Second, washing machine producers are beneficial with this information system adoption. RFID enables firms to generate information in terms of productivity and service effectiveness at the same time. Washing machine producers need strong management commitment to change the structure of washing machine business and invest heavily on R&D in such system. This investment could receive the significant great return and leverage benefits through information sharing across fashion supply chain. Such information sharing creates the great value and is critical for fashion supply chain. In the future, its business models may be changed: washing machine producers may not just sell the washing machine with a substantial upfront price, but a service of selling market information. Service is more lasting and creates large value (Spohrer and Maglio 2008).

Third, users are beneficial with smart machine for better decision making. Users are acceptable to wear the clothes with RFID (Loebbecke and Palmer 2006), and willing to use this kind of smart washing machine at home. People may repeat some actions and form an automatic response in stable environment (Verplanken and Aarts 1999). Thus, users may not have solid knowledge that which washing mode is suitable for clothes (e.g., wool-made clothes should be treated differently compared to cotton made one). This may lead to negative outcomes that the washed clothes are damaged, and extra energy and water are used. The proposed system can provide more customization with personalized services to users. Smart washing

Table 1 Technology push and need pull factors for adoption of an RFID-embedded smart washing machine system

Parties	Technology push	Need pull
Fashion companies	• RFID tags • Data mining • Business analytics	• Better quality control • Better product sustainability • Better knowledge of product usage
Washing machine producer	• Information receiver and storage via RFID technology • Cloud computing platform • Business analytics	• Better clothes treatment • Value-added service provision • Transform the awareness of sustainability
End-users	• Smart washing mode selection	• Customization with personalized services • Extend product life cycle • Increase sustainability

machine with the RFID reader can read information from the tags attached to the clothes. This allows information about the fabric type and color to be collected from RFID-tagged buttons, helping users to avoid mixing white and dark laundry and optimizing the washing program based on the characteristics it reads from both the clothing and the washing detergent used. For example, if colored and white clothing items cannot be washed together or woollen clothing item cannot be washed together with a cotton clothing item, the smart washing machine can identify the color and the texture of the clothes based on the real-time information collected from embedded RFID tags in clothes. Therefore, to better maintain the quality of clothes and extend its life duration, consumers are willing to use the embedded RFID smart washing machine in daily time. Thus, the proposed system is able to better treat the clothes, extend the clothes' life cycle, and transform the awareness of sustainability.

Table 1 follows Shih et al. (2008) and Ngai et al. (2012) to use the concept of technology push and need pull to examine the adoption intention of RFID+SWM system. As shown in Table 1, this approach provides the key factors in the adoption decision of a new technology in the engineering/R&D management discipline.

4.2 Value in Fashion Business

Applying RFID in the smart washing machine is an innovative idea. Implementation of the new system implies the outdated processes are replaced. The value of such RFID technology is particularly apparent in the fashion industry. It contributes to real-time fashion trend management, increases efficiency in production planning, and enhances sustainability in fashion supply chain. The values of adopting RFID+SWM are as follows.

First, product design is enhanced based on the data of consumer behavior in use. Fashion designers can identify the popular styles, fabrics, and colors by using the data analysis from the proposed system. Moreover, the more sustainable product design can be inserted into the product development process with higher frequency of washing. For example, one polyester made item is produced in a relatively unsustainable manner, but it may be more frequently wore and washed by consumers; or one wool-made item is produced sustainably, but it may not be worn and washed frequently. Both scenarios are not enough sustainable if sustainability is considered as not only manufacturing process, but also consumer use process. Hence for product development, if the products are more frequently used, more sustainable materials should be made in the products.

Second, the proposed system helps better manage apparel production planning. It assists fashion managers to perform more effectively in strategic production planning. It has visibility of wearing in downstream customer sites so that proactive production decisions can be made. The proposed system provides higher visibility of sustainability in the entire fashion supply chain. RFID technology has the ability to provide an accurate data of carbon emission, water and energy usage in operation and production process. The proposed system would enable the supply chain operations to have visibility of the products' washing frequency as well as the carbon emission, and water and energy usage in washing process (Singh et al. 2015, 2017).

Third, the proposed system provides better visibility in fashion retailing management. It can monitor what consumers are washing and provide more accurate data for fashion trend monitoring and forecasting. By tracking the real-time washing items, fashion companies gain better visibility of consumer preference toward fashion products. More accurate real-time data can remove the human factor compared with the traditional fashion trend forecasting. The data analysis provides more accurate demand forecasting. Based on the washing data, it can analyze the fashion preference, provide the recommendation of fashion products development, and enhance the consumer experience.

Fourth, the proposed system can trace and monitor how consumer washes and treats the clothes. This knowledge provides information and managerial insights to product design, production planning, and retailing management. As shown in Fig. 3, the massive data of the consumer behavior at use stage can be analyzed in the proposed system. The analytical results can help decision making in fashion design, production planning, and retailing management.

With implementation of the proposed system, the new fashion supply chain system can become smarter than before. The new concept of smart fashion supply chain (SFSC) is proposed. SFSC is defined as a fashion supply chain is intelligent, interconnected, and visible throughout the entire channel. SFSC is capable of connecting all supply chain parties (i.e., designer, manufacturers, retailers, and consumers), learning and making real-time decision associated with product design, production planning, retailing management and use process by itself, as a result predicting the future development based on the results from data mining. Table 2 is summarized the business value-added framework for RFID-embedded smart washing machine.

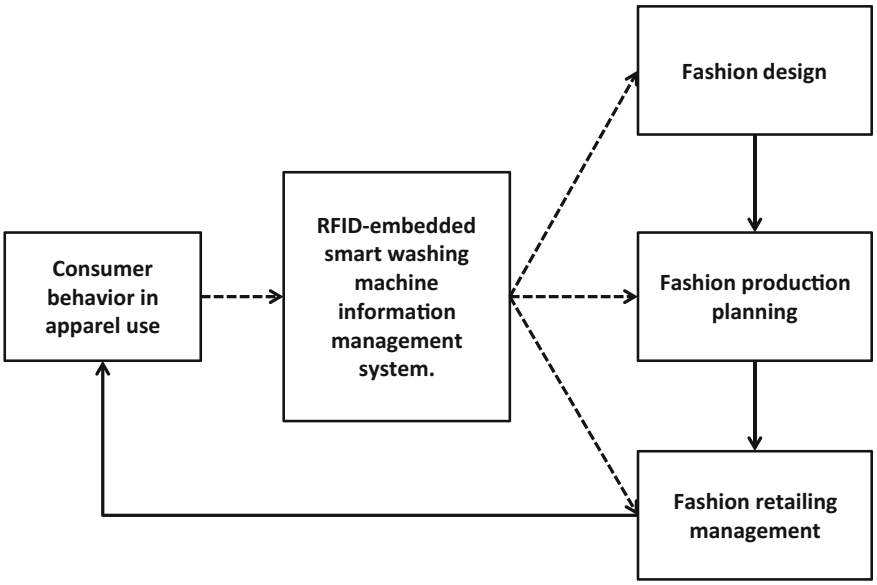

Fig. 3 Flowchart of SFSC

Table 2 Business value-added framework for RFID+SWM system

Considerations	Details of business value-added
Operational level	Provide a platform for real-time business intelligence
	Ensure the suitable washing mode to minimize usage of energy and water, and carbon emission
	Interconnected within supply chain parties
Management level	Data mining and business analytics
	Learning and making real-time decision
	Predict what consumer like (i.e., forecast fashion trend)
	Better visibility of sustainability in the fashion industry
Strategic level	Better visibility of fashion trend and better decision making in production
	Tight collaboration between fashion companies and washing machine producers in information sharing
	Strong awareness of sustainability
	Smart fashion supply chain construction

4.3 Challenges for Implementation

It had no equipment or technology which could monitor and trace fashion wearing behavior after purchasing. Implementing the proposed system can help fill this gap but may raise several potential challenges. First, the deployment of RFID tags should be attached to the entire fashion industry, rather than several brands. The adoption of RFID entails a large investment and requires careful planning. However, it has been largely evident that RFID technology could help better manage fashion supply chain. This challenge is addressed by the fact that whether companies can receive great more benefits from using RFID technology than investment. Second, it has challenges for washing machine producers to install RFID reader and corresponding systems if consumers are not willing to purchase such smart machines. Hence, efficient product promotion and favored prices should be provided to consumers. Third, privacy is a critical issue in consumer adoption. Consumers may be concerned with the privacy that what they are washing (wearing). Thus, it is important to avoid the privacy conflicts before consumers adopt this smart machine.

5 Implications and Recommendations

Data is essential components of managing decision making. Data mining, analytic applications, and business intelligence system are well integrated in the proposed system. The analytical results are actionable. However, the existing data is not capable enough to trace and monitor consumer wearing behavior in fashion. RFID technology can help collect customers' information in fashion stores. The data from RFID-embedded smart washing can provide immediate information of what customer are washing (wearing), so that fashion retailers can get better knowledge of consumer washing (wearing) preference and behavior.

The conventional fashion forecasting system is based on fashion show analysis, current market offerings, and art exhibitions. It is extremely challenging to predict dynamic consumer demand because the current forecasting tools may not be able to provide a real-time product life cycle from usage perspective. Through the RFID technology, the proposed system is able to accurately track the real-time washing behavior and predict what consumers may like. When certain types of clothes are mostly washed in households, it implies that consumers are largely wearing this type of clothes in a specific time period. As a result, fashion designers can identify the corresponding innovative design, fabric, and colors to satisfy customers.

Given the real-time information of clothes washing, producers can integrate the quality system with emission reduction through manufacturing efficiency. The proposed system can obtain data associated with consumer wearing behavior in use process. The results can improve (1) product development process from design innovation, (2) production planning process from quality management and sustainability perspectives, (3) retailing management process in better matching supply and

demand, and (4) understanding of consumer wearing behavior in real-time apparel use. The proposed system is particularly important for large fashion brands with high market share (e.g., Zara, H&M) and high-end fashion brands. They can keep tracking product usage, monitoring fashion trend, predicting purchase time point, and location. Based on the data collected and business analytics, they can develop more desirable product lines, better stock plans, and identify brand/product authenticity. The RFID+SWM system can collect real-time information and increase operational efficiency. With more data available about which items are used by consumers, suppliers and retailers can boost profits and mitigate the risk.

Moreover, sustainability is one of the most important performance metrics. In the proposed system, the whole fashion product life cycle from sustainability perspective can be measured. Specifically, the proposed system can monitor product sustainability (i.e., carbon emission, and water and energy usage) in the use process. It is able to balance the product sustainability in manufacturing process and the use process associated with washing frequency. Afterward, the feedbacks can be sent to the manufacturers for optimizing production process and mitigating environment impacts. The proposed system can enhance accessibility and traceability in environment protection and integrate Corporate Social Responsibility (CSR) in supply chain.

Last but not the least, the proposed system can collect information, analyze new business opportunities and spark new business model. Internet and computing techniques have changed our life and business models tremendously. The proposed system provides an opportunity to create the new business models for both washing machine and fashion companies. For example, a producer of a smart washing machine could consider a "free washing" or "pay-as-you-wash" model in which customers pay nothing or little every time when they use the washing machine instead of making a substantial upfront payment. The machine producers can make profits from sharing washing data to fashion companies as service providers. The Internet of Things is able to facilitate these new business models and differentiate markets. Fashion companies may sell products to the potential consumers based on their washing machine location.

6 Conclusion, Limitation and Future Research

This paper describes the development of an RFID+SWM system with a focus on adoption motivation and value creation. Data collection, storage, processing, and other issues specific to analytics are incorporated into overall system design. The proposed system helps fashion companies to monitor consumer behavior in apparel use process. The proposed technology and developed prototype system transform fashion business landscape. The proposed intelligent decision support system delivers various values to optimize sustainability and quality management in production planning, and better match supply and demand in retail management in the fashion industry.

This study opens a new discussion in the fashion industry. More fashion companies are encouraged to incorporate the RFID tags into every piece of clothes items as well as the washing machine companies are encouraged to promote RFID+SWM system with financial support. The proposed system will transform fashion business models and present significant potentials to enhance firm's efficiency and sustainability.

This paper is beneficial to practitioners who interested in implementing an RFID system in the fashion industry. In future research, it would be significantly meaningful to investigate big data application based on the proposed RFID+SWM system. The empirical studies at both the macro- and the microlevels are suggested to investigate the factors that drive fashion business development in terms of big data and RFID.

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Part III
Fashion Supply Chain Management Cases

Chapter 8
The Value of Online-to-Offline Channel for Start-up Fashion Designer Brands: Lessons from China

Jingjing Wang and Yixiong Yang

1 Introduction

Being a start-up fashion designer is a trend in China. In recent years, after receiving well education in fashion design, more and more start-up fashion designers start to develop their own brands and sell new collections. However, with limited brand recognition, start-up designers may not have sufficient resources to find consumers. As a result, brand growth suffers from the following two obstacles: (1) the high cost of operation to run a new brand and (2) the slow return on investment if the brand recognition is limited. Therefore, it is challenging for the start-up designer brands to be survived under the fierce competition in the fashion industry.

When the concept of "Internet plus" came into fashion consumption, e-commerce opened up a new direction for the development of garment enterprises with its real-time communication and feedback of information and data. Online-to-Offline (O2O) model has been widely used in the field of fashion retail. In China, in the booming environment of innovative economy, the Showroom platform, a new business model in fashion industry, including both online and offline channels, serves for start-up designers to sell products. With the help of O2O marketing model, the majority of start-up designers sell products through O2O Showroom. As a rising platform in recent years, O2O Showroom has attracted an increasing number of little-known designer brands and their potential like-minded partners by bidirectional services both for start-up designer brands and fashion buyers.

In this paper, we explore the value of an O2O Showroom platform model for both start-up designers and fashion buyers (hereinafter referred to as O2O service

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platform). We conduct the expert interviews and analyze desk data. We discuss the O2O Showroom service and its profit model. We find that start-up designers are eager to find more outlets with the use of the internet. However, the O2O marketing model of select shops is new in China's fashion market with many challenges, such as the conflict between high setup cost and slow return. We find that launching new collections in the Showroom platform is beneficial for the start-up designers and more diversified online channels such as Web site, mobile applications, social media, and Wechat micro-shop can attract young consumers' attention on start-up designers' brands and collections.

The rest of this paper is organized as follows. Section 2 reviews the relevant literature. Section 3 introduces the research methods. Section 4 discusses results. Section 5 concludes this study and discusses the lessons of O2O channel for start-up fashion designer brands.

2 Literature Review

2.1 O2O Marketing Model

The concept of O2O was first proposed by Alex Rampell, the founder and CEO of American trial product marketing and advertising service provider—Trial Pay (Rampell 2010). The emergence of e-commerce retailers had a huge impact on traditional retailers. However, with the development of network, drawbacks of online shopping gradually appeared. The emergence of O2O has brought the retail industry a further development (Ji et al. 2014). Pan et al. (2014) find that as a new model, O2O has been gradually accepted in the traditional industry, and the retail practitioners are full of expectation to the value of O2O marketing model. For example, UNIQLO achieved a multi-channel distribution of "stores + website + Tmall flagship store + mobile phone App" in April 2013. O2O mainly provides services for offline stores, helping increase the sales and achieve promotion effect. Gao and Yang (2016) find that more than 80% customers accept and love UNIQLO's form of sales activities in China. Combination of traditional commerce and mobile ecommerce platform (O2O) will be main sales model of Chinese apparel industry (Subramanian et al. 2013), and offline experience stores will be necessary for brand management (Chocarro et al. 2013).

Service quality is critically important for online business. To improve the quality of services, Xiao and Dong (2015) establish a reputation management system (HSMM-RMS) based on a probabilistic model called the hidden semi-Markov model (HSMM) to improve reputation management in the emerging O2O e-commerce setting, providing a realistic solution for reputation management in the O2O e-commerce market. Tsai et al. (2015) define an O2O Commerce Service Model and propose an O2O Commerce System Framework, which helps avoid the costly mistake of designing various mechanism and gives user adoption analysis and digital marketing strategy

via online/offline. Pan et al. (2017) propose a novel O2O service recommendation method based on multi-dimensional similarity measurements encompassing three similarity measures: collaborative similarity, preference similarity, and trajectory similarity. Their experimental results show that a combination of multiple similarity measures performs better than other similarity measures.

The online direct selling mode has been widely accepted by enterprises in the O2O era. However, the dual-channel (online/offline, forward/backward) operations changed the relationship between manufacturers and retailers, thus resulting in channel conflict. In the recent years, scholars focus on solving the multi-channel conflicts. For example, Qi (2014) studies the influence of offline retailing store service quality (RSSQ), online store E-service quality (ESQ), and O2O multi-channel integration service quality (MCISQ) on traditional retailers' customer loyalty as well as the relationship among above three multi-channel service quality. Choi et al. (2017) find an online–offline model with the focal points on the choice of franchising contract and the ordering time. Taking a dual-channel operations of the closed-loop supply chain (CLSC) as the investigated target, Kong et al. (2017) find that the optimal price and service level correlate positively in centralization, but the degree of correlation relies on consumers' price sensitivity in decentralization. When consumers are more sensitive to price, a substantial decrease in the service level should be employed to eliminate price declination and to minimize profit loss. By constructing a competition model with cooperation conditions, Long and Shi (2017) analyze the optimal pricing strategies and revenues in the Stackelberg and Bertrand game. Results indicate that service level, unit sale commission, service cost coefficient, and unit service compensation coefficient have different influences on pricing decisions.

2.2 Fashion Buyers and Designer Brands

Fashion buyers can influence the firm's strategic decisions on visual merchandising, product variety, brands establishment, and brand sustaining in fashion retailing (Helen 2006). Entwistle (2006) examines the qualification and mediation of fashionable clothing by fashion buyers at Selfridges, London. Liu et al. (2011) compare the development of fashion buyers at home and abroad and suggest the ways to improve their comprehensive abilities.

The well-known fashion designers such as Emporio Armani and Coco Chanel all were nobody in the fashion industry and created their own brands. The increasing brand recognition and sales performance help them to grow up. Malem (2008) provides an insight into how fashion designer businesses work and survive in London, with an understanding of business techniques and the survival strategies of British fashion designers. Frenken et al. (2011) find that the fashion designers consider the urban amenities are more important than agglomeration economies for their location decisions.

In the recent years, the increasing number of independent designer brands has stepped into public's awareness, becoming a newly emerging force of online apparel sales. In this context, the specialized e-commerce platform for independent designer brands emerges gradually (Zhu 2015). China has emerged many outstanding independent designer brands, but most of them are still in the initial stage. The brand acceptance is not enough. As a result, many of them are on the edge of bankruptcy. Because of the lack of good promotion channels, many brands are not able to receive enough attention from consumers. As a matter of fact, start-up designer fashion brands are purchased by not only mass consumers, but also fashion buyers, who will select the satisfied products and sell them in the large-scale department stores or the well-known designer brands. As a result, it is important for the start-up fashion designers to find the suitable and successful retailing channel.

The word "select shop" is originated from the French "Boutique," which means shops selling all kinds of boutique clothing without a big brand name. It is a business model developed by European operators with a history of more than one hundred years. Designer brands select shop is kind of select shops which stocks with goods from Showroom or exhibitions. As the main channel of goods in designer brands select shops, the Showroom also plays a crucial role. Ren and Liu (2017) find that the elements buyers concern about are the influence of the designers and the brand exclusivity, product assortment, order's lead time, and replenishment ability, while the designers concern about are Showroom's location, publicity, promotional ability of the Showroom, and the merchandising training service, etc.

3 Research Methods

3.1 Enterprise Interview and Questionnaire Survey

In order to understand the basic situation, the operating environment and the intention to expand O2O marketing model of designer brands and select shops, choose representative fashion brands among designers and select shops as the research objective, design interview outline and questionnaire for these brands, have depth interviews with fashion designers, and collect questionnaires from professional fashion buyers.

Our interviews were conducted in April 2016, during the period of Showroom platform ordering meeting. Taking professional designers and buyers as the objective, in-depth interviews and a questionnaire survey were carried out, aimed to analyze the acceptance and the intention to expand the O2O marketing model of designer brand select shops from a professional perspective. The interviewees were two domestic designer brands: by FANG, JESS ZHAO. In the form of on-site interviews, their marketing status was discussed. By FANG is a designer brand of high-end route with high popularity, while JESS ZHAO is a start-up designer brand with low popularity. So the comparison of the two has a good representation.

Table 1 Basic information of respondents and their select shops

No.	Store	Qty	Year	Place	Price/(yuan)	Name	Position
1	Fulang	2	2008	Jinan	500–10,000	Miss Su	Buyer
2	Salvatore	4	2009	Suzhou	2000–10,000	Roymond	Shopkeeper
3	Haiyi	1	2009	Wuhan	500–10,000	Miss Luo	Buyer
4	Xinlelu.Com	1	2010	Shanghai	500–10,000	Sam	Buyer
5	T.9	1	2011	Ningbo	2000–10,000	Joy	Buyer
6	Lemon	2	2011	Shanghai	500–10,000	Lemon	Buyer
7	Lori	2	2012	Jiaxing	500–10,000	Leon	Buyer
8	Yongshow	1	2013	Ningbo	2000–10,000	Mr Wu	Buyer
9	Serious	1	2013	Guangzhou	500–5000	Lra	Buyer
10	Cecidico	1	2014	Wenzhou	500–5000	Cici	Buyer
11	Juneshan	1	2014	Wenzhou	2000–10,000	Mr Cai	Buyer
12	Hermoso	1	2014	Chongqing	2000–5000	Miss Zheng	Manager
13	Liubai	1	2015	Xi'an	500–10,000	Mr Sun	Manager
14	EUOZI	1	2015	Wenzhou	500–5000	Miss Wang	Buyer
15	Mon Amour	1	2015	Shanghai	500–10,000	Angela	Buyer
16	LCS	1	2015	Chongqing	2000–10,000	Miss Pan	Buyer
17	SuRoom	1	2015	Wenzhou	500–2000	Sui	CEO
18	Fashion. JS	2	2015	Ningbo	500–5000	Mr Yu	CEO
19	J'Editoria	1	2015	Taiwan	500–2000	Miss Jiang	Buyer
20	Stubration	1	2015	Shanghai	500–2000	Mr Ding	Buyer
21	TOA vant	1	2016	Wuhan	2000–5000	Oliver	Buyer

From April 7 to April 17, 2016, a total of 21 questionnaires were sent out and 21 valid questionnaires were recovered through field investigation. The questionnaire survey was mainly for professional buyers in designer brand select shops. The respondents were distributed in select shops all over the country. Taking up the job of select shop CEO, buyer manager and other important positions, their work experience and industry knowledge were quite abundant. The basic information of respondents and their select shops were shown in Table 1.

3.2 Construction of Marketing Model

Combining enterprise interview and questionnaire analysis, we examine an O2O Showroom service platform model and its profit model including order commission, retail profit, advertising revenue, consulting service charge.

The difficulty of this model's construction is mainly based on the online platform. The platform resource management (PRM) system is considered as the information support system, with the main idea of providing services like IT resources, data, and applications for users online. Through centralized IT resources, it will save operating costs, improve service efficiency, and enhance competitiveness.

4 Results and Discussion

4.1 Interview Results of Designer Brands

From in-depth interviews, it showed that the attitude towards O2O marketing model was not identical because of different fashion designer brand positioning. The high-end designer brands would not spend too much time and energy on online marketing; instead, they paid more attention on serving high-end customer groups, even a tailor customized service. On the contrary, the start-up designer brands attached great importance to the use of current network technology, hoping to expand brand awareness, and influence degree with O2O marketing model. What is more, they used the personal network to carry out pre-sale activities in order to accept the market test in advance, which was succeeded in playing a multiplier effect. At the same time, start-up designer brands were willing to actively participate into all kinds of order meeting held by Showroom platform. With the help of Showroom, designers can display the brand style in front of fashion buyers as much as possible, helping enhance brand awareness and find the right partners.

Taking Showroom platform as a carrier, designer brand select shops have played a vital role in building the bridge between designer brands and consumers. On the one hand, fashion buyers often travel all over the world and are able to deliver the trend information to brand designers (or through the Showroom platform) in time and promote designer works to the international market integrating globalized vision. On the other hand, concerning their own profit, select shops will actively introduce the designer brands to consumers. Designers can make adjustments timely according to the consumer demand feedback from select shops, eventually achieving a win-win sales performance.

Table 2 Respondents' intention to participate in O2O during the ordering link (Respondents: 21)

Platform type	Respondents	Percentage (%)
Offline sample show	21	100
Online information acquisition	20	95.2
Online goods order	9	42.9
Online order payment	13	61.9

Table 3 Respondents' intention to participate in O2O during the selling link (Respondents: 21)

Platform type	Respondents	Percentage (%)
Offline physical stores	21	100
Online self-built platform	15	71.4
Online third-party platform	17	81.0

4.2 Questionnaire Survey Results of Fashion Buyers

The results of questionnaire survey showed that fashion buyers were generally optimistic about the development prospects of O2O marketing model. If it could serve start-up fashion designer brands and select shops in high quality, O2O marketing model will increase the economic benefit for both parties. The respondents thought that the problems in the development of O2O were mainly concentrated in high-cost investment, big turnover pressure, little trial effect, unobvious sales growth, and difficult to balance both online and offline demand.

As shown in Table 2, respondents tended to take the online platform as a popular information access point or browse designers' latest works online. This participation intention was as high as 95%, but the willingness to participate in ordering and paying links online were not sufficiently strong with the percentages of 43 and 62%, respectively.

All of the 21 respondents were willing to carry out the O2O marketing model with the way of offline first and then online. As shown in Table 3, the participants' intention in the O2O sales process mainly relies on the third-party platform, accounting for 81% of the total number. This is potentially because in China, consumers purchase products in third-party platform such as Tmall.com and jd.com, instead of the brand's official Web site.

4.3 Construction of O2O Service Platform Model

In this section, we introduce a real company, enterprise D, which is the service platform for start-up fashion designers. Enterprise D, founded in 2014, is a fashion brand management company. With the permanent Showroom display platform in

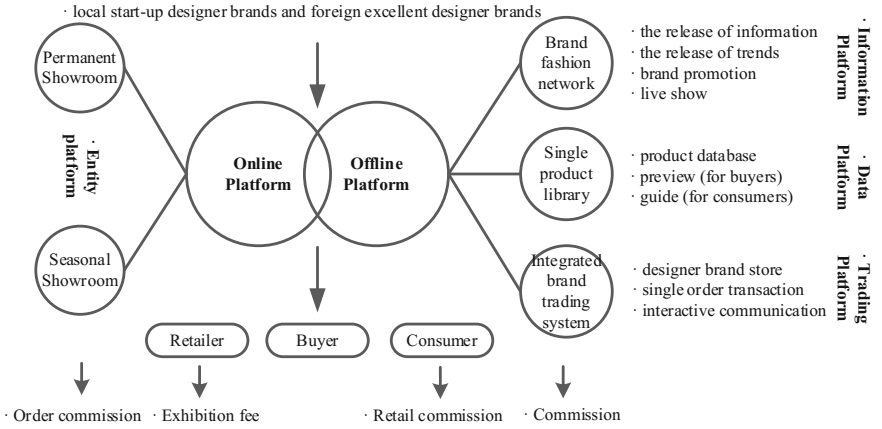

Fig. 1 Basic model of the showroom O2O service platform serving for designer brands and fashion buyers

the fashion center of Shanghai, it has hosted several large Showroom exhibitions and order meetings for designer brands in New World of Shanghai, Fu Xing SOHO Square, Sinan mansions, SOHO in the Bund, and other places. As a result, it has many fashion buyer resources in China and has accumulated much valuable experience for start-up designer brands to enter fashion select shops. In 2014, the whole sales from Enterprise D's Showroom platform were nearly 20 million Yuan (about 3 million USD). In October 2017, the accumulative sales had exceeded 50 million Yuan.

Combined with offline business activities and services, integrating customer resources of Enterprise D's Showroom, an O2O Showroom service platform serving for designer brands and fashion buyers was constructed. On the one hand, it can provide online ordering service for select shops on this platform, tracking trends changes and information dissemination, organizing domestic or foreign enterprises and brands to carry out consulting exchanges, fashion salons, fashion buyers trainings and many other activities. The O2O service platform will also promote the development of fashion industry, especially the incubation and growth of excellent local designer brands.

The basic model of O2O service platform is shown in Fig. 1, including the online platform and the offline platform.

To realize the profit of designer brand products, cooperating with designer brands at home and abroad to grow up together, the online platform provides services like product preview, product information announcement, online purchase, logistics distribution. It also can be further divided into information platform, data platform, and trading platform.

With fashion Web site as the carrier, the information platform is responsible for releasing fashion trend information, promoting the brands and carrying on live shows. Data platform has a fashion brand product library (single product library). Buyers can preview the designer brand products and consumers can get the shopping guide.

Trading platform belongs to the brand integrated trading system. With the form of fashion designer brands online shop, it can realize some business activities, for example, single payment and exchange interaction.

One of the main tasks of the offline platform is to hold two-season order meetings for designer brands in the Showroom. The entities of the offline platform include two parts: Enterprise D's physical Showroom and seasonal Showroom. The seasonal Showroom only operates during Shanghai Fashion Week (twice a year).

The profit model consists of commission, exhibition fee, and service fee:

a. Commission: According to the amount of transactions generated by offline orders or online platforms, a commission for a certain proportion of the order or transaction amount is collected;
b. Exhibition fee: Expenses for market promotion, public relations activities, and so on are collected from domestic and foreign designer brands participating in the ordering process;
c. Service fee: Expenses related to business activities, such as process control of goods ordering and delivery, trademark registration, logistics, customs clearance.

5 Conclusion

In this paper, we examine the value of Showroom platform model. We conduct expert interviews and collect the questionnaire surveys, and we find that in order to increase brand recognition and attract more consumers, the start-up fashion designers are particularly eager to sell products with the use of the internet. However, the O2O marketing model of select shops has challenges such as the conflict between high-cost investment and low return. We find that launching new collections in the Showroom platform is beneficial for the start-up designers and more diversified online channels such as Web site, mobile applications, social media, and Wechat micro-shop can attract young consumers' attention on start-up designers' brands and collections. In this paper, after conducting the in-depth interviews and collecting questionnaires from practitioners, we have the following lessons on Showroom development.

- **Lesson 1**: O2O marketing model is a derivative of the Internet era. Although it is still new, it has a great potential development prospect. Designers of high-end brands are reluctant to spend too much effort in online selling. However, start-up designers are eager to sell products through online channels which have lower cost compared with the physical channels. Most of the designer brands select shops are expecting to create more revenue for the store through O2O marketing model.
- **Lesson 2**: The O2O marketing model of designer brands select shops involve three parts: designer brands, select shops, and consumers, which cover two basic links of ordering and selling. However, the O2O marketing model of select shops is still new with several challenges such as the high cost of investment and the low rate of return.

- **Lesson 3**: In the process of ordering, fashion buyers use the online platform more often for the acquisition of popular information. However, if the technology is mature, many buyers are still willing to participate in online orders to simplify the complicated ordering process. In the process of selling, with adequate strength and energy, most designer brands select shops are willing to carry out O2O marketing. The development approach tends to achieve O2O double channels by selling the relatively cheap but good styles online with a slightly lower price.
- **Lesson 4**: Showroom, with its high degree of specialization and wide range of resources, plays an important role in the connection between designer brands and select shops. Aimed at the shortage of O2O marketing model, the construction of an O2O service platform containing the entity Showroom, Web sites, mobile application, and micro-shop will help a lot, which realizes the designer brand online exhibition and trade, and promotes the development of O2O marketing model in the buying industry.

At present, there are some enterprises operating in accordance with the Showroom platform mode. Through the two-season designer brand integrated ordering meetings held during the Fashion Week, it attracts many nationwide fashion buyers' attention and a large number of domestic buyers' resources. Fashion buyers actively participate in the construction of Showroom O2O service platform and make full use of O2O marketing model to broaden the online and offline channels. This will achieve effective links such as ordering and selling, help designer brand buyer business standardization, and realize the sharing of information and benefits.

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Chapter 9
The Impacts of Transshipment on Dual-Channel Coordination: A Fashion Company Case Study in China

Tianyu Sun and Yixiong Yang

1 Introduction

Fashion market is competitive with a number of various brands and retailers. In the new era of Internet, fashion retailing is not only in the physical stores, but also online channel. This is particularly true in China. According to statistics in 2016, China's online retail sales is 5.16 trillion Yuan (about 0.7 trillion USD) with an increase of 26.2% compared with 2015, and particularly, fashion retail sales online reach to 1.44 trillion Yuan (about 0.2 trillion USD) (National Bureau of Statistics of the People's Republic of China 2017). This data implies that fashion and apparel is one of the important sectors in online retailing with approximately 30% of total online retail sales. In China, the well-known online retailing platforms include Taobao.com, Tmall.com, and jd.com. These platforms help fashion brands to sell in-season and out-of-season products, which seriously affect volume and value of sales offline retailing. Online retailing is challenging due to the low-price strategy and intensive competition, many fashion retailers face difficulties in inventory management between dual-channel coordination so that the profit margins are squeezed. To better balance online and offline channels, both the manufacturer and the retailer should collaborate on inventory distribution and transshipment (Wang 2013). Therefore, transshipment contract is widely adopted by fashion supply chain members to solve channel problems, such as shortages, inventory, and uneven distribution of interests between direct marketing channels (e.g., direct sale store offline and self-support store online) and franchisees.

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In the transshipment contract, one particular retailer can transfer his excessive products to other retailers who are in stock shortage at a certain price (Dong and Rudi 2004). Transshipment contract has been widely examined in the extant literature in supply chain management. The transshipment is implemented in traditional retail channel can reduce cost of the whole system and improve service level through risk pooling (Tagaras 1989). It always benefits the O2O supply chain and offers many managerial insights by studying fashion products in market demand (Zhao et al. 2016).

In this paper, in order to further highlight the validity of transshipment contract, we explore the method of dual-channel interest coordination in fashion retail management. This paper is organized as follows. Section 2 reviews the relevant literature on the transshipment strategy in a dual channel. After it, in Sect. 3, we conduct a case study based on the model and analyze the impact of the transshipment contract on order, inventory, shortage, transport capacity, and profit. Finally, the paper concludes the managerial insights for fashion channel members.

2 Literature Review

This paper firstly reviews the application of wholesale price contract which is one of the most common strategies in apparel industry, and then we review the extant literature on the transshipment contract.

The wholesale price contract mainly refers to the price determined by wholesale order quantity that buyers paid for. The research on the wholesale price contract can be traced back to Spengler (1950), and the author finds that the wholesale price contract cannot coordinate supply chain and is difficult to solve the actual benefits distribution between channels. This result has been proved in recent studies (e.g., Qu et al. 2012; Lan and Ji 2016). From retailers' perspective, Qu et al. (2012) conduct the numerical simulation analysis and examine the value of wholesale price contract. Lan and Ji (2016) analyze whether inequity aversion (self-interest is higher or lower than others' interests) makes loss of benefit. They find that the wholesale price contract cannot coordinate the retailer management. In fact, the wholesale price contract is able to achieve coordination under certain conditions (Wang et al., 2015). By setting up the incentive model, the wholesale price contract coordinates supply chain only with certain demand distribution (Yu and Liu 2010).

In order to promote the development of enterprises better and faster, the transshipment strategy has been examined by scholars and adopted in the real business world. Comparing the transshipment strategy with non-transshipment strategy between competitive firms in a dual-channel supply chain, Zhu and Zhao (2011) conclude that transshipment operations are beneficial to the firms' performance. Using a soft drink supply chain as an example, Dong et al. (2012) find that transshipment can better match supply and demand. In order to deal with matching problem, Li and Xu (2010) examine that the supply chain inventory collaboration of short life-cycle products under dual-channel structure. This result is consistent with Zhang (2005),

which compares the adjusted demand with the original demand and proves that transshipment strategy fortifies supply–demand match, especially in the circumstance of the increasing demand uncertainty. With the adoption of vendor managed inventory (VMI) strategy, Chen et al. (2012) demonstrate that transshipment can reduce the mismatch between demand and supply, which is an effective strategy to resist of supply risk and improve whole supply chain profit (Hezarkhani and Kubiak 2010; Zhang 2014).

Transshipment strategy may benefit or hurt the firms' performance (Shao et al. 2010). The demand and capacity variability have a significant effect on the magnitude of coordinating transshipment prices which exists for only a narrow range of problem parameters (Hu et al. 2007). No matter how the transshipment price changes, Zhao and Atkins (2009) further explain that transshipment will not lead to a lower retail price, a higher safety stock and a situation that benefit consumers, only definitely benefit retailers, suppliers, or the entire supply chain.

Therefore, this paper highlights transshipment contract which can alleviate the imbalance of supply and demand without considering the influence of transfer price, through taking fashion brand J as an example of dual-channel operation mode. This study aims to provide inspiration for the enterprise operation management by a comparative analysis, which is different from previous research methods.

3 Case Study: A Chinese Apparel Company Comparative Analysis

3.1 The Background of Company J

J fashion brand was founded in 1994, and its headquarters locates in Hangzhou, China. The brand strives to become the best design platform in China based on the core value concept of "better design, better life." At present, J brand with a number of sub-brands continues to expand its market coverage and gradually form a good brand image with clear and precise brand positioning, highly recognizable design, and professional fashion collocation.

As of June 30, 2016, there are about 1316 retail stores in China and 12 other countries or regions, consisting of about 432 self-owned stores, about 855 franchise stores and 29 overseas stores; in addition, J brand also extends to its business to online platforms such as Tmall.com, jd.com, Vip.com, WeChat.com. In October 18, 2016, a total of 966 million Hong Kong dollars (about 100 million USD) were raised in Hong Kong IPO prospectus, and 28% of which will be used for the construction and improvement of dual-channel interactive platform. Obviously, it shows that J brand attaches importance to the dual-channel retailing mode.

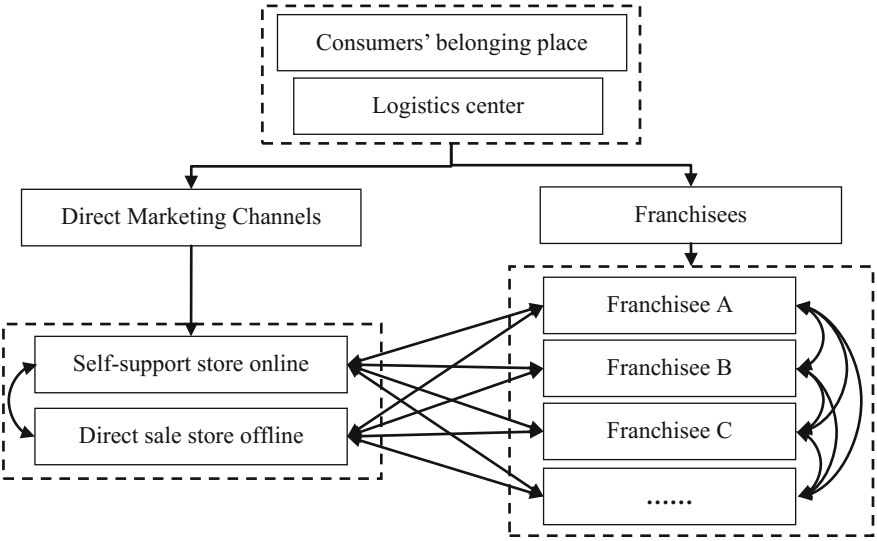

Fig. 1 Implementation process of brand J

3.2 Transshipment Contract Implementation in Company J

J fashion brand formally launched dual-channel project in March 2014 through unified order platform management, intelligent logistics delivery system, and reasonable benefits distribution, to achieve products integration of online and offline channel. The results reveal that dual-channel operation situation of J fashion brand is greatly improved by enterprise investigation. For instance, there are about 200 stores offline involved in supplying for online stores in period of November 11, 2016 and Fig. 1 shows the implementation process of brand J. Turnover of goods is increased by 7%, and volume of sales is raised by 19.7% through information visualization and transparency. Moreover, inventory sharing and transfer products can reduce the occurrence of shortage and inventory backlog, thereby improving overall retailing profit.

3.3 Implementation Evaluation

Understanding the background of company and the reasonable use of transshipment contract in J brand, this section will further highlight the advantages of the transshipment contract based on the implementation conditions of the transshipment contract.

Table 1 Order quantity changes in dual-channel under different contract conditions

	σ	Wholesale price Contract		Transshipment contract	
		Order quantity	Order increment	Order quantity	Order increment
Franchisees	10	2506	–	2505	–
	50	2658	6.1	2627	4.9
	100	3132	25.0	3006	20.0
Direct marketing channels	10	5505	–	5502	–
	50	5634	2.3	5558	1.0
	100	6037	9.7	5730	4.1

3.3.1 Implementation Conditions

The imbalance between supply and demand includes the uncertainty of market demand and the low sharing degree of inventory information between direct marketing channels and franchisees result in imbalance of apparel dual-channel retailing.

Each product sells at the same retail prices within online and offline channels. This is beneficial to maintain good brand image and implement transshipment strategy effectively.

Demand follows uniform distribution. Apparels are short life-cycle products with absolute competitiveness in market, and the demand obeys uniform distribution (Sigma is the standard deviation of demand, and it is limited to 10–100 in this paper).

3.3.2 Contrastive Analysis and Results

Provided that a certain type of J brand's product has been sold 2500 pieces in Franchise stores and 5500 pieces in direct marketing channel, this study carries out data simulation of order quantity, inventory quantity, shortage quantity, transshipment quantity, and expected profit in a dual channel by using MATLAB software according to the standard deviation of demand changes from 10 to 100. The analysis between the wholesale price contract and transshipment contract is as follows:

Order quantity

When the standard deviation of demand changes from 10 to 100, the order increment of franchisees respectively reaches to about 25 and 20% on the basis of wholesale price contract and transshipment contract, and the direct marketing channel is about 9.7 and 4.1% separately (Table 1). Though the rising degree of franchisees is larger than that of direct marketing channel with the increase of market demand, transshipment contract can effectively reduce the order quantity of direct marketing channel and franchisees, and the reduction rate is about 5%.

Table 2 Inventory and shortage changes in dual-channel under different contract conditions

	σ	Wholesale price contract		Transshipment contract		
		Inventory	Shortage	Inventory	Shortage	Transport capacity
Franchisees	10	6	1	5	0	0
	50	158	17	132	9	3
	100	632	67	525	35	13
Direct marketing channels	10	5	3	2	0	0
	50	134	18	53	3	9
	100	537	37	211	13	35

Inventory and shortage

Under the condition of wholesale price contract, when the standard deviation of demand is 100, the inventory and shortage quantity of direct marketing channel and franchisees increase correspondingly. Meanwhile, the direct marketing channels' inventory quantity is 537 and the shortage quantity is 37, which is on the low side relative to the franchisees' stock 632 and shortage 67 (Table 2). The inventory and shortage degree of direct marketing channel are lower, as direct sale stores offline and self-support stores online belong to the brand enterprises, who can realize internal sharing and transportation.

Direct marketing channel's and franchisees'inventory and shortage decrease under the transshipment contract. Then, the decrement of direct marketing channel is more significant compared to franchisees' 525 and 35, whose inventory and shortage is respectively 211 and 13. Hence, the implementation of transshipment contract can deal with the overstock and shortage problem effectively.

Transport capacity

The application of transshipment strategy improves the frequency of goods transferred and promotes cooperation in a dual supply chain. When the standard deviation of demand reaches to 100, the number of products can be transferred from direct marketing channel to franchisees about three times more than that franchisees transfer, after both channels completing self-adjustment task (Table 2). It is obvious that the franchisees need more transported capacity to solve the profit loss because of shortage.

Profit

When the standard deviation of demand reaches to 100, the impact on profitability in a dual supply chain is intensified with the market demand enlarging, and the order quantity increasing (Table 3).

There is still a big gap in the profit increment among franchisees (−15.5%) compared to direct marketing channel (2.8%) according to transshipment contract.

Table 3 Profit changes in dual channel under different contract conditions

	σ	Wholesale price contract		Transshipment contract	
		Profit	Profit rate increment	Profit	Profit rate increment
Franchisees	10	498,864	–	499,217	–
	50	471,603	−5.5	480,416	−3.8
	100	386,412	−22.5	421,664	−15.5
Direct marketing channels	10	1,758,527	–	2,060,585	–
	50	1,750,151	−0.5	2,074,623	0.7
	100	1,738,583	−1.1	2,118,491	2.8

However, it has been obviously improved compared with the wholesale price contract. Therefore, transshipment contract is feasible to implement, and it can achieve positive promotion and raises the profit margins by 4–7% (Table 3).

3.3.3 Overall Performance Analysis

This subsection is still using MATLAB software to simulate sales data by comparing both of contracts, analyzing order quantity, inventory quantity, shortage quantity, and profit of J brand dual-channel retailing system (Fig. 2). This study finds that transshipment strategy is an important value-added tool for apparel supply chain management, making the overall orders decreased about 5%, amount of inventory, and shortage reduced about 35–45% and 50–85%, respectively, and the overall profit rate increased by nearly 20%. Therefore, transshipment contract is more conducive to achieve optimal allocation of resources and the maximization goal of profit in the dual-channel supply chain than the wholesale price contract which cannot carry out cooperation and coordination.

4 Conclusion, Insights, and Future Research Opportunities

4.1 Conclusion

This paper mainly explores how the transshipment contract affects order quantity, inventory, shortage, and profit based on the dual-channel mode and takes J brand as a case study to evaluate different market demand. The real data was adopted for simulation. The results show that whether direct marketing channel or franchisees can significantly overcome the uncertainty of market demand by means of products transferred. Moreover, the transshipment strategy can reduce order quantity, resist of inventory risk and opportunity loss due to shortage, and improve firms' profits finally.

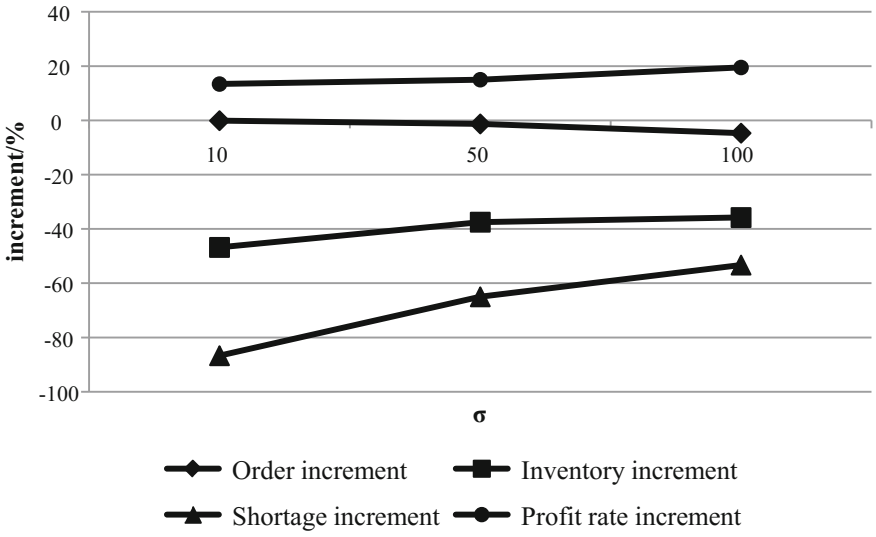

Fig. 2 Overall retail changes compared to the wholesale price contract

4.2 Managerial Insights

In light of current situation of business case and future development direction in the fashion industry, forecasting sales demand timely and reacting to order quickly can significantly affect firms' profit. Coordination and cooperation sharing of information are the key to develop the dual-channel mode. Thus, information construction, mining sales data deeply, and close collaboration are greatly helpful to optimize order and promote mutually beneficial cooperation between the channels. If we can adopt this strategy appropriately, it cannot only strengthen stable development of enterprises, but also achieve the maximum profit of the whole supply chain.

4.3 Future Research Opportunities

The effective transshipment rules between direct marketing channel and franchisees are not formulated in this paper, which just analyzes advantages of transshipment contract comparing with the wholesale price contract. For the future research, it is interesting to investigate how to select appropriate franchisees fairly for direct marketing channel according to types of products, inventory, delivery address, how to make a reasonable transfer price to further balance benefit distribution in dual channel, and how to share inventory information and then reduce the rate of customer loss.

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