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T. C. Edwin Cheng *Editors*

Sustainable Fashion Supply Chain Management

From Sourcing to Retailing

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Preface

Sustainability is a global issue. A sustainable supply chain is one that is environmentally friendly, socially responsible, and economically sustainable. In the fashion industry, disposable fashion under the fast fashion concept has become a trend. In this trend, fashion supply chains must be highly responsive to market changes and able to produce fashion products in very small quantities to satisfy changing consumer needs. As a result, new styles will appear in the market within a very short time and fashion brands such as Zara can reduce the whole process cycle from conceptual design to a final ready-to-sell "well-produced and packaged" product on the retail sales floor within 15 days. Interestingly, in this trend, debates relating to sustainability arise. For example, is this kind of disposable fashion under the fast fashion concept environmentally unfriendly? From the consumer's perspective, the answer seems to be definitely "yes" because consumers only use the fashion items for a short period before replacing them with new ones. The disposal of fashion products because they are "fashion-obsolete" creates waste and causes environmental problems. However, from the supply chain's perspective, the fast fashion concept helps to better match supply and demand and lower inventory. Moreover, since many fast fashion companies, e.g., Zara, H&M, and Topshop, adopt a local sourcing approach and obtain supply from local manufacturers (to cut lead time), the corresponding carbon print is more reduced. Thus, this local sourcing scheme under fast fashion would enhance the level of environmental friendliness compared with the more traditional offshore sourcing. Furthermore, since the fashion supply chain is notorious for generating high volumes of pollutants, involving hazardous materials in the production processes, and producing products by companies with low social responsibility, new management principles and theories, especially the ones that take into account consumer behaviors and preferences, need to be developed to address many of these issues in order to achieve the goal of sustainable fashion supply chain management. Despite being an important and timely topic, there is currently an absence of a comprehensive reference source that provides state-of-the-art findings on related research in sustainable fashion supply chain management.

In view of the above, upon the invitation by the Series Editor Professor Christopher Tang, we have co-edited this Springer research handbook. This handbook contains three parts, organized under the headings of "Reviews and Discussions," "Analytical

Research," and "Empirical Research," and features peer-reviewed papers contributed by researchers from Asia, Europe, and the USA. The specific topics covered include the following:

1. Reverse logistics of US carpet recycling
2. Green brand strategies in the fashion industry
3. Impacts of social media on consumers' disposals of apparel
4. Fashion supply chain network competition with ecolabeling
5. Reverse logistics as a sustainable supply chain practice for the fashion industry
6. Apparel manufacturers' path to world class corporate social responsibility
7. Sustainable supply chain management in the slow-fashion industry
8. Mass market second-hand clothing retail operations in Hong Kong
9. Constraints and drivers of growth in the ethical fashion sector: The case of France
10. Effects of used garment collection programs in fast fashion brands

We are very pleased to see that this handbook contains many new findings with valuable implications for sustainable supply chain management. We believe that the findings reported in this handbook not only provide important insights to academic researchers and practitioners, but also help lay the foundation for further research on sustainable fashion supply chain management. To the best of our knowledge, this book is a pioneering book that specifically explores sustainable fashion supply chain management in literature.

We would like to take this opportunity to sincerely thank Professor Christopher Tang for inviting us to develop this important book project and Mr. Matthew Amboy for his helpful advice along the course of carrying out this project. We are also very grateful to all the authors who have contributed their research to this handbook. We are indebted to the reviewers who reviewed the submitted papers and provided us with constructive comments. In particular, we thank Christy Cagle, Linda Chow, Kannan Govindan, Claire Hau, and Jerry Shen for their insightful comments on this book, and Hau-Ling Chan and Wing-Yan Li for their helpful assistance. We also acknowledge the funding support of The Hong Kong Polytechnic University. Last but not least, we thank our families, colleagues, and students, who have been supporting us during the development of this important handbook.

The Hong Kong Polytechnic University Tsan-Ming Choi and T.C.E. Cheng
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Contents

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Part I
Reviews and Discussions

Chapter 1
Reverse Logistics of US Carpet Recycling

Iurii Sas, Kristin A. Thoney, Jeffrey A. Joines, Russell E. King and Ryan Woolard

Abstract A high volume of post-consumer carpet (PCC) is discarded each year in the USA, placing significant pressure on landfills and leading to the loss of valuable materials contained in carpets. To explain factors that influence landfill diversion rates for different types of products, an overview of the reverse logistics framework in the literature is provided. The framework is used to analyze the current state of carpet recycling in the USA, and PCC recycling is shown to be a typical material recovery network. Therefore, because PCC recycling requires a high volume of carpet to be collected and transportation costs to be minimized for it to be economical, a well-organized reverse logistics network is critical. In this respect, a review of reverse network design studies for different products is provided and research conducted to design PCC collection and recycling networks is discussed in detail.

1.1 Introduction

While collection and reuse of some postconsumer products and materials, such as scrap metal, paper, and bottles, are not new concepts, these activities have been motivated by pure economic benefits for the collectors (Fleischmann et al. 1997). Other, less attractive, streams of postconsumer products have been largely ignored by both manufacturers and third-party firms and have been landfilled or incinerated (Ferguson and Browne 2001). This situation has begun to change in recent years due

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to growing environmental issues created by disposed products. Scarcity of landfills, harmful emissions and depletion of nonrenewable resources make both governments and consumers more concerned about proper treatment of products at the end of their life (Thierry et al.1995; Georgiadis and Vlachos 2004). Manufacturers are under increasing pressure to collect and reuse their old products coming from customers to minimize emissions and recover the residual value of the waste (Krikke 1998).

In 2012, 3.5 billion pounds of post-consumer carpet (PCC) was discarded in the USA (CARE 2013). Being a bulky product usually composed of synthetic materials, carpet occupies a significant volume of landfill space. In addition, valuable materials that can be recovered from carpet are lost when PCC is landfilled. Despite these issues, only 10 % of carpet discarded in the USA in 2012 was diverted from the landfills and only 8 % was recycled (CARE 2013). Such a low diversion rate may be attributed to the low economic attractiveness of carpet recycling. To make recycled materials competitive with virgin materials, the cost of recycled materials needs to be as low as possible. Due to the high bulkiness of carpet, the transportation cost of PCC is high which makes carpet reverse logistics a significant portion of the total cost of recycled materials.

In this chapter, reverse logistics of US carpet recycling is discussed. Section 1.2 provides an overview of the reverse logistics framework in the literature, and US carpet recycling is analyzed in terms of this framework in Sect. 1.3. Then, in Sect. 1.4, literature on reverse logistics network design is reviewed, with particular emphasis on network design for carpet recycling. Section 1.5 presents the conclusions.

1.2 Reverse Logistics

The main concerns of reverse logistics are efficient collection, transportation, recovery, proper disposal, and redistribution of products coming from consumers to maximize economic and environmental value at minimum cost (Krikke 1998). Reverse logistics is an important component of modern supply chains (de Brito and Dekker 2004) and can be defined as "the process of planning, implementing and controlling flows of raw materials, in process inventory, and finished goods, from a manufacturing, distribution or use point, to a point of recovery or point of proper disposal" (de Brito and Dekker 2004).

The combination of several aspects of reverse logistics determines the type of reverse system and consequently the issues that may arise in managing such a system. Four main characteristics of reverse logistics systems are discussed further, including motivation, activities, type of recovered items, and entities involved (Fleischmann et al. 1997). Combinations of different aspects define several typical reverse systems. Channel structure, coordination, and leadership have been shown to have an effect on reverse supply chain performance.

1.2.1 Reasons for Product Returns and Motivations for Company Involvement

The question of motivation covers two distinctive characteristics: why products are returned at all and why companies are willing to accept and manage these products. Starting with the former, the reasons for product returns may be classified in three groups that correspond to different stages of the forward supply chain, namely manufacturing returns, distribution returns, and customer returns (de Brito and Dekker 2004; Kumar and Dao 2006). Surplus of raw materials, rework of products due to low quality, and production leftovers are typical reasons for manufacturing returns. At the distribution stage, returns to a manufacturer may occur due to product recalls, products being unsold at the end of the season, outdated products, wrong or damaged deliveries, stock adjustment, and functional returns (e.g., packaging). Customers may return products to manufacturers due to customers' dissatisfaction, the mismatching of products to customers' needs, warranty service, and product end of use or end of life.

Economics and legislation are two main reasons that motivate companies to accept product returns. Recovery of valuable parts or materials from used products and avoidance of disposal costs are direct economic gains that companies can obtain from reverse logistics (de Brito and Dekker 2004). In-house remanufacturing or recycling of postconsumer products may be used to protect technologies from competitors. Taking responsibility for end-of-life products can improve company/product "green" image and preempt environmental regulation.

In addition to economic benefits, companies have to manage return flows to comply with legislation. Environmental regulation, especially in Europe, makes manufacturers responsible for their products that customers do not need anymore and want to dispose. In the USA, this regulation is less strict and tends to encourage recovery instead of mandating it (Guide and Van Wassenhove 2001). De Brito and Dekker 2004 identified corporate citizenship as an additional force driving companies to implement reverse logistics.

1.2.2 Activities Comprising the Reverse Supply Chain

In terms of activities involved, four main steps can be identified in reverse logistics: acquisition and collection of postconsumer products, inspection and grading, value recovery processing, and redistribution (Fleischmann 2001). These activities connect consumers that want to get rid of their old unneeded goods (also called disposal markets) with reuse markets, where collected goods, recovered parts, or materials are used again (Krikke 1998).

Collection is the only true "reverse" activity (Fleischmann 2001) because only at this step do products flow from consumers to firms (manufacturers or recyclers). This step involves transportation of small quantities or small numbers of disposed items

from many customers to their points of reuse. This results in collection costs that compose a significant part of the total costs of a reverse supply chain, especially in the case of bulky, low-value products (Fleischmann 2001). Depending on the type of product or material of interest, a collection scheme may utilize a waste management system (e.g., curbside recycling) or drop-off centers where customers bring their discarded products (Srivastava and Srivastava 2006).

Curbside pickup is a relatively expensive scheme because it requires trucks to travel significant distances without being completely loaded. Therefore, this scheme is typically used to collect products made of homogeneous materials that can be easily recycled at low costs (e.g., plastic containers, paper, glass bottles, and aluminum cans). In addition, products that should be kept dry to qualify for recycling can either not utilize this method or require additional expenses to provide households with packaging materials.

Establishing drop-off collection centers allows shifting some of the collection costs to the customers. However, some kind of motivation for the customers must exist, and it should be convenient for customers to carry their recyclables to the points of collection. Customers may be motivated to use drop-off collection points due to environmental consciousness, a ban on disposing the waste at local dumpsters, financial benefits, deposit systems, etc. (Guide and Van Wassenhove 2001).

Another way to decrease the collection cost is to combine collection with other types of activities (e.g., with distribution of new products, like new for old programs) or to utilize mail delivery services especially for small, high-value items (Fleischmann 2001). It is also important to take into account that if the recycling process requires high volumes of input to realize significant economies of scale, collection costs may be kept slightly higher (e.g., more collection centers or more frequent pickup) in favor of better coverage, higher collected volumes, and/or more stable flow of recyclables (Fleischmann 2001).

After collection, products should be graded by wear condition, quality, and type to identify the most value-added recovery option or the most environmentally friendly way of disposal. Early sorting is preferable to avoid unnecessary transportation of unrecyclable products and to direct recyclables to the appropriate recycling facility. Therefore, if this activity is inexpensive and fast, it may coincide with the collection. However, if sorting requires specific expensive equipment or highly skilled labor, centralized sorting facilities may be more economical (Fleischmann 2001). Consequently, the number and exact location of sorting facilities in the reverse supply chain depend on the product, and there is a trade-off between transportation costs and the annual operation cost of sorting facilities.

Legislation may impose additional constraints on the location of sorting operations. For example, many states in the USA do not accept waste from other states. So, waste should be separated from recyclable products within a state which reduces the possibility of centralization (Fleischmann 2001). Additional preprocessing operations, such as baling or shredding, may be used after grading to compact the materials and reduce transportation costs.

There are many recovery options that may be utilized in the reverse supply chain depending on the type and quality of end-of-life products. Returned products that

are new or as good as new can be directly resold to the same market or second-hand markets, which is called direct recovery (de Brito et al. 2005). Value-added recovery includes repair, refurbishing, and remanufacturing (Guide and Van Wassenhove 2001; Akdoğan and Coşkun 2012), where products are brought to like new conditions and are sold with some discount. Parts recovery or cannibalization is used when the product cannot be repaired to function properly or is outdated, but some of its modules are still working and can be used during manufacturing of new or remanufacturing of similar postconsumer products (Akdoğan and Coşkun 2012). Recycling converts postconsumer products to raw materials that can be used for production of the same product (closed-loop recycling) or products that require a lower quality of materials (down cycling). Finally, if any of the described options cannot be used, collected products and leftovers from other options are incinerated to recover energy. Direct, value-added, and parts recovery conserve product/part identity and are usually the most profitable and environmentally friendly because they allow avoiding many production steps in the forward supply chain.

Recovery steps usually require the highest investments (Fleischmann 2001). Remanufacturing or parts retrieval from complex products that consist of many modules may require a multistep reprocessing network where different repair or disassembling operations are performed at different stages. While a recycling network may involve one or two tiers, recycling equipment is usually expensive and built to realize economies of scale when processing high volumes of end-of-life products. When the original manufacturers are responsible for recovery, they may integrate some reverse logistics steps into the forward supply chain to reduce costs (Fleischmann 2001).

Finally, repaired products, recovered parts, or recycled materials are delivered to the consumers in the redistribution step. In many cases, this step resembles a traditional distribution network, especially when original manufacturers are owners of the reverse activities (Fleischmann 2001). Problems with redistribution may occur when retrieved parts are outdated or quality of recycled materials is lower than virgin materials. In this case, the most profitable markets should be found or new uses for the materials should be created.

1.2.3 Types of Recovered Items and Product Characteristics

As can be seen from reverse logistics activities, characteristics of the product have a great influence on the possible recovery options and on the design and profitability of the reverse supply chain. de Brito and Dekker (2004) identified the next important characteristics of returned products: composition, level of deterioration, and use pattern. Depending on the product and its characteristics, it can be refurbished, disassembled to retrieve components, recycled to recover the initial materials, or incinerated to recover energy.

The number of modules or materials as well as the way that they are combined together defines the complexity of the disassembly operations, the recycling technology required, and the quality of the recycled materials. If a product is designed for remanufacturing or recycling, the costs of these operations should be significantly

lower. Some products that are made of different types of materials (especially from different plastics) are difficult or impossible to recycle into separate streams of materials, and the resulting composite materials can be used for low-value products only, significantly reducing the profitability of recycling. In some cases, the only recovery option for such products is incineration to produce energy (Wang 2006). Size and weight of the returned product have a significant influence on transportation costs (de Brito et al. 2005).

The deterioration of products determines if parts or materials retrieved from them may be used in new products. Deterioration can occur due to physical aging or becoming outdated, where product components and materials are not used in new products anymore. In addition, deterioration can be nonhomogeneous, when a product can no longer perform its function due to problems with some components while other components are still functioning properly (de Brito and Dekker 2004).

Use pattern defines the location, intensity, and duration of use. Usually products that were bought for individual use are disposed of in small quantities; this increases collection costs, but products used by institutions may be returned in large volumes that are more economical to collect. Intensity and duration of use have a great influence on the deterioration of products (de Brito and Dekker 2004).

1.2.4 Entities Involved

Type of returns, type of products, economic benefits, and regulatory requirements define the set of entities involved in the reverse logistics systems for different products. Manufacturing and distribution returns have been a common practice for the forward supply chain for a long time. They occur between or even within one of the members of the forward supply chain, such as material suppliers, manufacturers, distributors, and retailers (de Brito and Dekker 2004).

Customer returns of new products or products for warranty service are also well-established processes. Customers can drop off these returns at retail stores or can send them using mail services. Manufacturers or distributors may contract third-party logistics companies to handle these returns. In terms of reprocessing, new products can be directly resold or sent to discount outlets (Tibben-Lembke and Rogers 2002). Warranty repair can be handled by the manufacturers themselves or they may contract specialized companies (Blumberg 2005).

Compared to new products and warranty service returns, returns of end-of-life products may involve a higher number of different stages in the reverse supply chain. In the case of end-of-life returns, consumers supply used products, which are “raw materials” for the reverse supply chain. Collection can be conducted by municipal and commercial waste companies (e.g., curbside recycling), specialized independent collectors, or collectors affiliated with the owner of the recovery process (Srivastava and Srivastava 2006). Recovered parts and materials can be sold or sent to end users of secondary materials in the forward supply chain. These end users may be traditional entities of the original forward supply chain, second-hand consumers, or other manufacturers.

An important consideration is the owner of the collection and recovery processes. Third-party collectors and recyclers can create their own recovery network if the resulting parts or materials can be sold at a profit. Original manufacturers may create their own collection networks to gain direct and indirect economic benefits or they can be forced to do so by legislation introduced by policy makers. Another way for manufacturers to respond to environmental legislation is to create a branch organization that will handle recovery of postconsumer products for an entire industry (de Brito and Dekker 2004).

1.2.5 Types of Reverse Networks

Before going into a discussion of typical reverse logistics networks, it is important to distinguish closed-loop recovery systems from opened-loop ones. Many authors define a closed-loop supply chain as a system that includes traditional forward supply chain activities and additional reverse activities (Guide et al. 2003). De Brito and Dekker (2004) argued that some kind of cycling should exist in the system to be defined as closed-loop. Therefore, collected products should be returned to the original manufacturer or collected products should be recovered to their original functionality.

The type and specific features of a reverse network are defined by a combination of several factors including type of items to recover, motivation, form of recovery, processes and entities involved, and owner of the recovery process (Fleischmann 2001; de Brito and Dekker 2004). Based on these criteria, Fleischmann (2001) identified four generic types of reverse logistics networks, namely networks for mandated product take-back, networks owned by original manufacturers for value-added recovery, dedicated remanufacturing networks, and recycling networks for material recovery.

The first type of reverse networks, networks for mandated product take-back, are initiated by the original manufacturers to comply with environmental regulation and to accept responsibility for the entire life cycle of their products (e.g., electronics, packaging, cars in the EU or batteries in the USA). Because such networks are motivated by legislation and not by economic benefits, the value recovered from products (usually through recycling) is small, and manufacturers usually try to minimize their costs rather than maximize their profits. Reverse activities are outsourced to specialized recycling companies with drop-off collection. Customers are charged for disposal through collection fees or via prices of new products. Industry-wide cooperation is common. Testing and grading is not important because separation of materials occurs at the recycling stage.

In contrast to the previous type of reverse systems, a value-added recovery network managed by the original manufacturer is designed to recapture value from used products (e.g., auto parts) and to generate profit. It is usually built as an extension of the forward supply chain to reduce investments and transportation costs and improve coordination of recovery activities with production. Testing and grading play an important role in maximizing the value recovered from used products. Testing is

centralized to benefit from economies of scale. The network is a complex, multilevel structure, due to the complex set of interrelated processing steps.

Dedicated remanufacturing networks are managed by third-party recyclers because there is an opportunity to make profit. Examples of such networks are auto parts, equipment, or tire recovery. Acquisition of used products and brokerage are the main activities to find the best matching secondary market for collected products. Recyclers have to build the entire network.

The last type of recovery network is a recycling network for material recovery. Such networks are usually organized to comply with or to prevent legislation. Both original manufacturers and material suppliers can play a significant role in the recycling. Material recovery recycling networks are characterized by low profit margins and high investments in recycling equipment. Therefore, the recycling activity is centralized at one facility to create high recycling volumes and to reduce processing costs. Sorting is not very important, but preprocessing is used to reduce transportation costs. The network usually consists of a small number of levels.

1.2.6 Channel Structure, Coordination, and Leadership

The structure of the reverse channel for collecting used products from customers, the degree of coordination between supply chain members, and the leadership within the supply chain can have a significant effect on the profitability of closed-loop supply chains. Savaskan et al. (2004) analyzed the effects of different collection and coordination options on the profitability of closed-loop supply chains for the case of product remanufacturing. They compared a centrally coordinated manufacturer–retailer collection system with three decentralized cases: collection by the manufacturer itself, retailer-based collection induced by providing sustainable initiatives from the manufacturer, and subcontracting collection activities to a third party. The study showed that if centralized coordination of collection is not possible (i.e., manufacturer does not own retailers), with proper sustainable initiatives and by aligning the objectives of closed-loop supply-chain members, retailer-based collection can increase the used product return rate, resulting in profitability comparable to the centralized case.

Choi, Li, and Xu (2013) studied the performance of a closed-loop supply chain consisting of a retailer, collector, and manufacturer. They studied cases in which the retailer was the supply chain leader, the collector was the leader, or the manufacturer was the leader. Based on their analysis, they concluded that a retailer-led closed-loop supply chain is superior to a manufacturer-led closed-loop supply chain. In addition, they found that in terms of the effectiveness of collecting used products, having a retailer-led closed-loop supply chain, rather than a collector-led closed loop supply chain, was best.

1.3 Current State of Carpet Recycling in the USA

This section discusses the most important aspects related to carpet recycling in the USA. Organizational and regulatory issues are discussed in Sect. 1.3.1. Section 1.3.2 discusses technical issues of carpet recycling as well as potential markets for recycled materials. The reverse supply chain is described in Sect. 1.3.3.

1.3.1 Organizational and Legislation Issues

The diversion of PCC from US landfills and recycling it into valuable materials have been considered for a long time. In the 1990s, big fiber producers developed chemical processes for the recovery of Nylon 6 (Honeywell) and Nylon 6,6 (DuPont and Monsanto) from used carpet (Peoples 2006). DuPont and Monsanto invested in pilot facilities only and did not extend their efforts to large-scale recycling due to lack of market interest and for economic reasons. Honeywell collaborated with Dutch State Mines (DSM) and built the Evergreen Nylon Recycling plant in Augusta, GA. However, the plant was closed in 2001 due to the low prices of caprolactam and problems with the collection of PCC (Peoples 2006). Later, Shaw Industries, Inc., the biggest carpet manufacturer in the USA, acquired the plant and reopened it in 2006.

In 2001, three states, Minnesota, Iowa, and Wisconsin, initiated discussions of carpet diversion. In 2002, these states, the US Environmental Protection Agency (EPA), and some nongovernmental organizations signed a memorandum of understanding (MOU), which set up a schedule of target diversion rate goals of PCC from landfills for the next ten years. To manage this project, a nonprofit organization, named the Carpet America Recovery Effort (CARE), was created. The goal of this organization was to facilitate the development of a nationwide carpet collection and recycling network to divert 40 % of PCC from landfills by 2012 (Woolard 2009). However, due to the recent economic downturn and limited outlets for materials recovered from PCC, the actual recovered volumes are far below the target values. According to the latest CARE report (CARE 2013), the diversion rate in 2012 was only 10 %.

In September 2010, California became the first state in the USA that passed a carpet stewardship bill (California Assembly Bill No. 2398 "Product stewardship: carpet"). All carpet sold in the state of California is subject to a $ 0.05 fee per square yard, which is added to the purchase price of all carpet. According to California's Department of Resources Recycling and Recovery (CalRecycle 2014), these fees are to be collected by manufacturers or a carpet stewardship organization that redistributes them to collection, sorting, and recycling businesses to encourage carpet recycling in California. CARE currently serves as the carpet stewardship organization. Manufacturers that sell carpet in California either need to be covered by CARE's stewardship plan or they must submit their own carpet stewardship plan (CalRecycle 2014). According to Werner Braun, Chairman of the CARE Board of Directors, "California

Table 1.1 Organizations and their role in the US carpet industry

Organization	Role in US carpet industry
Environmental protection agency (EPA)	Agency within the US government concerned with the environmental impact of carpet, "including issues of material use, production waste, indoor air quality, and ultimately, carpet disposal" (EPA 2014)
California's Department of Resources Recycling and Recovery (CalRecycle)	A department within the government of the State of California within the USA that promotes "waste reduction, recycling, and reuse" in the state (CalRecycle 2014)
Carpet America Recovery Effort (CARE)	Organization of carpet manufacturers, suppliers, flooring industry associations, carpet retailers, contractors, and recycling industry members dedicated to "advance market-based solutions that increase landfill diversion and recycling of post-consumer carpet" (CARE 2013)

is an ongoing experiment that so far has offered both encouraging results and significant challenges" (CARE 2013). Other US states are currently considering carpet recycling legislation (CARE 2013). A summary of the organizations discussed and their role in the US carpet industry are shown is Table 1.1.

1.3.2 Recovery Options for Post-consumer Carpet

The biggest problem with carpet recycling is its complex structure. Because it is designed to be used for a long period, a carpet consists of several layers made of different materials that are tightly bonded together. Some manufacturers are redesigning their carpet to be more recyclable. However, due to the long lifetime of a carpet, benefits from these efforts will not be seen until ten or more years from the introduction of such carpet to the market.

The majority of carpets sold in the USA are broadloom tufted carpet, which consist of face fibers, primary backing, bonding agents, and secondary backing (Wang et al. 2003). The face fibers, which can be made of nylon (N6 or N66), polyester (PET), polypropylene (PP), acrylic fiber, wool, or a mix of polymers are tufted to the primary backing and secured by latex adhesive by applying it under primary backing. Finally, secondary backing is bonded to primary backing (Mihut et al. 2001). Both primary and secondary backings usually are made from the same polymer (e.g., PP). The most common adhesive is styrene butadiene latex rubber (SBR) filled with calcium carbonate ($CaCO_3$). According to a recent estimate made by CARE, the content of face fibers in carpet is 35–40 % for residential carpet and 25–30 % for commercial carpet (CARE 2011a). On an average, the filler, backing, and adhesive represent 35 %, 10 %, and 9 % of the total weight, correspondingly (Wang 2006).

Since a carpet's composition differs depending on the type of face fiber and carpet end-use, different technologies are required to recover useful materials from PCC. In addition, the complex structure of a carpet does not permit the recovery of all materials in pure form. Therefore, these materials cannot be used in carpet production again but have to be marketed for different applications, where the quality of the material is less important.

The recovery options that may help to reduce the volume of carpet going to landfills include reusing it, refurbishing it, recycling it into other products with lower value, and recycling it in a closed-loop manner. Some PCCs are good enough to be reused again after trimming and cleaning them. Such carpets can be donated to charitable organizations that can resell them at reduced prices or redistribute them for free to low-income households.

Another approach is refurbishing or reconditioning carpets. Some companies accept their old carpets from consumers, and clean, recolor, and then sell them in secondary markets at reduced prices (Mihut et al. 2001). Companies that recondition carpet include Milliken and Interface, Inc. Both take back their commercial carpet tiles for refurbishing (Colyer 2005).

While reuse and refurbishing are probably the most economical ways to reduce the volume of landfilled carpet, they are limited in their application because most carpets are not good enough for reuse, and only a small portion of them can be refurbished. In addition, these options solve the problem only temporarily, just postponing the time when the carpet will be disposed of.

Methods to recycle carpets can be categorized into four groups: depolymerization, material extraction, melt-blending, and energy recovery. Depolymerization is a process to break down the used polymer into monomers via chemical reactions. These monomers are then polymerized again to produce the same polymer with virgin-like quality. Due to the high value of nylon, this process is used to recycle nylon fibers from carpets. A detailed discussion of the depolymerization process for nylon can be found in Mihut et al. (2001) and Wang et al. (2003). While both Nylon 6 and Nylon 6,6 can be broken down to monomeric units, depolymerization of the latter one is more complicated. The recycling of Nylon 6 is run at full scale at the Evergreen Nylon Recycling facility in Augusta, GA, which is currently owned by Shaw Industries, Inc. The quality of recycled nylon is high, and it is used in a blend with virgin nylon to produce face fibers for new carpet, forming a closed-loop carpet recycling chain. The plant can recycle 100 million pounds of Nylon 6 carpet into 30 million pounds of caprolactam (monomer for N6) (Delozier 2006).

Another way to recycle carpet is through extracting separate materials by mechanical methods. In this process, the carpet is grounded and then the components are separated based on density using air or liquids (Wang 2006). Alternatively, face fibers can be sheared or shaved from a carpet. Fibers are cleaned, sent to customers as is, or pelletized with the possible addition of some filler. While this process can be used on any type of face fiber, the purity of the resulting material is lower. It cannot be used in carpet production again but has to be directed to other applications, including different molded products (e.g., automotive parts, drainage systems) or carpet cushions (Colyer 2005; CARE 2011b).

The entire carpet can also be shredded without component separation, and the resulting fiber mixture can be used for concrete and soil reinforcement. Molded products (e.g., railroad crossties, fiber blocks), where quality of the resin is not very important, can be produced from composite resin obtained by melting all carpet components together. Some compatibilizer or reinforcing components (such as glass fibers) can be added to improve the properties of such melts. In the case of Collins and Aikman, this approach is used in closed-loop production, where their used nylon carpet with PVC backing is melted without separation and is used to produce a new backing called ER3 (environmentally redesigned, reused, recycled) (Fishbein 2000). If none of the options described above can be used due to economic reasons, the carpet or residuals from carpet recycling are usually burned with energy recovery.

Examples of some products made of materials recovered from PCC can be found on CARE's website (CARE 2011b). These include carpet cushions, erosion control systems, chambers for septic and storm water management, fiber blocks, automotive parts, and fuel made, in part, of carpet binders. However, the markets for these products as well as for the low-quality resins produced by melting carpets or their components are limited in size or the value of the resulting products is too low to justify investments in recycling equipment and collection networks. According to CARE's 2012 Annual Report (CARE 2013), there is an "alarming trend in polyester (PET) face fiber growth" due to the "lack of viable outlets for this material." Depolymerization of Nylon 6 obtained from face fibers seems to be one of best options to divert a significant volume of carpets from landfills. However, formic acid dissolution, another chemical recycling process that can be used to process both Nylon 6 and Nylon 6,6 and is implemented in a commercial operation in Delaware (CARE 2014), may also prove to be promising.

1.3.3 Reverse Supply Chain of Carpet

Acquisition of used carpets from consumers is the first step in the carpet reverse supply chain. This stage determines the volume of carpet that goes to recycling. There are several options to collect PCC, including sorting from general trash, aggregation at retail sites and collection at specialized centers (Woolard 2009). Sorting of carpets from general trash is problematic, since it is mixed with other waste and becomes wet and contaminated, making it inappropriate for recycling (Realff 2006). The issue with retail-based collection is that many retailers do not have enough space to store collected carpet and protect it from the outside environment (Realff 2006). The option where end-users or installers bring old carpets to specialized collection centers is the most attractive, and many individual companies specializing in carpet collection and recycling utilize this scheme. For example, 75 sites are listed at the CARE website as CARE certified collectors (CARE 2013). Used carpets can be delivered to their collection centers for a tipping fee.

After collection, a carpet has to be sorted and preprocessed. It is often difficult to identify different types of carpets by sight only. However, special equipment exists to

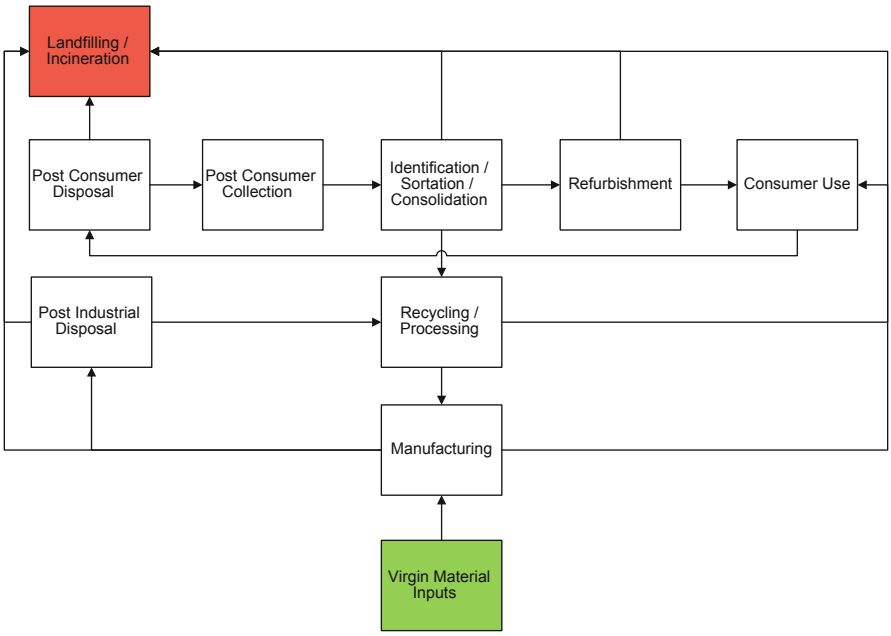

Fig. 1.1 Carpet closed-loop supply chain

sort carpets in manual or automatic modes. Sorting can be carried out manually with a portable spectrometer, which is labor-intensive (Wang 2006). If significant volumes are processed at a collection center, more expensive automated sorting equipment can be used (Realff 2006). Then, sorted carpets are baled to increase the amount of carpet that can fit into a truck to be shipped for further processing. Nonrecyclable carpets are sent to local landfills or incineration facilities.

The processing steps conducted at a recycling facility depend on the recycling options selected. In most cases, the carpet is shredded or ground to reduce its size. If a processor is interested in the recycling of face fibers only, they can be ripped off or shaved. After size reduction, carpets are used in the recycling processes discussed in previous sections, which includes caprolactam recovery from Nylon 6 carpet, mechanical separation of carpet to different material streams, melting the entire carpet to produce pellets or molded products, and incineration for energy recovery. Fig. 1.1 shows the flow of materials and connections of activity nodes in a carpet closed-loop supply chain.

According to the classification of reverse logistics networks proposed by Fleischmann (2001), carpet recycling is a typical material recovery network. The main motivation for organization of such networks is legislation requirements or attempts to preempt possible legislation. In the typical material recovery network discussed by Fleischman, both product manufacturers and material suppliers participate in recycling activities or form an industry-wide organization that is responsible for product

recovery. This recycling is characterized by low profit, and it requires significant investment in equipment; this can be justified only with high processing volumes. The network usually consists of a small number of levels, and transportation costs are a significant part of total costs.

1.4 Reverse Logistics Network Design

One of the most important tasks of a reverse logistics network is to convey used product from a "disposer market" to a "reuse market" efficiently (Fleischmann et al. 2001). In this way, returned products go through a set of reverse logistics activities, including collection, sorting, reprocessing, and redistribution. Analogous to the forward supply chain, the appropriate location of reverse activities and setting up links between them has a significant influence on the economic viability of the reverse network (Fleischmann 2001). During network design, the following decisions should be made (Akçali et al. 2009):

- How many facilities are required and where should they be located?
- What is the capacity of each facility and what tasks should each facility perform?
- How should the flow of materials or products between facilities be allocated?

While these decisions resemble the typical ones that arise during the design of the forward supply chain, some specific questions for reverse logistics are:

- How should returned products be collected to maximize the collection rate?
- Where should they be graded to avoid transportation of unrecyclable materials and to minimize investments into sorting equipment?
- What recovery options should be used to recover the maximum value?
- How many levels should be included in the network?
- How centralized should the recovery facilities be to realize economies of scale?
- Should the recovery network be an extension of the forward network or not?
- What links between the forward and reverse networks should exist?
- What are the markets for the recovered products/materials?
- How does the uncertainty of the reverse supply influence the network design?

The growing importance of effective handling and processing of returned flows of products has resulted in an increasing number of publications on network design for reverse and closed-loop supply chains. In many cases, these problems are similar to those of the forward supply chain and are often expressed as some modification of forward models. However, multiple recovery options for the returned products and the additional reverse activities, together with high uncertainty of returned volumes and the need for integration of the reverse and forward supply chains, significantly increase the complexity of the reverse network design.

This section provides a literature review of network design problems for reverse logistics applications. Section 1.4.1 discusses the literature in general, while Sect. 1.4.2 provides a more detailed explanation of those papers that focus on carpet applications.

1.4.1 Literature Overview

There is a series of review papers in the literature concerning network design for reverse logistics. De Brito and Dekker (2004) analyzed reverse network studies with respect to product, recovery activities, entities involved, and reasons and drivers of the recovery systems. As part of a broader review of facility location decisions in supply chain management, Melo et al. (2009) discussed network structures, performance measurements, and solution approaches utilized for reverse network optimization. The paper of Akçali et al. (2009) is focused on modeling and solution approaches used for network design in reverse logistics. The authors considered more than 30 papers, analyzing network structure and attributes, solution approach, computational testing, types of decisions, including location decisions, and cost elements included in the objective function.

Table 1.2 summarizes many studies related to network design for reverse logistics. The reverse activity column specifies for what step of the reverse logistics network or for what recovery option the model was designed. If this information was not specified in the corresponding study or if the model developed can be applied to any recovery option, the term "recovery" is used. This column also contains information about the type of products or materials considered. This is given within parentheses under the activity. The next column "Layers and Location Decisions" specifies the structure of the network. Layers in regular font were considered as fixed and facilities in layers given in *italic* font were located to optimize the objective function. If the list of layers for a study starts and ends with a layer of the same name, this means that the network considered was closed-loop. The next column, "Attributes," specifies some characteristics of the model, which include:

- *Fixed charge* vs. P-median
  - In this classification, P-median problems are problems aimed at locating a predefined number of facilities and allocating "customers" to them to optimize an objective, which is only a function of "customer"–facility distance. Fixed charge problems consider costs associated with opening facilities in the objective and in addition to location-allocation decisions, seek to find the optimum number of facilities to open.
- *Discrete* vs. continuous
  - Discrete problems select an optimum location of facilities from a limited set of potential locations where facilities can be opened. In continuous problems, facilities are located on a continuous plane.
- *Uncapacitated* vs. capacitated
  - Uncapacitated problems assume that facilities do not have limits on the volume of inbound and/or outbound flow. In a capacitated case, facilities can accept only limited flow volume from customers.

Table 1.2 Network design studies for reverse logistics

Reference	Reverse activity (case)	Layers and *location decisions*	Attributes	Solution approach
(Kroon and Vrijens 1995)	Redistribution (returnable containers)	Distribution center *Container depot* Distribution center	–	Not specified
(Wang et al. 1995)	Recycling (paper)	Used paper suppliers *Processing stations* Markets	Capacitated	MILP-solver Branch and bound
(Spengler et al. 1997)	Recycling (demolition wastes, industrial wastes)	Waste generators *Reverse facilities* Markets	Capacitated Multi-commodity	Benders decomposition
(Barros et al. 1998)	Recycling (sand)	Demolition projects *Regional depots* *Treatment facilities* Construction projects	Capacitated Multi-commodity	Linear relaxation, Branch and bound
(Marin and Pelegrin 1998)	Remanufacturing	Consumers *Plants* Consumers	–	Lagrangian relaxation
(Jayaraman et al. 1999)	Remanufacturing	Collection zones *Recovery facilities* Demand zones	Capacitated Multi-commodity	MILP-solver
(Louwers 1999)	Recycling (carpet)	Sources of used carpet *Regional preprocessing sites* Secondary consumers	Continuous Capacitated Multi-commodity Nonlinear	Nonlinear solver (E04UCF)
(Realff et al. 1999)	Recycling (carpet)	Collection sites *Sorting sites* *Processing sites*	Capacitated Multi-commodity	MILP-solver

Table 1.2 (continued)

Reference	Reverse activity (case)	Layers and *location decisions*	Attributes	Solution approach
(Chang and Wei 2000)	Collection (recyclable wastes)	Consumers *Drop-off stations*	P-median/max coverage Capacitated Nonlinear Multi-objective	Genetic algorithm
(Realff at al. 2000)	Recycling (carpet)	Collection sites *Processing sites* Markets	Capacitated Multi-period Multi-commodity	MILP-solver
(Fleischmann 2001)	Remanufacturing Recycling (copiers, paper)	Consumers *Disassembly centers* *Plants* *Warehouses* Customers	–	MILP-solver
(Jayaraman et al. 2003)	Recovery (returned products)	Origination sites *Collection sites* *Recovery sites*	Capacitated	Heuristic concentration, MILP-solver
(Realff et al. 2004)	Recycling (carpet)	Collection sites *Processing sites* Markets	Capacitated Multi-period Stochastic Multi-commodity	MILP-solver
(Sim et al. 2004)	Recovery	Consumers *Disassembly centers* *Plants* *Warehouses* Customers	Capacitated Multi-commodity Multi-period	LP-based genetic algorithm

Table 1.2 (continued)

Reference	Reverse activity (case)	Layers and *location decisions*	Attributes	Solution approach
(Listes and Dekker 2005)	Recovery	Markets *Collection centers* *Manufacturers* Markets	Capacitated Stochastic	Integer L-shaped decomposition
(Min et al. 2006a)	Collection	Customers *Initial collection centers* *Centralized return centers*	Nonlinear	Genetic algorithm
(Min et al. 2006b)	Collection	Customers *Initial collection centers* Centralized return center	Nonlinear Multi-period	Genetic algorithm
(Salema et al. 2006)	Remanufacturing (copiers)	Customers *Disassembly centers* *Factories* *Warehouses* Customers	Capacitated Multi-commodity	MILP-solver
(Ko and Evans 2007)	Recovery	Consumers *Collection centers* Manufacturers *Warehouses* Consumers	Capacitated Multi-period Multi-commodity	Genetic algorithm
(Lieckens and Vandaele 2007)	Recovery	Disposer markets *Recovery facilities* Reuse markets	Capacitated Nonlinear Stochastic	Genetic algorithm

Table 1.2 (continued)

Reference	Reverse activity (case)	Layers and *location decisions*	Attributes	Solution approach
(Listes 2007)	Recycling (sand)	Demolition projects *Regional depots* *Treatment facilities* Construction projects	Capacitated Stochastic Multi-commodity	MILP-solver L-shaped decomposition
(Lu and Bostel 2007)	Remanufacturing	Customers *Collection centers* *Remanufacturing centers* *Producers* Customers	–	Lagrangian relaxation
(Salema et al. 2007)	Remanufacturing	Customers *Disassembly centers* *Factories* *Warehouses* Customers	Capacitated Stochastic Multi-commodity	MILP-solver Branch and bound
(Üster et al. 2007)	Remanufacturing (auto parts)	Retailers *Collection centers* *Remanufacturing facilities* Distribution Centers Retailers	Multi-commodity	MILP-solver Benders decomposition
(Wang and Yang 2007)	Recycling (E-waste)	Collection centers *Storage sites* *Recycling plants* Demand sites	Capacitated Multi-commodity	Heuristic concentration, MILP-solver

Table 1.2 (continued)

Reference	Reverse activity (case)	Layers and *location decisions*	Attributes	Solution approach
(Aras et al. 2008)	Collection	Consumers *Collection centers*	P-Median Multi-commodity Nonlinear	Tabu search
(Kumar et al. 2008)	Recycling (paper)	*Collectors* *Dealers* *Sorters* *Recyclers* Manufacturers	Multi-commodity Multi-objective	MILP-solver
(Lee and Dong 2008)	Recovery (computers)	Customers *Warehouses* Manufacturers *Warehouses* Customers	Capacitated Multi-commodity	Tabu search
(Cruz-Rivera and Ertel 2009)	Collection (vehicles)	Consumers *Collection centers*	Multi-period	Lagrangian relaxation
(Kara and Onut 2010)	Recycling (paper)	Customers *Collection centers* *Recycling centers* Secondary customers	Capacitated Stochastic	MILP-solver
(Bucci et al. 2014)	Recycling (carpet)	Collection centers *Recycling centers*	Nonlinear	Constructive ADD, Alternative location Allocation

- *Single-period* vs. multi-period
  - While single-period problems are concerned with static location-allocation decisions assuming that all model parameters do not change over time, multi-period problems find the optimum evolution of the network over a planning horizon, depending on the dynamics of demand, costs, and other network parameters.
- *Deterministic* vs. stochastic
  - In contrast to deterministic models where all parameters are defined with specific values, in stochastic problems, there are uncertainties regarding some parameters that are incorporated into the decision process.
- *Single-commodity* vs. multi-commodity
  - In contrast to a single-commodity case where one type of product flows from one network layer to another, multi-commodity models consider several products that may have different transportation costs, require product-specific facilities, compete for common capacities, etc.
- *Linear* vs. nonlinear
  - In linear models, the objective and constraints are expressed with linear equations, which allow solving these models using (mixed-integer) linear programing techniques. In nonlinear models, the relationships are more complex and usually require different solution approaches.
- *Single-objective* vs. multi-objective
  - In contrast to single-objective problems, multi-objective models are designed to find the optimum location of facilities and balance between several, usually conflicting, criteria, simultaneously.

Values in *italics* in the list above are default values, and only deviations from these default values are specified in Table 1.2.

Table 1.2 shows that while there are several papers that consider the collection phase only, the majority of studies are designed to optimize the entire recovery process. The field of application of these models varies from demolition waste to electronic products. The structure of the discussed models varies from simple, open-loop, two-layer models with one optimization layer to complex, closed-loop systems that include four or more interrelated layers, most of which have to be optimally located. In addition to location decisions, all papers also define the allocation of lower-level nodes (customers or facilities) to higher-level nodes and volume of product that has to be directed through each path. It is also common for many studies to define a set of reverse logistics tasks that have to be carried out at each facility and to select the best transportation options between facilities.

All models given in Table 1.2 are discrete location models with one exception (Louwers 1999), where preprocessing facilities were allowed to be located anywhere within the studied region. In terms of the combination of model attributes, the studies vary from deterministic, uncapacitated, single-period, single-product, linear models with one objective to capacitated, multi-product, multi-period, nonlinear models with stochastic parameters and multiple objectives. The models with relatively small number of decision parameters and constraints were optimally solved with standard linear or nonlinear solvers with the possible utilization of branch and

bound or decomposition procedures. For larger problems, solutions were obtained using Lagrangian relaxation, heuristic concentration, heuristic expansion, tabu search, genetic algorithms, or combinations of these heuristics.

1.4.2 Reverse Logistics Network Design for Carpet Recycling

As can been seen from Table 1.2, the published literature on reverse logistics network design for carpet recycling consists of the studies of Louwers (1999), Realff et al. (1999, 2000, 2004), Realff (2006), and Bucci et al. (2014). In addition, research on setting up carpet collection and carpet recycling networks in the USA has recently been completed by Sas (2013). In this section, a detailed overview of each of these studies is provided.

Louwers (1999) developed an optimization model to locate an intermediate layer of regional preprocessing centers between the sources and processors of PCC. The model was applied to cases of carpet recycling in Europe and the USA. The problem was formulated as a single-period, multi-commodity, capacitated, continuous model with three layers. The PCC collected at the sources was transported to the preprocessing centers, where it was sorted and compacted. The recyclable carpet was shipped to the processors, and the other carpet was shipped to landfills or incineration facilities. The model objective was to minimize total costs, which included PCC acquisition costs, transportation costs, storage costs, preprocessing costs, and disposal costs. The decision variables were capacities, number and location of preprocessing centers, quantities shipped from each source to each preprocessing facility, and quantities of each material shipped from each preprocessing facility to each processor or disposal site.

Realff et al. (1999, 2000, 2004) and Realff (2006) published a series of papers concerning carpet recycling in the USA. In general, the model used for these studies can be described as follows. The PCC was collected at predefined locations within the USA. The collection volumes at each site were proportional to the population. Reverse logistics tasks included sorting and three types of reprocessing: depolymerization of Nylon 6, depolymerization both of Nylon 6 and Nylon 6,6, and shoddy production. Two different sets of potential locations for two depolymerization processes were given. Sorting could be set up at any collection point or processing site. Both sorting and recycling processes were capacitated, and recycling sites could set up a depolymerization process with three different capacities. Carpet collected at processing sites could be sold from one site to another, converted to secondary materials, or disposed for some fees. The model objective was to maximize the net revenue by locating processing sites and sorting operations, and defining the transportation modes between sites and volumes of carpet shipped. Revenue was generated from the sales of recycled materials, and costs included the fixed cost to open sites and to set up storage, collection, transportation, and/or recycling capabilities at sites, and variable storage, collection, processing, and transportation costs.

This model was used to study the influence of collection volumes and different assumptions about possible site locations on the net revenues of a nationwide recycling system and a recycling system in the state of Georgia within the USA. Later, the model was used for the robust design of a nationwide carpet recycling system to account for unpredictable collection volumes and prices of recycled materials.

Bucci et al. (2014) studied a large-scale carpet recycling network in the USA. The network consisted of two layers: 400 collection centers located in the most populous 3-digit ZIP codes and recycling centers that can be located at any 3-digit ZIP code. The model objective was to minimize cost, which included fixed costs to open recycling centers, transportation costs between collection centers and the closest recycling center, and processing costs. The latter was modeled to be volume-dependent. The model was solved using a metaheuristic that allows optimizing large-scale network design problems with economies of scale. The metaheuristic was a constructive add procedure combined with a discrete alternate location-allocation (ALA) procedure. Through comparison with CPLEX, the metaheuristic was shown to find near-optimal solutions for problems without economies of scale. Bucci et al. (2014) solved a series of problems with increasing annual collection amounts. As the annual collection amount increased, the optimal number of recycling centers increased. In addition, the optimal locations and allocations of recycling facilities changed moderately, demonstrating the importance of long-range planning to minimize costs.

Sas (2013) focused on two aspects of a carpet reverse logistics problem in the USA: the location of collection centers and the design of the recycling network. For the collection problem, he assumed that PCC was generated at the population centroids of all 5-digit ZIP codes with a population greater than zero (32,515 supply points of old carpets) and that the volume of carpet generated at each location is proportional to the population. The potential locations of the collection centers were the population centroid of all 5-digit ZIP codes, including those with zero population (41,237 potential locations). This problem of locating collection centers was formulated as a set covering optimization model with partial coverage. In order to solve very large instances of this NP-hard problem, a novel greedy randomized heuristic was created by combining and extending greedy approaches for similar problems available in the literature. Computational results showed that the heuristic performs better than other greedy heuristics proposed in the literature for similar types of problems and that the heuristic found near optimal solutions for those problems that CPLEX could solve. By applying the heuristic, a set of nationwide collection networks utilizing different target collection rates was designed. Two different cases were considered: one extended the current collection network and another built a new collection network. As the target collection rate was increased, the number of collection centers increased exponentially. From this relationship, Sas (2013) concluded that an appropriate target collection rate could be established by considering the effort and investment required to build the corresponding collection network.

In the second part of Sas' (2013) research, the design of a recycling network for Nylon 6 carpet was determined. Three alternative network designs for a nationwide carpet recycling system were developed and compared. In two scenarios, the networks included layers of local collection centers, recycling plants, and markets for

recycled materials. In the third scenario, a layer of regional collection centers was inserted before the recycling plants to aggregate carpet for more efficient sorting and transportation. To find the optimal number and location of the recycling plants (and regional collection centers) and the optimal flows among network facilities, a hierarchical facility location model was formulated. To solve large instances of the problem, a heuristic method based on the alternative location–allocation procedure was developed, and a computational study was conducted to assess its performance. The scenario that included the intermediate layer of regional collection centers reduced the total cost of the network significantly. The cost of recycled Nylon 6 was determined to be very sensitive to the utilization of the recycling plants. The study concluded that in order to minimize cost, the recycling network should receive a sufficient volume of carpet to operate the recycling plants at full capacity.

1.5 Conclusions

This chapter focused on the reverse logistics of US carpet recycling. Despite the high volume of carpet disposed in the USA each year, which leads to the loss of valuable materials and puts significant pressure on landfills, the carpet diversion rate is low. To explain factors that influence the recovery rate of different products, Sect. 1.2 provided a review of the reverse logistics framework from the literature. Section 1.3 discussed the current state of carpet recycling in the USA and analyzed it in respect to this framework, demonstrating that transportation cost is a significant portion of total carpet recycling costs. In such settings, well-organized reverse logistics networks are very important. Section 1.4 provided an overview of network design problems for reverse flows of different products as well as a more detailed discussion of papers focused on the design of carpet reverse networks.

Carpet recycling in the USA was shown to be a material recovery network, as per the classification of reverse logistics networks proposed by Fleischmann (2001). Material recovery networks include those networks established by industry-wide organizations that have been formed to preempt possible legislation. They typically have low profits, large recycling equipment costs that require high processing volumes to be economically feasible, and transportation costs that make up a large portion of total cost.

CARE was established in the USA in 2002 to aid in developing a carpet collection and recycling network. However, it fell short of its original goal of diverting 40 % of PCC from landfills in the USA by 2012 and was only able to divert 10 % (CARE 2013). While it seems that CARE members had hoped that opportunities for making money alone would inspire entrepreneurs and carpet manufacturers to develop the innovations necessary to divert sufficient amounts of PCC from the landfills, governments within the USA seem concerned about the rate of progress. In September 2010, California became the first state in the USA to pass a carpet stewardship bill

that places a special tax on carpet that is used to encourage carpet recycling in California. Several other states in the USA are considering similar legislation (CARE 2013).

Regardless of the ultimate combination of free market opportunities versus legislated requirements in the USA, research into all of areas of carpet recycling is crucial to prevent billions of pounds of carpet from being disposed of in US landfills in the most cost-effective manner. There is clearly a need for identifying new markets for recovered carpet materials as well as developing new recycling techniques and improving existing ones. However, because logistics costs are often a significant part of the costs of recycling carpet and high volumes of PCC are usually necessary to keep processing costs manageable, network design issues are also of great importance. There has been quite a bit of research on network design for general reverse logistics problems and some for carpet applications. All studies of reverse network design for PCC focused on national collection/recycling networks, mainly for recovery of Nylon from carpet fibers. While this seems to be the most feasible option, incorporating other recovery options, such as melt-blending, down-cycled products, and waste-to-energy, in a model may lead to new insights into network structure and profitability. In addition, all papers considered reverse carpet recycling networks separately from the forward supply chain. However, locating collection, preprocessing, and recycling facilities close to/at existing retail stores, distribution centers, and production plants may reduce the investment required to build such a network, and coordinating forward and reverse flows may have an effect on transportation costs.

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Chapter 2
Green Brand Strategies in the Fashion Industry: Leveraging Connections of the Consumer, Brand, and Environmental Sustainability

Hye-Shin Kim and Martha L. Hall

Abstract With a growing number of major fashion brands engaging in green-branding initiatives, environmental sustainability is becoming a management agenda that is being prioritized among many companies. However, the research literature is mixed in assessing the potential of the green strategy. Based on the schema theory as the theoretical framework, this chapter offers propositions that address how to leverage the interrelationship among the consumer, brand, and environmental sustainability within the context of green-branding strategies for fashion. Supported by the research literature and current movements in the fashion industry, this chapter explains how consumer receptivity to and decision making with regard to green fashion brands are influenced by the relationship between (1) consumer and environmental sustainability, (2) brand and environmental sustainability, and (3) consumer and brand. Consumer acceptance of green brands is dependent on how consumers process new green information within the context of the brand schema. Consumer motivation and ability to incorporate environmental sustainability within the brand schema will influence consumer attitudes toward the green brand. Also, the perceived fit between the brand and environmental sustainability as well as the authenticity of the business strategy will influence consumer response. In addition, consumers' ability to integrate the fashion brand's image with environmental values and the strength of their relationship with the brand will determine how green brand attributes are accepted. Industry implications for green branding are discussed and recommendations for future research are presented.

2.1 Introduction

According to a survey of 4000 managers from 113 countries, 70 % of companies have placed environmental sustainability permanently on their management agendas with two thirds of the managers noting this as a necessity to be competitive (Haanaes et al. 2012). Likewise, strategies related to environmental sustainability are active in the apparel industry. An increasing number of apparel brands are placing environmental

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sustainability at the center of their brand strategy (e.g., Patagonia, Stella McCartney, and Loomstate) and are positioned to benefit from the predicted growth in this market. Furthermore, a growing number of major brands are being reported in the media for their initiatives in environmental sustainability (e.g., Ann Inc., Gucci, LVMH, Macys, Ivanka Trump). As such, we see a growing commitment to environmental sustainability, with companies not only viewing this as a necessity to their business practices but also a source of financial profits (Haanaes et al. 2012).

Fashion brands can be considered "green" based on the intrinsic characteristics of the apparel product, the process by which the product is made, and/or their environmental contributory business practices (Dickson et al. 2009). Long-established apparel brands, including H&M, Eileen Fisher, and Levi Strauss, have responded to consumer and industry-wide interest in environmental sustainability through innovative and strong branding strategies in product design, development, and sourcing. H&M's Conscious garments offer products from organic cotton, recycled cotton, recycled polyester, and vegetable tanned organic leather. H&M's goal is to have 100 % of their cotton from sustainable sources (Reduce Waste n.d.). In addition, H&M's closed-loop system allows consumers to hand in unwanted garments from any brands at any H&M stores. Closed-loop systems keep unwanted apparel products out of landfills, with some companies (e.g., lingerie brands Wacoal and Bonluxe in Hong Kong) offering cash incentives for consumer participation (Choi et al. 2014). Levi's Water < Less^{TM} products reduce the use of water in the finishing process by up to 96 %. According to Levi's website, the company has made over 13 million Water < Less^{TM} products and saved over 172 million L of water (Levi's® Water 2014). In Patagonia's Common Threads Program, organic cotton and recycled polyester are used in many of their products, efforts are made to minimize packaging and transportation waste, and quality products are produced that last a long time. Urban Outfitters' Urban Renewal-Vintage line features original and reworked vintage pieces and garments (May 2014; "Urban Renewal" n.d.). Finally, Eileen Fisher's Eco Collection line includes classic and well-made garments that can be worn a long time and seamless knits that cut down on waste ("Meet Eileen Fisher" n.d.). Fashion brands are also considered green with their support of environmental causes (Milne 2013). For example, apparel brands who are members of 1 % for the Planet (http://www.onepercentfortheplanet.org), contribute 1 % of their annual sales to environmental nonprofit organizations. In addition, companies routinely support environmental causes as part of their corporate culture where sales of the green brand apparel products indirectly support various environmental causes. Loomstate (http://www.loomstate.org) is one apparel company which actively participates in multiple local, regional, and international environmental programs. Consumers purchasing Loomstate T-shirts indirectly support company participation in beach cleanup projects, wildlife conservation efforts, and upcycling projects.

As such, we are witnessing a growing number of big companies make management decisions to weave environmental sustainability within their products and business operations. In spite of the common practice of the "greening" of brands, the literature is mixed in assessing the actual potential of a brand's green strategy and its receptivity by consumers. In the research literature, many studies show a weak relationship

Fig. 2.1 Model of relationships that influence green branding

between environmental concern as predictors of corresponding environmental behavior (e.g., Fransson and Gärling 1999; Hiller Connell and Kozar 2013). Also, a 2013 report published by Landor Associates (Romero and Braun 2013) states that "U.S. consumers appreciate corporate efforts to be green, but it is not a key driver in their purchasing decisions" (p. 1). The report notes that although being green was a considered brand attribute, it fell behind other basic brand attributes such as value, quality, and trustworthiness. Although some evidence shows a potential disconnect between consumers and green-branding strategies, there is still a strong market that expects companies to consider environmental sustainability within their business decisions. Cone Communications (2013) reports that 71 % of Americans consider the environment when they shop and 45 % of consumers actively seek out environmental information about products they buy.

This chapter offers a discussion of the interrelationship among the consumer, brand, and environmental sustainability within the context of green-branding strategies. Using the schema theory, we explain how consumer receptivity to and decision making with regard to green fashion brands are based on three connections: (1) consumer and environmental sustainability, (2) brand and environmental sustainability, and (3) consumer and brand (see Fig. 2.1). Consumer acceptance of green brands is dependent on how consumers process new green information pertaining to the brand. Whether consumers develop positive attitudes toward the new green attribute or new green brand extension is dependent on how the green strategy brand fits into consumer motivation and ability to incorporate environmental sustainability within the brand schema, consumer's perceptions about environmental sustainability in relation to the brand, and consumer's strength of relationship with the brand.

2.2 Conceptual Background

The schema theory focuses on the importance of the mental structure or schema of preexisting ideas or framework that represents one's understanding and knowledge related to particular aspects of an individual's experience such as an event, person, or object (Rumelhart 1980). Based on one's existing knowledge framework, schema also serves as a system for structuring, organizing, and interpreting new information (Crocker et al. 1984). Consumers' schema of brands can include their knowledge about brand attributes and their evaluations of the brand. As such, a schema has an influential role in how new knowledge is processed and accepted.

The schema theory has been used as the theoretical base in the brand management literature to explain consumer response to brand extensions or sub-brands where firms leverage the association of successful established brand's category extensions or line extensions (Chatterjee 2009; Park et al. 1993; Loken and Roedder John 1993). The schema theory also explains attitude and belief change and how consumers evaluate brands (Park et al. 1993). Specifically, theories of stereotypic change (Crocker et al. 1984), which is grounded in the schema theory, supports the idea that attitudes and beliefs change in response to new stimuli that vary in congruence with an individual's existing schema (Crocker et al. 1984; Park et al. 1993). While schemas can mature with increasing experience to fit varied experiences, individuals can be exposed to information incongruent with the schema in which case knowledge structures must be modified to accommodate the incongruent information. Several information-processing models (e.g., subtyping, book-keeping, conversion) have offered insight into how individuals may integrate existing knowledge with new knowledge resulting in an impression that is meaningful to them (Chatterjee 2009; Gürhan-Canli and Maheswaran 1998; Weber and Crocker 1983). The subtyping model suggests that consumers process new information that does not fit into their current schema in a compartmentalized way. For example, if a brand extension does not share similarities to the parent brand, consumers will store information concerning the brand extension in a separate cognitive category which limits the negative impact of atypical information. The book-keeping model suggests a gradual modification of schema with a higher accumulation of incongruent information prompting more substantial change (Weber and Crocker 1983). Here, the book-keeping model views attitude change as an incremental process triggered by sustained informational influence. Finally, the conversion model suggests schema to change drastically in response to extremely atypical information and remain unchanged in response to minor differences. Sudden changes in brand attributes or introduction of dramatically atypical information perceived as being unrelated or contradictory to the current impressions of the brand may prompt perceptual changes in brand image.

Within the fashion industry, we see a growing number of green brands that leverage the brand equity of the current or parent brand. The schema theory can also be applied within the context of firms introducing green attributes within existing product brands where consumers must process new information using their own existing schemata for the brand. However, the stability of the schemata and brands and their influence on

consumer attitude change may differ depending on the consumer, their green values, and perceptions of brands. Using the schema theory as the conceptual framework, this chapter offers insight into how consumer response to green-branding efforts is moderated by the three important connections among environmental sustainability, consumer, and the brand. Based on a literature review of theoretical and empirical studies, the propositions formulated within the chapter summarize past studies on green branding and offer ideas on how consumers process and respond to green brands, which will be moderated by their own environmental sustainability values, perceptions of fit between the brand and environmental sustainability, and the strength of their preexisting relationship with the brand.

2.3 Leveraging the Connection Between Environmental Sustainability and the Consumer

Consumer attitude toward environmental sustainability, also known as environmental or "green" attitude, is a function of individuals' beliefs, feelings, and behaviors related to environmental issues (Schultz et al. 2004; Milfont and Duckitt 2004, 2010). Through the years, marketing research has examined consumer perceptions of green products and related marketing activities (e.g., Kim and Choi 2005; Kinnear et al. 1974; Roberts 1996; Straughan and Roberts 1999; Gam 2011). Results from these studies do not consistently show strong relationships between attitude and behavior. While some studies have found environmental attitudes to be directly linked to environmentally sound consumption (e.g., Kim and Choi 2005; Lee 2008, 2009; Van de Velde et al. 2010), other studies note various factors, including cost, availability, and beliefs about the green product itself to serve as barriers to consumer purchase (Costa 2010; Chan and Wong 2012; Fransson and Gärling 1999; Grail Research 2011; Hiller Connell and Kozar 2013; TerraChoice 2010). Several apparel studies offer evidence that environmental attitude influence intentions to purchase green apparel (e.g., Gam 2011; Hustvedt and Dickson 2009; Yoo et al. 2013). Results from these studies can be supported by Strahilevitz and Myers's (1998) findings that cause-related marketing campaigns for high-involvement products such as apparel have a higher likelihood of influencing purchase decisions. Although several empirical studies examining consumer perceptions of green messages via apparel product advertisements or labeling can be found in past literature (e.g., Kim and Damhorst 1999; Kim et al. 1997; Stall-Meadows and Davey 2013; Sonnenberg et al. 2014), studies that examine consumer perceptions of green fashion brands are limited. In one study, Yan et al. (2012) found environmental commitment to directly influence attitude toward the brand and intent to purchase the product and Myers et al. (2012) found consumer attitude toward a cause and prior brand attitude indirectly influenced post brand attitude. Several non-apparel related studies also point to the direct relationship between environmental attitude and green brand attitude (e.g., Hartmann and Apaolaza-Ibanez 2012; Yeoh and Paladino 2013). Although conclusions concerning green brand attitude and purchase behavior are less clear, previous studies

consistently offer evidence that consumers with higher levels of environmental concern will more likely have favorable attitude toward products or related company efforts that support environmental sustainability.

Based on the schema theory, we propose that consumers with higher environmental attitude will have a predisposition to draw a natural connection between environmental sustainability and products and brands. Even if the brand has no previous track record with environmental sustainability, environmentally conscious consumers will be more willing to incorporate the green attribute within their current parent brand schema and thus form a positive response toward green brands. The following proposition reflects this idea.

Proposition 1 Consumers' environmental sustainability value positively moderates consumers' motivation to fit new green brand attributes into the current fashion brand schema.

In the case of apparel, sustainable business practices are often linked to the design and production processes for products within the same product line or category. Consumer preference for product-related messages compared to cause-related messages highlight the importance of green strategies that are linked directly to the product (Phau and Ong 2007). Yan et al. (2012) found respondents favored apparel brands with explicit information about environmentally friendly products. Several studies point to how consumers respond to green strategies in various marketing contexts (e.g., promotional messages, labeling, and advertisement). Hiller Connell (2010) found lack of concrete knowledge to be a constraint on green apparel consumption. Kang et al. (2013) found knowledge of organic cotton apparel influenced consumers' attitudes toward the organic product. Cheah and Phau (2009) found ecoliteracy to influence attitude toward a wide range of environmentally friendly products. Borin and Cerf (2011) note that clear explanations of environmental impact on labels will improve consumer evaluations. A study by Cone Communications (2013) reports that 85 % of respondents want companies to educate them on how to properly use and dispose of products. Chatterjee (2009) found that consumers were more likely to purchase green brand extension with higher environmental impact. This reasoning indicates that the ability of the consumer to be able to understand the evidence behind the green strategy is critical to the success of a green strategy. Interestingly, a study by D'Souza and Taghian (2005) indicates that consumers who were more highly environmentally involved tended to be more critical to green advertisements.

When considered within the context of how consumers connect green strategies with fashion products and brands, we assume that consumers with higher levels of knowledge of product development and production processes will have a better understanding of the environmental implications of the green strategy of the fashion brands. Consequently, consumers' ability to better understand the environmental implications of fashion products will also influence formation of their environmental attitude. Working under the assumption that the green strategy is meaningful, we propose that consumers with higher product and production knowledge will be

predisposed to recognize and accept the natural connection between environmental sustainability and fashion brands. The following proposition reflects this idea.

Proposition 2 Consumers' knowledge of product development and production processes of fashion products is positively related to consumers' ability to understand how environmental sustainability fits within a fashion brand schema.

2.4 Leveraging the Relationship Between Environmental Sustainability and the Brand

As consumer perceptions of the relationship between environmental sustainability and the green brand are important, green brands must be able to position themselves as authentic players in the green brand market. The brand's current image within the consumer market, whether consumers' see a good fit between the brand and green strategy, and how the brand's environmental strategy is communicated as part of their new market positioning are important factors. This section discusses how companies can strengthen their green brand strategy through communication strategies and aspects of brand image that support its connection with environmental sustainability.

A study by Landor Associates (Romero and Braun 2013) show advertizing and brand's own websites to be the most powerful ways to increase awareness and knowledge of a brand's environmental practices. Green brand communication needs to be an integrated strategy "consisting of deliberate and proactive actions aimed at the definition of distinct consumer perceptions" (Hartmann et al. 2005). A successful green brand must distinguish itself in the marketplace from other green brands in such a way so as to be distinctive to consumers. Studies indicate that consumers frequently receive green-marketing communication where the validity of environmental claims are in question, confusing, or unverifiable (Bonini and Oppenheim 2008; Yan et al. 2012). Ng et al. (2014) found a brand's credibility to be influential in green brand perceptions. Sound green branding increases consumer trust and creates brand loyalty (TerraChoice 2007). According to Chatterjee (2009), brand managers need to discern the perceived value of the green brand extension and conceive and maintain an appropriate marketing strategy for maximum brand equity.

The credibility of a company's environmental values is influenced by whether the new green branding-based knowledge fits into the existing consumer schema of the apparel brand. For example H&M's recent marketing campaign highlights the brand's sustainable apparel collection called "Conscious." This H&M collection of "green" apparel products is built on several environmental consumer commitments, from textile sourcing to factory working conditions. Fernandez (2013) notes that albeit well-intentioned, the Conscious collection is inherently paradoxical when compared with H&M global distribution practices of fast fashion. Fast fashion offers consumers products at lower prices and quality where the idea is to encourage frequent purchases while offering consumer gratification with relatively disposable

products. These types of brand associative incongruities can become problematic with green-branding credibility, which may ultimately lead to misalliances between consumer schema of brand and green-branding efforts. We propose that a more effective brand's green strategy should be implemented where consumers' perceive a company's environmental values to be authentic.

Proposition 3 Consumers respond more positively to green brands with authentic environmental values and credible environmental business strategies which influence perceptions of fit between the green brand strategy and brand schema.

Effective communication of brand attributes is important to the successful positioning of distinctive and competitive green brands (Hartmann et al. 2005). Aaker and Joachimsthaler (2000) note the importance of actively communicating a brand's identity and value proposition to customers. Although the importance of communicating green brand attributes is noted (Pickett et al. 1995), relying on a brand strategy that solely depends on its functional attributes is limiting. Most of past research literature relates to the influence of cognitive and rational factors (e.g., environmental concern, environmental knowledge) that lead to positive consumer response to green strategies (e.g., Hyllegard et al. 2012; Kim et al. 1997; Kim et al. 2012; Lee et al. 2012).

According to Keller (2013), effective branding goes beyond communicating performance and rational benefits but also emotional benefits. Indeed, as some studies show a weak connection between cognitive factors such environmental concern and environmental knowledge with purchase behavior (e.g., Fransson and Gärling 1999; Hiller Connell and Kozar 2013), several scholars (e.g., Coddington 1993; Hartmann et al. 2005) have recommended a need to incorporate emotional appeals as a means to build an affective relationship with consumers. In a study of green positional strategies, Hartmann et al. (2005) found that advertisements that combined both functional attributes and emotional benefits achieved a stronger brand attitude. Also, an experimental study by Matthes et al. (2014) found emotional and the functional and emotional mixed-type ads significantly affected brand attitude whereas functional ads only impact brand attitudes when consumers' green involvement was high.

For fashion products, there is a fine line between using cognitive elaboration versus emotional involvement in consumer decision making. Decisions related to fashion products are associated with individual preferences for and social acceptance of design and style as well as evaluation of fit, quality, and value. Although almost all brands can be identified and described by customers' emotional response, emotions can be used to describe consumption behavior of many fashion brands in particular. Green fashion brands may better be able to incorporate their green brand attributes and emotionally appeal to a customer base that is accustomed to identifying brands in an affective way. For example, fashion designer Stella McCartney's website offers not only informative details of her green product line but also evidence of sustainability as part of the brand's values and mission. The brand website offers a strong commitment to sustainability in its products, product development, and co-branding opportunities with Adidas. The outdoor apparel brand

Nau (http://www.nau.com/) positions its brand as embodying style, performance, and sustainability and is branded as an environmental lifestyle company. Similar to Stella McCartney, Nau's website also presents a strong commitment to environmental sustainability with an informative website that details sustainability as being part of the company's genetic make-up. Nau's website offers the brand's perspective on sustainable fashion as being intertwined with decisions related to design and development. Whereas Stella McCartney is represented as an eco-chic contemporary upscale fashion brand, Nau exudes a Zen-like presence of simplicity and calm.

We propose that consumers are able to better modify their brand schema with persuasive communication that leverage both the functional and emotional appeal of green brands. As functional appeals may be better evaluated by consumers with higher levels of environmental awareness, emotional appeals are necessary to achieve a strong brand attitude among the general consumer group. Consumers are accustomed to developing fashion brand images based on communication strategies that incorporate various dramatic and fantastic imagery and emotions. As such, green brand communication strategies that emotionally appeal to consumers and build affective relationships should be impactful.

Proposition 4 Consumers are able to modify their brand schema when supported by marketing communications strategies that incorporate both functional and emotional appeal of green fashion brands.

2.5 Leveraging the Relationship Between the Consumer and the Brand

Branding is a means employed by brands to distinguish their products from competitors through the creation of awareness and reputation (Keller 2013). Keller (2013) states, "These differences may be rational and tangible-related to product performance of the brand-or more symbolic, emotional, and intangible-related to what the brand represents" (p. 3). In the case of brand extensions where established parent brand names are used to introduce new products, many studies have noted the influential role of parent brands on consumer attitudes toward the new brand extension (e.g., Czellar 2003; Pina et al. 2013; Völckner and Sattler 2006). The perceived fit between the parent brand and extension as well as consumers' impressions of the parent brand is influential in the success of the new brand (Pina et al. 2013; Völckner and Sattler 2006). The success of any green-branding strategy is important so as not to negatively impact the parent brand (Chatterjee 2009). Given the growing offering of green brands, many of which may hold negative perceptions with regard to authenticity, quality, and price competitiveness, parent brand equity will play a bigger role in how consumers evaluate green brands. Current customers are more likely to consider and favor brands with which they are familiar.

The subtyping model suggests that consumers process new information that does not fit into their current schema in a compartmentalized way. For example, if a

new brand strategy does not share similarities with the brand, consumers will store information concerning the new brand attribute in a separate cognitive category which limits the negative impact of atypical information. In their study of green brand extensions, Kim and Ma (2014) found that consumers who strongly identify with the parent brand showed intentions to purchase green brand extensions even though they did not develop positive attitudes toward the green brand extension itself. As such, in situations where customers are loyal to the brand regardless of whether a new green brand strategy does not necessarily relate to the current brand or appeal to the customer base, we propose consumers will respond positively to the new green brand extensions.

Proposition 5 Positive response to a new green brand extension may occur based on the strength of consumers' schema of the parent brand and their ability to compartmentalize the new green information separately from the parent brand.

2.6 Summary and Industry Implications for Green Branding

In order to maintain a strong brand, companies should do the "right thing" by embracing corporate social responsibility and taking a long-term vision on managing the brand (Keller 2013). Like many other industries, various aspects of product development, production, and consumption can be improved for fashion products to be environmentally sustainable. Along with the increasing awareness among consumers to be green, many fashion brands have implemented strong and wide-ranging strategies to be environmentally sustainable. Some strategic efforts have been in direct response to consumer demand for accountability whereas other efforts have been part of prioritized corporate values and mission to be environmentally sustainable. Despite the increasing participation in environmental sustainability by both consumers and brands, whether and how environmentally sustainable branding receives favorable response by consumers is still unclear. Using the schema theory as the theoretical framework, we proposed factors that facilitate consumers processing of green-branding information to modify or fit into their brand schemas. Successful green-branding programs have a good understanding of how consumers think and feel about environmental sustainability and the brand. Leveraging the strength of the relationships among environmental sustainability, consumer, and brand offers ways in which green branding can be incorporated within a company's branding strategy.

The literature shows overwhelming evidence that consumers with environmentally sustainable values strongly respond to green brands and products. Certainly, we are living in a big wave of environmental movement as profit, nonprofit, and government organizations are supporting and implementing environmentally sustainable programs. As a growing number of the general population embrace the issues surrounding environmental sustainability, green-branding strategies is a more favored part of consumer decision making. How a fashion brand presents itself as a green brand influences consumer motivation to accept the green-branding strategy. Fashion

brands are communicating relevant and concrete evidence of green-branding strategies on their websites. Companies are going beyond gratuitous mentioning of their green-branding efforts. Fashion brands are offering technical information and innovative ways to reduce waste and pollution. Fashion brands such as Stella McCartney and Patagonia offer well-crafted information that balances the technical challenges with the esthetic appeal. As such, fashion brands not only appeal to knowledgeable consumers who appreciate the information which allows them to better assess the significance of the green-branding efforts but fashion brands can also serve as leaders of green branding through educating and transforming consumers as well.

In some ways, fashion brands may be more challenged in transforming their image due to fashion's inherent reputation of satisfying consumers' esthetic, expressive, and psychological needs that may be considered nonessential and excessive. The fashion industry is based on the principle of planned obsolescence where new styles are introduced every season to stimulate the need to buy "something new" among consumers. The challenge for fashion brands is to integrate and align these two seemingly antithetical business practices. Fashion brands must maintain their strong image and profitability but at the same time show that they care about the people and the planet. Developing an image of authenticity and commitment to "do the right thing" is critical to establishing a green strategy.

Brand image building must be supported by carefully planned green communication strategies that weave green branding within their current brand strategy. Consumers must be able to fit the green brand strategy within their current brand schema. Fashion brands that exude deep fundamental values that place importance on people and the planet will be better positioned to leverage their image into green brand initiatives. Although green attributes within apparel products themselves are not apparently visible, emotional appeals through green imagery and other meaningful descriptions capturing designer or brand's commitment to environmental sustainability would be an effective way to deliver information. As consumers understand fashion brands mostly from an esthetic and symbolic point of view, communication strategies that incorporate environmental sustainability in a similar way would be important. Communication strategies should aim to create an emotional need for sustainable fashion brands (Fernandez 2013).

Fashion brands should take advantage of becoming leaders in environmental sustainability by leveraging their existing brands. Research shows consumer response to new branding strategies is influenced by their existing relationships with the parent brand. Stronger well-recognized brands are in better positions to initiate green-branding strategies. Moreover, larger multinational fashion companies have a moral obligation to the human race and the planet to do their part in cutting down waste and pollution in the product development, production, and distribution process. The many opportunities to engage in environmental sustainability from concept to consumer should be considered.

Research opportunities for academic scholars are discussed. Overall, the population's growing awareness of environmental sustainability has influenced how consumers think about their purchases and their commitment to doing less harm to the planet. In many instances, fashion brands are working at an even faster pace

than consumers' adoption rate to incorporate environmental sustainability into their brands in a variety of ways. In-depth studies are needed that offer an overview of how fashion companies are working to incorporate environmental sustainability (1) as a corporate value, (2) within their product development process, and (3) within their branding strategy. Also, how corporate decisions are made reflects the brand's commitment to environmental sustainability and employees' attitude, as "believers" of the green effort would offer interesting insight into the green culture of the company.

There is still much needed research that examines the compatible and/or conflicting values of being a fashion enthusiast versus a conscientious green consumer. Also, more research that examines consumer decision making that takes into consideration the trade-offs among price, quality, and sustainability is in order. Finally, studies should examine the potential effects of corporate leadership versus regulatory compliance related to production of sustainable fashion products.

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Chapter 3
Impacts of Social Media Mediated Electronic Words of Mouth on Young Consumers' Disposal of Fashion Apparel: A Review and Proposed Model

Nadine Ka-Yan Ng, Pui-Sze Chow and Tsan-Ming Choi

Abstract In recent decades, sustainability has been a very popular research topic in the fashion apparel industry. There is no doubt that sustainability is a serious issue for people living anywhere in the world. As fashion is one of the most essential facets in everybody's life, sustainable consumption is one of the methods to assist the development of sustainability. Yet, prior studies have paid little attention to investigate consumers' disposal behaviors of fashion clothing. Nowadays, on the other hand, young consumers are seriously committed to their "virtual life" on social media and are being influenced tremendously by the associated electronic words of mouth (E-WOM) in their behaviors. Motivated by the importance of environmental sustainability in fashion and the importance of social media mediated E-WOM, this chapter reviews the literature and proposes a conceptual empirical research model to explore the impacts of social media mediated E-WOM on young consumers' disposal behaviors of fashion apparel. Some specific propositions have also been developed.

3.1 Introduction

Sustainability is a critical issue in the fashion apparel industry. The concept of sustainability concerns the balance between the needs of people and the capacity of natural resources. In the fashion apparel industry, fashion designers might select organic fabrics to design clothing items in order to reduce pollution and be more environmentally friendly. Yet, the aspect of consumers' disposal behaviors is a novel field for researchers to investigate (De Coverly et al. 2008). Thanks to fast fashion, fashion garments are cheaper than before, and customers are purchasing more and more than their real needs. The term "disposable fashion" (Birtwistle and Moore 2007; Morgan and Birtwistle 2009) describes the scenario where many customers dispose of their unwanted clothing to landfills just because they consider them out

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of fashion. This kind of disposal behavior definitely harms the environment and deserves further exploration.

With advance in computing technologies, social media and associated platforms are commonly used by consumers everywhere. There is little doubt that many consumers are heavily influenced by the social media mediated electronic words of mouth (E-WOM); hence, the importance of using social media platforms in influencing consumer behavior has been rather popularly explored in recent years. However, to the best of our knowledge, so far there is no empirical study that specifically links social media mediated E-WOM with consumers' disposal behaviors of fashion clothing. Therefore, this chapter attempts to review the literature, develop a conceptual empirical research model, and propose propositions for researchers to further investigate the relationship between social media mediated E-WOM and young consumers' disposal behaviors.

3.2 Literature Review

3.2.1 Consumer Disposal Behaviors of Apparel

The fashion industry is listed as one of the most unsustainable industries due to the huge consumption of precious resources leading to unsustainable development for the earth. Greenpeace International (2012) describes fashion as one of the most polluting businesses because members within the fashion supply chain create intolerably huge negative impacts on the environment. Textile waste is a complex issue for all countries. Due to the lack of regulations and infrastructure, there are huge amounts of textile wastes being sent to landfills every year. The average weight of clothing that is discarded by a typical American every year is around 30 kg (Ha–Brookshire and Hodges 2009). In the UK, the textile waste made by the households and commercial activities that ends up in landfill reaches one million tonnes (Bianchi and Birtwistle 2010). In the USA, 14.3 million tonnes of textile solid wastes were generated in 2012 (U.S. Environmental Protection Agency 2012). In Hong Kong, which is very small compared to the USA and UK, over 92,000 tonnes of textile wastes were sent to landfills in 2009 and over 71 % of wastes were caused by households alone (Chua 2011). Waste and pollution caused by the fashion industry have caused great ecological harm and negative impact on the environment.

The most common way to process textile garbage is by landfilling. However, this method leads to environment problems, which eventually harm human life since they negatively impact soil and even air. For example, a fashion item that is made of wool may generate a certain amount of toxic emissions (such as ammonia, methane, etc.) during the processes of decomposition in landfills. A larger number of this kind of items being landfilled will imply a large amount of pollutants being released (Caufield 2009). To reduce the disposal of fashion clothing, consumers can help by making responsible decisions in a sustainable way at the time of disposing clothing.

In terms of consumers' disposal behaviors, Jocoby et al.'s (1977) disposition decision taxonomy is a classic model. This taxonomy suggests that consumers can choose the way of disposing products via three approaches, which are (1) keeping the products, (2) getting rid of the products permanently, and (3) getting rid of the products temporarily. Besides, consumers' decisions can be summarized into three categories that might influence their choices, namely the psychological characteristics of decision makers, intrinsic factors of the product, and the situational extrinsic factors of the product. This taxonomy has influenced many later studies on consumer disposals. After that, Hanson (1980) develops the paradigm of consumer product disposition processes (PCPDP) which is a further development of disposition decision taxonomy. It is designed to classify the stages of disposition processes. All processes in PCPDP are based on the psychological, extrinsic, and intrinsic factors categorized by Jocoby et al. (1977). There are four stages within the disposition processes, which are problem recognition, search evaluation, disposition decisions, and post-disposition outcomes. In the PCPDP framework, there are two factors influencing the disposition processes, namely consumers and external stimuli.

Despite the above, relatively limited number of studies have been devoted to exploring the problems of fashion product's disposal (Birtwistle and Moore 2007; Saunders 2010). Until now, regarding consumers' fashion clothing disposal behaviors, prior studies have mainly investigated the motivation for disposing of unwanted clothing and the factors that influence their choices in specific regions and age segments (Birtwistle and Moore 2007; Fisher et al. 2008; Ha–Brookshire and Hodges 2009; Morgan and Birtwistle 2009; Bianchi and Birtwistle 2010; Koukouvinos 2012). We review some of them as follows. Birtwistle and Moore (2007) focus on identifying the difference between how consumers dispose of luxury and cheap clothing. They also highlight the reasons behind improper disposal habits and propose that they are related to fast fashion phenomena and the lack of knowledge of disposing outdated purchases in an environmentally friendly way. Fisher et al. (2008) identify three motives for consumers to dispose their surplus clothing, namely the condition of clothes, fitness, and the degree of fashionability of the garments. Ha–Brookshire and Hodges (2009) create a conceptual model and argue that the reasons behind consumer donation (as a way to dispose clothes) are related to the available storage space and the threat of feelings of guilt throughout the process, especially in the decisions associated with whether to discard or donate the used clothing. Morgan and Birtwistle (2009) discover seven factors which may influence young adults' textile disposal behaviors. The seven factors are "fashion innovativeness," "general recycling behavior," "awareness of the environment," "attitude to textile re-use and recycling," "demographic," "influence by celebrity and media," and "fashion purchasing behavior." All of these factors weigh heavily in influencing consumers' habits and behaviors. After that, Bianchi and Birtwistle (2010) conduct a comparative research in Australia and Scotland which is based on disposition decision taxonomy in order to investigate the factors that affect consumers' choices of clothing disposal methods. They narrow down the choices of clothing disposal as one of the following: selling it, giving it away, and donating it.

3.2.2 Social Media

Well-developed Internet technologies, social media, such as Facebook, twitter, etc., have been commonly used in all walks of life and are very influential. Note that there are different definitions for social media. For example, Kaplan and Haenlein (2009) view social media as "a group of Internet based applications that build on the ideological and technological foundations of Web 2.0." Dann and Dann (2011) think social media is formed by three elements, which are social interaction, content, and communication media. Another characteristic of social media is that it generates an inner circle that enhances sharing with others on a global scale (Bough et al. 2010) and allows users to communicate via smartphones and other technological devices in their everyday life (Kietzmann et al. 2011). Safko (2010) describes the functions of social media as "activities, practices, and behaviors among communities of people who gather online to share information, knowledge, and opinions using conversational media." Various types of social media are commonly seen, e.g., social networking sites, blogs and micro–blogging, virtual social world, collaborative community sites, and content community sites. Each of them provides distinctive features and experiences to individual users, e.g., marketers and consumers, in the social media sphere.

In the fashion industry, a growing number of luxury fashion retailers and small business owners have given significant attention to social media marketing in recent years in order to find the most cost–effective way to reach their target consumers on a larger or even a global scale. To have an effective and efficient interaction with customers, fashion brands have put their efforts into different social networking sites, such as Facebook, Twitter, and Youtube, since social networking sites have the ability to deliver content to a specific interest-based segment in the networks. Content can be hyper-targeted to users based on key words from their profiles, pages they are fans of, and so on. Nowadays, fashion retailers understand the ability and the power of social media, and the use of social media for famous brands started to emerge in 2009. Many prestigious fashion houses and brands have begun to use social media to introduce their latest collections and news since that time. For instance, Louis Vuitton, one of the most traditional luxury fashion brands in the world, has adopted social media as one of the channels to deploy their integrated marketing communication strategy. It started Facebook and Weibo accounts to publicize its latest design collection and provided live fashion shows on its official website and Youtube to allow customers to view shows online and immediately leave comments from anywhere in the world. The profits of another luxury fashion brand Burberry increased by 21 % in 2011–2012. Burberry's CEO Angela Ahredts credited the success to investments in flagship markets and digital technology, as both of them enabled their team to drive customer engagement and continuously improve their operational effectiveness. She also believed that social media would help the brand to extend its leading position (Burberry annual report 2012).

Apart from social network marketing, social media also plays a vital role in delivering correct values to younger populations and affecting users' decision-making

styles (Bolton et al. 2013). It is commonly observed that youngsters nowadays actively participate in contributing and sharing contexts and information through social media. They also tend to search information from other people's posts on social media. Moreover, they utilize social media in multiple ways acting as creators, conversationalists, critics, collectors, joiners, and spectators. Some studies (e.g., Tuten 2013) show that people's values, behaviors, and identities would be affected through the use of social media. Users' behaviors and identities would also be changed.

3.3 Consumer Behaviors and Social Media Mediated E-WOM

According to The American Marketing Association (Tyagi and Kumar 2004), consumer behavior is stated as "the dynamic interaction of affect and cognition, behavior, and environment events by which human beings conduct the exchange aspects of their live." Blackwell et al. (2006) define consumer behavior as "the study of the processes involved when individuals or groups select, purchase, use or dispose of products, services, ideas or experiences to satisfy needs and desires." Solomon (2006) also mentions that consumer behavior is a study of how consumers make decisions to spend their available capital, such as money, time, and effort on consumption-related items. From Blackwell's definition (and others', e.g., Schiffman et al. 2005), the process of disposing of products or services can be treated as part of consumer behavior.

Berman and Evans (2013) think the consumer decision-making process consists of six steps, which are stimulus, problem awareness, information search, evaluation of alternatives, purchase, and post-purchase behavior. Blackwell et al. (2006) state that the process can be classified into seven stages which are recognition, search for information, pre-purchase evaluation of alternatives, purchase, consumption, post-consumption evaluation, and disposal. Despite differing views, we can see that the consumer decision-making process is affected by both external and internal factors and usually includes five stages: (1) problem recognition, (2) information search, (3) evaluation of alternatives, (4) purchase decision, and (5) post-purchase behavior. We now review how social media may affect these five stages.

First, problem recognition is the beginning of the consumer decision-making process. It occurs when consumers recognize a problem or a need due to dissatisfaction. It is initiated by external or internal stimuli. Digital natives might not be aware of their needs and desires until they interact with social marketing activities and notice the information that triggers their recognition of problems. Information can be a post from a friend, or a family member about a new product or service, suggested pages from social networking sites, a message from companies, and so on (Tuten 2013). At this stage, the motive of social media is to stimulate consumers' needs and wants of specific items. Online marketing activities are important and needed at this stage in order to reach potential consumers and stimulate their needs and wants.

Information search is the second stage of the buying decision-making process. It provides the content for individuals or organizations to have the first understanding

of products and services offered. It can be classified into internal and external search. Internal search is memory. External search includes WOM, sources provided by companies, peer conversations, and so on. At this stage, technology savvy, Generation Y young consumers can use social media to gather information by simply asking other Internet users for help and view reviews and ratings (Tuten 2013). According to the survey conducted by Market Force (2012), 80 % of digital natives will try new items based on friends' suggestions and over 70 % of respondents encourage friends to try new merchandise through social media. The motive of social media at this stage is to serve as a medium for consumers to learn about the particular products or services. According to the study conducted by Barrenechea (2013), over 38 % of social media users point to other consumers as the most reliable source of information about a brand or a product. Thus, E-WOM plays an influential role at this stage.

The third stage of the decision-making process is the evaluation of alternatives. Consumers have already compared different items and have comprehensive knowledge of items. At this stage, they are required to establish criteria for evaluation of each item to help them narrow down their choices. Since not many consumers are able to weigh the products in a rational way, social media can help them to rate the products in determining substitutions. Information and comments provided by companies and online consumers are useful at this stage (Tuten 2013).

Purchase decision is the fourth stage of action. It is the point at which consumers decide what product or service to purchase. They decide whether to buy, when to buy, what to buy, where to buy, and how to buy the product and service. Consumers can purchase a product or service with a specific company they chose (Blackwell et al. 2006). Generation Y can make the purchase by using social media directly, for instance, a Facebook page organized by a small business (Tuten 2013). According to research conducted by Market Force (2014), over 70 % of consumers think that the posts from companies on social media influence their purchase decisions as social media websites provide an opportunity to organizations to engage and communicate with potential and present consumers, to encourage an increased sense of intimacy in the customer relationship, and then build up meaningful relationships with consumers (Mersey et al. 2010). According to a survey conducted by Forbes and Vespoli (2013), Internet users purchase a product recommended by someone even if they do not know those people on review boards and social networking sites personally.

Post-purchase behavior is the last step in the decision-making process. It is a step for consumers to measure the level of satisfaction they experience since feelings towards the product might be generated by consumers after consuming the products or services. People can use social media to talk about their decisions and they might share with others if they have a positive purchase experience. On the other hand, they can use social media to share their comments about their negative purchase experiences or to complain to the companies through the use of social media. Normally, the comments are subjective as reviews are generated by personal experiences (Tuten 2013). The process of disposing of goods or services is classified into this step. Consumers can choose to buy a new product or an upgraded version of it, or they can throw it away, give it to a friend, or sell it on the Internet. Again, consumers

can share their thoughts through social networking sites to influence the actions of others.

In the area of how social media influences consumer behaviors, one critical dimension is E-WOM. In fact, WOM is the communication and dissemination of information between parties concerning evaluation of products and services. The WOM may be positive, negative, or neutral. Essentially, positive WOM include brilliant, novel experiences, or recommendations to others. Negative WOM can be broadly defined as undesirable behaviors, such as unpleasant shopping experiences, complaints, or product or service disparagement. In this sense, E-WOM is an online version of WOM. For traditional WOM, prior studies have found that WOM is known to be twice as influential as radio advertising, four times as influential as salespeople, and seven times as influential as newspaper and magazine advertising (Brown and Reingen 1987). According to several recent studies, WOM has substantially longer carryover effects than many traditional commercial promotion schemes (Fong and Burton 2006; Trusov et al. 2009). Moreover, for E-WOM, Kim et al. (2013) assert that there is a strong relationship between stimuli for positive or negative comments and the degree of E-WOM involvement. The higher the degree of involvement by online users, the more swift is the dissemination of information. Thus, the effect of E-WOM will be larger as well. Based on the conceptual model developed by Kim et al. (2013), "involvement" and "effect" are connected and influence one another. The higher the degree of involvement by digital natives, the higher is the effect on their intention, attitude change, and intention to retransmit messages. Constantinides and Fountain (2008) found that inputs provided by social networking site members, including friends, family, or complete strangers, are the foundations for influencing consumer preferences and decisions. In fact, all social media users have the ability to influence other consumers even in an "indirect contact" with them as social media is establishing a new kind of trust and enhancing the credibility of information amongst digital natives nowadays. Ramnarain and Govender (2013) show in their study that 80 % of social media users trust the comments and suggestions posted on social media by a friend or other anonymous people more than information from many other sources, such as advertisements on the Web. Besides, they also reveal that 50 % of consumers read other consumers' reviews, whilst 16 % have been affected by those comments while making purchases.

One of the most popular product categories influenced by E-WOM deeply is fashion apparel since fashion products not only reflect the consumers' values, but also their social status. Individuals always interact with their peers to confirm social acceptance by referring to their suggestions. As a consequence, E-WOM is the most effective method to interact and receive peers' opinion from the perspective of consumers. Hence, people are more likely to engage in E-WOM transmissions of information about fashion apparel products that have a high level of social visibility (Kim et al. 2013).

3.4 Conceptual Empirical Research Model

The above literature review reflects the environmental significance of exploring the disposal behaviors of apparel consumers. Besides, the impacts of social media on consumer behaviors have also been asserted. However, how the use of social media could help with this sustainability issue remains unknown. Some studies have shown that youngsters have a lack of knowledge of how clothes and accessories should be disposed of and pay less attention to the environment (Birtwistle and Moore 2007; Morgan and Birtwistle 2009). Recently, Koukouvinos (2012) investigates how the Triandis' theory of interpersonal behavior would affect young adults' disposal behaviors concerning clothing in Greece. The author focuses on studying how different factors, such as social factors, intention, and attitude, may affect consumers' disposal behaviors by adopting the Triandis' theory. Since the E-WOM through social media would influence the decision-making process of young consumers, it is important and practical to explore how E-WOM could affect their disposition decision and behaviors.

Based on the review of the disposition decision taxonomy, the PCPDP, and other related studies, a proposed disposition decision model connected with the use of social media mediated E-WOM is developed in Fig. 3.1. This proposed conceptual empirical research model encompasses three major components.

The first component is the psychological characteristics of consumers. These characteristics mainly relate to the ones proposed in and examined by Morgan and Birtwistle (2009), which are "awareness of the environment," "attitude towards textile recycling," and "general recycling behavior." These characteristics are selected because of their high relevance to the proposed research topic (which aims at exploring young consumers' attitudes and behaviors towards product disposal in fashion). Note that not all factors considered in Morgan and Birtwistle (2009) will be employed. For instance, the "influence by celebrity and mass media" are not included as they may dilute the focal point of the study which relates specifically to social media.

The second component is the extrinsic factors from social media mediated E-WOM which is an important variable of the framework. Undoubtedly, social media is versatile and has the power of connecting people. It is commonly believed that the extrinsic factors from social media are formed by E-WOM involvement and effect. There should be strong affiliation between E-WOM involvement and effect. To illustrate this point, imagine an individual who spends a lot of time and effort on social networking sites; that person would tend to be affected by other Internet users substantially and his attitudes, intentions, and behaviors would change. In the proposed conceptual research framework, the relationship between E-WOM involvement and young consumers' disposal behaviors will be investigated.

The last component of the conceptual model is disposal behavior. The model limits the options for the disposition of fashion clothing in order to fit the situation in fashion apparel we commonly observe in the market. For example, Jocoby et al. (1977) recommend that people can rent their unwanted items to others. However,

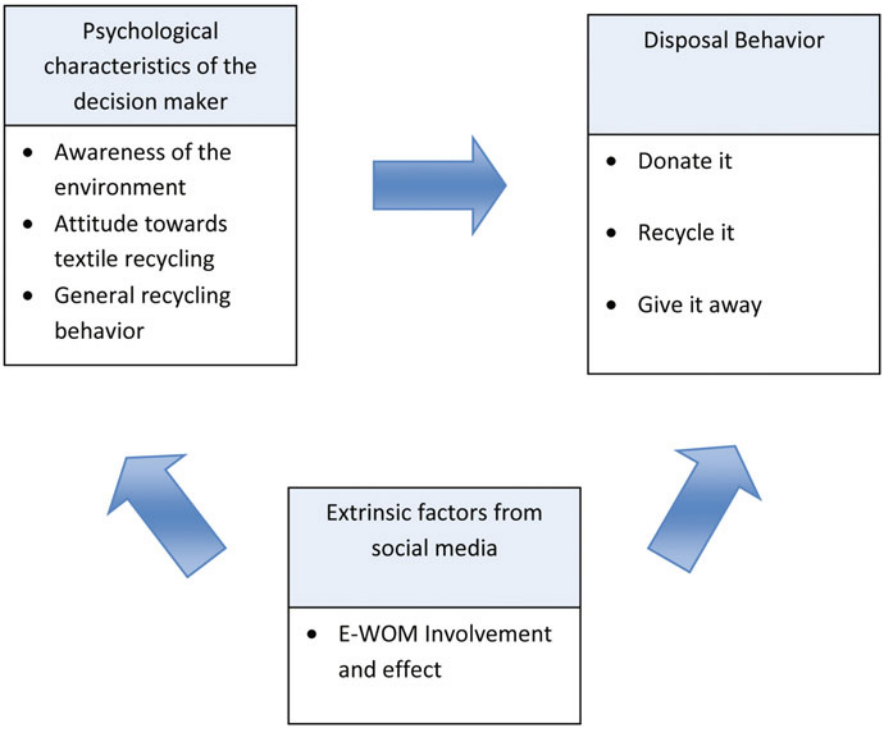

Fig. 3.1 The proposed conceptual empirical research model

this disposal method is not widely seen in many markets (especially in places such as Hong Kong and Singapore). Also, if there are too many possible disposal methods for the respondents (i.e., consumers) to choose, it may cause confusion. Therefore, donating surplus clothing to charities, recycling out of fashion clothes, and giving unwanted garments to friends or others are the adopted options for this proposed research model.

3.5 Concluding Remarks

Motivated by the importance of environmental sustainability associated with fashion apparel products and the popularity of social media, this chapter reviews the literature, examines the practice, and develops a conceptual research model. The proposed model provides a clear reference to future research on how social media affects young consumers' behaviors regarding disposal of fashion apparel. Based on the proposed conceptual research framework, propositions can be developed on each "arrow" as follows:

Proposition 1 The psychological characteristics of young consumers significantly affect their disposing behaviors.

Proposition 2 The social media mediated E-WOM significantly affects young consumers' disposing behaviors.

Proposition 3 The social media mediated E-WOM significantly affects the psychological characteristics of young consumers.

For future research, it will be promising to design questionnaires (based on the model and the related literature), and conduct consumer survey to collect data. The proposed propositions can be verified and other important findings and insights can be generated via standard statistical analysis.

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Part II
Analytical Modeling Studies

Chapter 4
Fashion Supply Chain Network Competition with Ecolabeling

Anna Nagurney, Min Yu and Jonas Floden

Abstract In this chapter we develop a competitive supply chain network model for fashion that incorporates ecolabeling. We capture the individual profit-maximizing behavior of the fashion firms which incur ecolabeling costs with information associated with the carbon footprints of their supply chains revealed to the consumers. Consumers, in turn, reflect their preferences for the branded products of the fashion firms through their demand price functions, which include the carbon emission information. We construct the underlying network structure of the fashion supply chains and provide alternative variational inequality formulations of the governing Nash equilibrium conditions. The model, as a special case, also captures carbon taxes. We discuss qualitative properties of the equilibrium product flow pattern and also propose an algorithm, which has elegant features for computational purposes. We provide both an illustrative example as well as a variant and then discuss a case study with several larger numerical examples.

4.1 Introduction

Apparel and fashion products, from fast fashion to luxury goods, are manufactured, stored, and distributed in global supply chains and, along with textiles, represent an immense industry with wide economic importance valued at US$ 3 trillion in terms of turnover in 2011 (cf. Martin 2013). At the same time, this industry utilizes extensive amounts of natural resources from water and grown cotton, energy, as well as chemicals. For example, it is estimated that cotton uses only 3 % of the world

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farmlands but about 25 % of the world's pesticides (Chen and Burns 2006). Moreover, this industrial sector is a primary source of GHG (greenhouse gas) emissions, including CO_2, one of the principal sources of global warming. According to World Wildlife Fund (2013), because of the scope of the industrial sector's activities, it is a significant GHG emitter with apparel and textiles accounting for about 10 % of the total carbon emissions, and with textiles being the fifth largest contributor to CO_2 emissions in the USA. Ten of the total CO_2 emissions from a life cycle perspective can be attributed to transport (Allwood et al. 2006). Growth in this industry is expected, along with an expected increase in associated emissions, if appropriate environmental mitigation actions are not taken, with estimates of there being 9 billion people on our planet in 2050, all with a need to clothe themselves (see, Martin 2013). Also, as noted by CleanMetrics (2011), clothing and accessories are the consumer goods that, next to food and beverages, are purchased most often and also replaced most frequently.

The rapidly changing world of fashion pushes toward overconsumption of resources, as products no longer may be made to last, but, rather, to be replaced by the next trend. It is noteworthy that fashion trends that once lasted for years, if not centuries, are now replaced several times per season. The increasing competitive pressure on lower prices has led to production moving to low cost countries in the Far East with less stricter health and safety legislation (de Brito et al. 2008). The fashion supply chain is international and long distance. For example, only 20 % of the UK's annual consumption of clothing is manufactured there (Allwood et al. 2006). The long, complex, and fragmented fashion supply chain is characterized by low transparency and control, resulting in a divide between those who get the benefits from fashion on the customers' side and those who pay the social and environmental costs (Pedersen and Andersen 2013). Hence, there exists an immense opportunity in this sector to contribute to positive change in terms of sustainability.

A transformation of this industry, as noted by Martin (2013), should include transparency, as well as the "optimization" of environmental footprints. Changes in this sector will be driven by customer choice (Allwood et al. 2006). Preliminary efforts are underway with the establishment of the sustainable apparel coalition (SAC) and its creation of the Higg Index (cf. Westervelt 2012). SAC, according to its website, http://www.apparelcoalition.org/, is a trade organization consisting of over 100 leading brands, retailers, manufacturers, government, nongovernmental organizations, and academic experts, reflecting more than a third of the global apparel and footwear market, and focused on the reduction of both environmental and social impacts associated with apparel and footwear products. Members range from Coca-Cola, which licenses its brand name for apparel, to the retailer Target, and manufacturers such as REI, Levi's, and Nike. Nevertheless, much remains to be done especially in terms of the development of rigorous analytical tools that can capture the impact of environmental emission reductions on consumer choices as well as firms' profitability in a systemic and system-wide manner. Furthermore, any such quantitative tools must also be able to handle the reality of competition in this sector.

Indeed, many fashion firm brands are recognizing that green or eco-friendly apparel is a way of differentiating one's products and enhancing brand recognition

(see also (Koszewska 2011)) with consumers also becoming increasingly aware of the negative environmental impacts of manufacturing apparel (cf. Infosys 2010). This is particularly evident in the market segment of children's clothing (Gam et al. 2010). Meyer (2001) argues that eco-friendly clothes are bought only if customers perceive the products as superior to competitors' offerings, thus looking at costs and benefits of the clothing. However, there are challenges, although a recent survey noted that 51 % identify environmental friendliness as being an important factor in their apparel purchasing decisions and only 26 % are willing to pay more for clothes that are identified as such (see (Cotton Incorporated 2013) or similar results in (Johannson 2008)). Consumers need a readily accessible and easily understandable mechanism to identify the environmental impact of the apparel that they purchase (cf. Rowe 2013). About 83 % of customers believe that the company selling the products should be responsible in informing the customers about the manufacturing conditions and 95 % of customers prefer to get this information through product labeling (Johannson 2008).

Ecolabels, in the form of carbon footprint labels, which reveal the product carbon footprint to consumers of a product, are a means of influencing consumer purchasing decisions in order to enhance supply chain sustainability (see, Craig et al. 2011; Vandenbergh et al. 2011). A study of the major Swedish clothing retailers found 12 different independent ecolabeling systems of different scope and complexity. In addition, several retailers offered their own labeling system (Holm 2010). Such labels entail a cost to producers, but provide valuable information to concerned consumers. Also, as noted by Mason (2011), some consumers may be willing to even pay a premium in order to "protect the environment" with possible other benefits attributed to a "warm glow" effect gained from adding to public welfare from one's benevolent activities (Andreoni 1989). There are currently 109 ecolabels related to textiles in the world (http://www.ecolabelindex.com). The environmental quality associated with an apparel or fashion product may, hence, be a positive attribute. For background on ecolabels, see the report by Global (2004).

In this paper, we contribute to the understanding of supply chain network sustainability through the development of a competitive fashion supply chain model with ecolabeling, consisting of multiple firms, each of which is distinguished by its brand. Unlike our previous research in fashion supply chain networks, in which the focus was on time and cost minimization (cf. Nagurney and Yu 2011) or emission reduction (Nagurney and Yu 2012), with various levels of concern, here we model supply chain network competition with environmental quality information shared with consumers via the ecolabeling of the firms' carbon footprints. Although recent research in competitive supply chain networks has explored issues of quality from product differentiation (cf. Nagurney and Li 2014a) to information asymmetry (cf. Nagurney and Li 2014b), as well as outsourcing issues in the context of a particular industry (Nagurney et al. 2013), in this chapter, for the first time, we focus on competition in a supply chain network framework where consumers, through ecolabeling, are provided, in a transparent way, the carbon footprints (and associated environmental quality or lack, thereof) attributed to fashion firms' supply chains. Consumers reflect their preferences through the demand price functions

which depend both on the product quantities and the carbon emissions associated with the fashion firms' supply chain networks. For an excellent background on fashion supply chain management, we refer the reader to the edited volume by Choi (2011). For an overview of an edited collection of papers on green manufacturing and distribution in the fashion and apparel industry, see Choi et al. (2013). Also, see Chan and Wong (2012) for background and findings concerning the consumption side of sustainable fashion supply chains with managerial implications.

The literature on sustainable supply chains has been growing, with a recent edited volume by Boone et al. (2012) providing a scope of topics in both breadth and depth. Sustainable supply chain network design (cf. Nagurney and Nagurney 2011; Nagurney 2013) as well as the role of the frequency of supply chain network activities on sustainability (see (Nagurney et al. 2013a)) and integrated logistics for green supply chain management (Sheu et al. 2005) have also garnered attention from the academic community. For a literature review and conceptual background, see Seuring and Muller (2008).

This chapter is organized as follows. In Sect. 4.2, we develop the model and describe the firms' competitive behaviors. We state the governing Nash equilibrium conditions (Nash 1950, 1951), present alternative governing variational inequality formulations, and also provide an illustrative example and variant. We also note how a special case of our model captures carbon taxes. Qualitative properties of the solution pattern in terms of existence and uniqueness that further support the model are given in the Appendix. In Sect. 4.3, we discuss a computational procedure for the determination of the equilibrium pattern of product flows and the incurred environmental carbon emissions, as well as the firms' profits. We detail a case study that demonstrates how our modeling and computational framework can guide decision-makers in the fashion industry to enhance the sustainability of their supply chain networks. We summarize our results and present our conclusions in Sect. 4.4.

4.2 The Fashion Supply Chain Network Model with Ecolabeling

As mentioned in Sect. 4.1, the fashion and apparel industry is globalized with manufacturing plants often located geographically at great distances from the consumers. Moreover, many of such plants may be in regions of the world where the environmental regulations are not as stringent as in parts of the developed world. Furthermore, given the geographical distances, the selection of appropriate transportation modes may also make an impact on the overall supply chain network environmental sustainability. Such aspects of these important supply chains create both challenges and opportunities for sustainability in terms of carbon footprint reduction.

The model that we develop in this section captures the supply chain networks of individual fashion firms involved in the production, storage, and distribution of a fashion product, which is distinguished by the firm's brand. This is relevant to this unique industry whether we are dealing with fast fashion products of such major brands as H&M, Zara, etc., or even luxury brands such as Chanel, Hermes, Louis Vuitton, etc. In the model, there are I competing fashion firms, with a typical such firm denoted by i. The notation for the model is given in Table 4.1.

Table 4.1 Notation for the Fashion Supply Chain Model with Ecolabeling

Notation	Definition
L^i	the links comprising the supply chain network of fashion firm i; $i = 1, \ldots, I$ with a total of n_{L^i} elements.
L	the full set of links in the fashion supply chain network economy with $L = \cup_{i=1}^{I} L^i$ with a total of n_L elements.
P_k^i	the set of paths in fashion firm i's supply chain network terminating in demand market k; $i = 1, \ldots, I$; $k = 1, \ldots, n_R$.
P^i	the set of all n_{P^i} paths of fashion firm i; $i = 1, \ldots, I$.
P	the set of all n_P paths in the fashion supply chain network economy.
$x_p; p \in P_k^i$	the nonnegative flow of firm i's fashion product to demand market k; $i = 1, \ldots, I$; $k = 1, \ldots, n_R$. We group all the firms' product flows into the vector $x \in R_+^{n_P}$, where n_P denotes the number of paths.
f_a	the nonnegative flow of the fashion product on link a, $\forall a \in L$. We group the link flows into the vector $f \in R_+^{n_L}$.
d_{ik}	the demand for the product of fashion firm i at demand market k; $i = 1, \ldots, I$; $k = 1, \ldots, n_R$. We group the $\{d_{ik}\}$ elements for firm i into the vector $d^i \in R_+^{n_R}$ and all the demands into the vector $d \in R_+^{I \times n_R}$.
$e_a(f_a)$	the carbon emissions generated on link a, $\forall a \in L$.
E_i	the emissions generated in the supply chain network of fashion firm i; $i = 1, \ldots, I$, where $E_i = \sum_{a \in L^i} e_a$.
E	We group the emissions generated by all the fashion firms into the vector $E \in R_+^I$.
$\hat{c}_a(f, e_a(f_a))$	the total cost associated with link a, $\forall a \in L$.
$l_i(\sum_{k=1}^{n_R} d_{ik})$	the ecolabeling cost of fashion firm i; $i = 1, \ldots, I$.
$\rho_{ik}(d, E)$	the demand price function for the product of fashion firm i at demand market k; $i = 1, \ldots, I$; $k = 1, \ldots, n_R$.

The fashion supply chain network economy consists of the entirety of the firms' activities as depicted and labeled in Fig. 4.1. Each fashion firm i; $i = 1, \ldots, I$; is considering n_M^i manufacturing facilities/plants; n_D^i distribution centers, and serves the same n_R demand markets. Let $G = [N, L]$ denote the graph consisting of the set of nodes N and the set of links L in Fig. 4.1. According to Fig. 4.1, each fashion firm has, at its disposal, multiple transportation options from the manufacturing plants to the distribution centers and from the distribution centers to the demand markets.

Also, we include the option that a fashion firm may have its product transported directly from a manufacturing plant to a demand market, and avail itself of one or more transportation shipment modes. Having multiple transport options, including intermodal ones, enables greater flexibility, which may, in turn, depending on the firms' decisions, be good for consumers and also for the environment.

It is important to identify the supply chain network structure since the topology reveals different choices that may present themselves. Furthermore, the network topology may be different from industry to industry (cf. (Yu and Nagurney 2013;

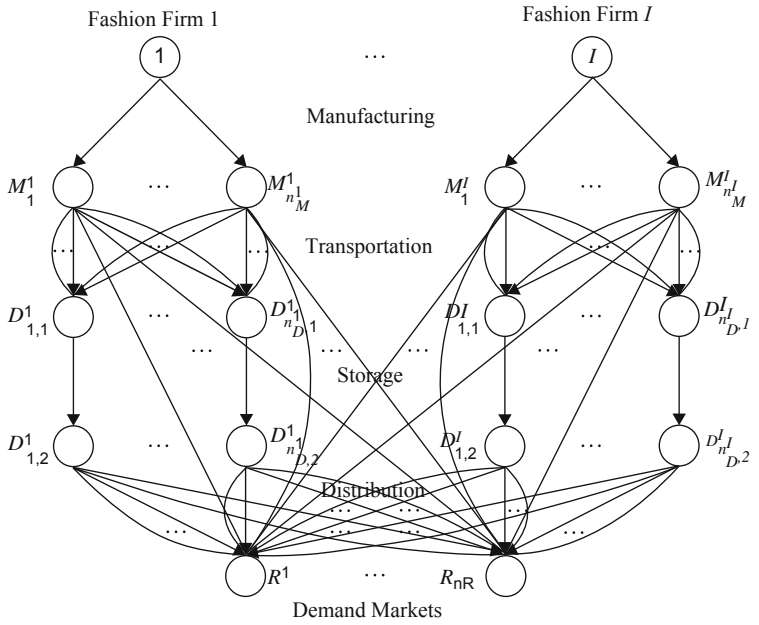

Fig. 4.1 The fashion supply chain network economy topology

Nagurney et al. 2013a, b) for several examples). In this chapter, we are interested in quantifying the effects of ecolabeling on fashion firms' profits as well as on their carbon footprints in the existing fashion supply chain network economy. Nevertheless, we emphasize that the framework constructed here may also be applied to other industries in which ecolabeling is being considered, with appropriate adaptation.

We first present the constraints in the form of the product conservation of flow equations. We then discuss the underlying supply chain network operational cost and emission functions, the ecolabeling cost functions, and the demand price functions.

The following conservation of flow equations must hold:

$$\sum_{p \in P_k^i} x_p = d_{ik}, \quad \forall i, \forall k, \tag{4.1}$$

that is, the demand for each firm's product at each demand market must be satisfied by the fashion product flows from the firm to that demand market.

Moreover, the path flows must be nonnegative, that is,

$$x_p \geq 0, \quad \forall p \in P. \tag{4.2}$$

Furthermore, the expression that relates the link flows to the path flows is given by,

$$f_a = \sum_{p \in P} x_p \delta_{ap}, \quad \forall a \in L. \tag{4.3}$$

Hence, the flow on a link is equal to the sum of the flows on paths that contain that link.

The total cost on a link, be it a manufacturing/production link, a shipment/distribution link, or a storage link is assumed, in general, to be a function of the product flows on all the links as well as the emissions generated, that is,

$$\hat{c}_a = \hat{c}_a(f, e_a(f_a)), \quad \forall a \in L. \tag{4.4}$$

We emphasize that the manufacturing cost associated with manufacturing at different plants also includes the cost associated with sourcing and the corresponding emission function includes the emissions generated also through sourcing. The above link total cost functions capture competition on the supply side, since the total cost on a link may depend not only on the product flows of the particular firm but also on those on the other firms' links. Fashion firms may share common suppliers and compete for fabrics, adornments, and even human resources, etc.

It is well-known that one of the reasons for manufacturing in the less-developed parts of the world is that the environmental regulations there may be less stringent, which also may account for, in general, lower operational costs. The link emission functions are for carbon emissions and these can also include other GHG emissions when transformed into their carbon equivalents.

Here we assume that the fashion firms adopt ecolabeling due to peer pressure from organizations such as SAC, as noted in the Introduction, and/or environmental regulations and/or the possible consumer pressure. There is a cost associated with ecolabeling, which includes the extra labeling of the fashion product as well as the research cost associated with quantifying the emissions on the supply chain network links or paying a neutral party for this information. As noted in Table 4.1, the ecolabeling cost is assumed to be a function of the total amount of the product produced by a given fashion firm, that is,

$$l_i = l_i\left(\sum_{k=1}^{n_R} d_{ik}\right), \quad i = 1, \ldots, I. \tag{4.5}$$

In view of (4.1), we may reexpress the ecolabeling cost function, $l_i(\sum_{k=1}^{n_R} d_{ik})$, as follows:

$$\hat{l}_i = \hat{l}_i(x) \equiv l_i\left(\sum_{k=1}^{n_R} d_{ik}\right), \quad i = 1, \ldots, I. \tag{4.6}$$

According to Table 4.1, the demand price function ρ_{ik}; $i = 1, \ldots, I$; $k = 1, \ldots, n_R$ depends not only on the firm's demand for its fashion product but also, in general, on the demands for the other firms' fashion products. Hence, we also capture competition on the demand side. In addition, because of ecolabeling, the consumers at the demand markets are now informed as to the total emissions generated by each of the fashion firms. Different demand markets may be more or less sensitive to the emissions generated and such functions provide enhanced modeling flexibility. Of course, we may expect that the price that the consumers are willing to pay for a fashion product will decrease if the overall emissions associated with that

firm and product increase. Note that we consider the total emissions generated by firms' supply chain networks rather than the amount of emissions per product at the demand market since the negative environmental impact needs to be fully captured and accounted for. In view of (4.1) and (4.3), and the definition of the generated carbon emissions in Table 4.1, we may reexpress the demand price function, $\rho_{ik}(d, E)$, as follows:

$$\hat{\rho}_{ik} = \hat{\rho}_{ik}(x) \equiv \rho_{ik}(d, E), \quad \forall i, \forall k. \tag{4.7}$$

We assume that the operational cost functions, the emission functions, the demand price functions, and the ecolabeling cost functions are all continuous and continuously differentiable.

The profit of a fashion firm is the difference between its revenue and its total costs, where the total costs include the total operational cost and the ecolabeling cost, that is,

$$U_i = \sum_{k=1}^{n_R} \rho_{ik}(d, E) d_{ik} - \sum_{a \in L^i} \hat{c}_a(f, e_a(f_a)) - l_i \left(\sum_{k=1}^{n_R} d_{ik} \right). \tag{4.8}$$

Let X_i denote the vector of strategy variables associated with fashion firm i; $i = 1, \ldots, I$, where X_i is the vector of path flows associated with fashion firm i, that is,

$$X_i \equiv \{\{x_p\} | p \in P^i\} \in R_+^{n_{P^i}}. \tag{4.9}$$

X is then the vector of all fashion firms' strategies, that is, $X \equiv \{\{X_i\} | i = 1, \ldots, I\}$.

Through the use of the conservation of flow Eqs. (4.1) and (4.3), and the functions (4.6) and (4.7), and the definition of the generated carbon emissions in Table 4.1, we define $\hat{U}_i(X) \equiv U_i$; $i = 1 \ldots, I$. We group the profits of all the fashion firms into an I-dimensional vector $\hat{U}$, where

$$\hat{U} = \hat{U}(X). \tag{4.10}$$

In the competitive oligopolistic market framework, each fashion firm selects its product path flows in a noncooperative manner, seeking to maximize its own profit, until an equilibrium is achieved, according to the definition below.

Definition 1 Fashion Supply Chain Network Cournot–Nash Equilibrium with Ecolabeling

A path flow pattern $X^* \in K = \prod_{i=1}^{I} K_i$ constitutes a fashion supply chain network Cournot–Nash equilibrium with ecolabeling if for each firm i; $i = 1, \ldots, I$:

$$\hat{U}_i(X_i^*, \hat{X}_i^*) \geq \hat{U}_i(X_i, \hat{X}_i^*), \quad \forall X_i \in K_i, \tag{4.11}$$

where $\hat{X}_i^* \equiv (X_1^*, \ldots, X_{i-1}^*, X_{i+1}^*, \ldots, X_I^*)$ and $K_i \equiv \{X_i | X_i \in R_+^{n_{P^i}}\}$.

Hence, an equilibrium is established if no fashion firm can unilaterally improve its profit by changing its product flows throughout its supply chain network, given the product flow decisions of the other firms.

Next, we derive the variational inequality formulations of the Cournot–Nash equilibrium for the fashion supply chain network with ecolabeling satisfying Definition 1, in terms of path flows and link flows (see (Cournot 1838; Nash 1950, 1951; Gabay and Moulin 1980; Nagurney et al. 2013b)). For the details in the variational inequality theory, please refer to the book by (Nagurney 1999).

Theorem 1 ***Variational Inequality Formulations***

Assume that, for each fashion firm i; $i = 1, \ldots, I$, the profit function $\hat{U}_i(X)$ is concave with respect to the variables in X_i, and is continuously differentiable. Then $X^* \in K$ is a fashion supply chain network Cournot–Nash equilibrium with ecolabeling according to Definition 1 if and only if it satisfies the variational inequality:

$$-\sum_{i=1}^{I} \langle \nabla_{X_i} \hat{U}_i(X^*), X_i - X_i^* \rangle \geq 0, \quad \forall X \in K, \tag{4.12}$$

where $\langle \cdot, \cdot \rangle$ denotes the inner product in the corresponding Euclidean space and $\nabla_{X_i} \hat{U}_i(X)$ denotes the gradient of $\hat{U}_i(X)$ with respect to X_i. Variational inequality (4.12), in turn, for our model, is equivalent to the variational inequality in path flows; determine the vector of equilibrium path flows $x^* \in K^1$ such that,

$$\sum_{i=1}^{I} \sum_{k=1}^{n_R} \sum_{p \in P_k^i} \left[\frac{\partial \hat{C}_p(x^*)}{\partial x_p} + \frac{\partial \hat{l}_i(x^*)}{\partial x_p} - \hat{\rho}_{ik}(x^*) - \sum_{j=1}^{n_R} \frac{\partial \hat{\rho}_{ij}(x^*)}{\partial x_p} \sum_{q \in P_j^i} x_q^* \right] \times [x_p - x_p^*] \geq 0, \quad \forall x \in K^1, \tag{4.13}$$

where $K^1 \equiv \{x | x \in R_+^{n_P}\}$, and for each path p; $p \in P_k^i$; $i = 1, \ldots, I$; $k = 1, \ldots, n_R$, and

$$\frac{\partial \hat{C}_p(x)}{\partial x_p} \equiv \sum_{a \in L^i} \sum_{b \in L^i} \frac{\partial \hat{c}_b(f, e_b(f_b))}{\partial f_a} \delta_{ap}; \tag{4.14}$$

$$\frac{\partial \hat{l}_i(x)}{\partial x_p} \equiv \frac{\partial l_i(\sum_{j=1}^{n_R} d_{ij})}{\partial d_{ik}}; \tag{4.15}$$

$$\frac{\partial \hat{\rho}_{ij}(x)}{\partial x_p} \equiv \frac{\rho_{ij}(d, E)}{\partial d_{ik}} + \frac{\partial \rho_{ij}(d, E)}{\partial E_i} \sum_{a \in L^i} \frac{\partial e_a(f_a)}{\partial f_a} \delta_{ap}. \tag{4.16}$$

In addition, (4.13) can be re-expressed in terms of link flows as: determine the vector of equilibrium link flows and the vector of equilibrium demands $(f^*, d^*) \in K^2$ such that,

$$\sum_{i=1}^{I} \sum_{a \in L^i} \left[\sum_{b \in L^i} \frac{\partial \hat{c}_b(f^*, e_b(f_b^*))}{\partial f_a} - \sum_{j=1}^{n_R} \frac{\partial \rho_{ij}(d^*, E)}{\partial E_i} d_{ij}^* \frac{e_a(f_a^*)}{\partial f_a} \right] \times [f_a - f_a^*]$$
$$+ \sum_{i=1}^{I} \sum_{k=1}^{n_R} \left[\frac{\partial l_i(\sum_{j=1}^{n_R} d_{ij}^*)}{\partial d_{ik}} - \rho_{ik}(d^*, E) - \sum_{j=1}^{n_R} \frac{\partial \rho_{ij}(d^*, E)}{\partial d_{ik}} d_{ij}^* \right] \times [d_{ik} - d_{ik}^*] \geq 0,$$
$$\forall (f, d) \in K^2, \tag{4.17}$$

where $K^2 \equiv \{(f, d) | \exists x \geq 0,$ *and* (4.1) *and* (4.3) *hold*$\}$.

Proof See the Appendix. □

Variational inequalities (4.13) and (4.17) can be put into standard form (see Nagurney 1999): determine $X^* \in \mathcal{K}$ such that,

$$\langle F(X^*), X - X^* \rangle \geq 0, \quad \forall X \in \mathcal{K}, \tag{4.18}$$

where $\langle \cdot, \cdot \rangle$ denotes the inner product in n-dimensional Euclidean space. Let $X \equiv x$ and

$$F(X) \equiv \left[\frac{\partial \hat{C}_p(x)}{\partial x_p} + \frac{\partial \hat{l}_i(x)}{\partial x_p} - \hat{\rho}_{ik}(x) - \sum_{j=1}^{n_R} \frac{\partial \hat{\rho}_{ij}(x)}{\partial x_p} \sum_{q \in P_j^i} x_q; \right.$$

$$\left. p \in P_k^i; \, i = 1, \ldots, I; \, k = 1, \ldots, n_R \right], \tag{4.19}$$

and $\mathcal{K} \equiv K^1$, then (4.13) can be re-expressed as (4.18). If we define $X \equiv (f, d)$ and $F(X) \equiv (F_1(X), F_2(X))$, such that

$$F_1(X) = \left[\sum_{b \in L^i} \frac{\partial \hat{c}_b(f, e_b(f_b))}{\partial f_a} - \sum_{j=1}^{n_R} \frac{\partial \rho_{ij}(d, E)}{\partial E_i} d_{ij} \frac{e_a(f_a)}{\partial f_a}; \; a \in L^i; \, i = 1, \ldots, I \right], \tag{4.20}$$

$$F_2(X) = \left[\frac{\partial l_i(\sum_{j=1}^{n_R} d_{ij})}{\partial d_{ik}} - \rho_{ik}(d, E) - \sum_{j=1}^{n_R} \frac{\partial \rho_{ij}(d, E)}{\partial d_{ik}} d_{ij}; \right.$$

$$\left. i = 1, \ldots, I; \, k = 1, \ldots, n_R \right], \tag{4.21}$$

and $\mathcal{K} \equiv K^2$, then (4.17) can be re-expressed as (4.18).

For qualitative properties of the equilibrium solution, in particular, existence and uniqueness, please see the Appendix.

Game theory and variational inequalities were first applied to supply chain network equilibrium problems by (Nagurney et al. 2002) with precursors to such models lying in spatial oligopolistic market equilibrium problems (cf. (Dafermos and Nagurney 1987)) and in spatial price equilibrium problems (see (Dafermos and Nagurney 1987)). Various multitiered supply chain network equilibrium models, both static and dynamic, are synthesized in the book by (Nagurney 2006). Vertically integrated supply chain models, including competitive ones, in which perishability of the products is a feature, which includes, fast fashion, in a sense, are described in the book by (Nagurney et al. 2013b).

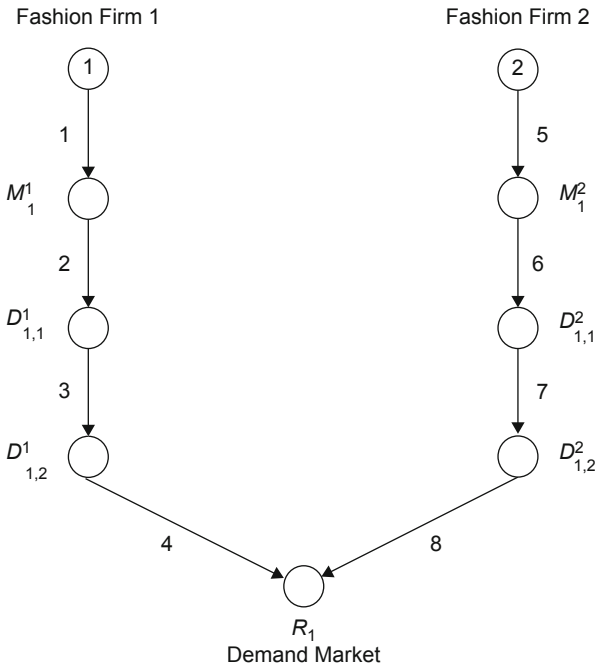

Fig. 4.2 Fashion supply chain network topology for the illustrative example

Remark

We emphasize that the above model contains, as a special case, a competitive supply chain network model in which the ecolabeling costs correspond to carbon taxes. In such a special case we remove the emissions terms in the demand price functions. We illustrate this feature with a variant example below.

4.2.1 An Illustrative Example and Variant

We now present a simple numerical example in order to illustrate the model.
In the example (cf. Fig. 4.2), two fashion firms compete in a single demand market R_1. Firm 1 is located in the USA and Firm 2 is in Bangladesh in Asia. The demand market R_1 is in Europe, specifically, in Germany. The product that they produce is a white ladies shirt.

Firm 1's distribution center is located in The Netherlands and Firm 2's in Germany. Firm 1 uses air transport to ship the product to The Netherlands to its distribution center and onward to the demand market in Germany. Firm 2 uses ship transport throughout.

Path p_1 corresponding to Firm 1 consists of the links: 1, 2, 3, and 4, whereas path p_2 corresponding to Firm 2 consists of the links: 5, 6, 7, and 8. Therefore, we have

$$x_{p_1} = d_{11}, \quad x_{p_2} = d_{21},$$

and

$$f_1 = f_2 = f_3 = f_4 = x_{p_1}, \quad f_5 = f_6 = f_7 = f_8 = x_{p_2}.$$

The emission functions reflect the total CO_2 generated on links, in kilograms, associated with this product. We utilized (Sarkar 2011), as a reference, in order to estimate the emission cost functions, which are given below:

$$e_1(f_1) = 5f_1, \quad e_2(f_2) = 2f_2, \quad e_3(f_3) = f_3, \quad e_4(f_4) = 2.5f_4,$$
$$e_5(f_5) = 6f_5, \quad e_6(f_6) = .1f_6, \quad e_7(f_7) = 2f_7, \quad e_8(f_8) = .07f_8.$$

Therefore, the respective total emissions generated by Firms 1 and 2 can be expressed in terms of path flows as

$$E_1 = 10.5x_{p_1}, \quad E_2 = 8.17x_{p_2}.$$

The total cost functions on the various links of manufacturing, shipment, storage, and distribution, in which we have embedded the emission functions are

$$\hat{c}_1(f_1, e_1(f_1)) = 5f_1^2 + 8f_1, \quad \hat{c}_2(f_2, e_2(f_2)) = 7f_2^2 + 3f_2,$$
$$\hat{c}_3(f_3, e_3(f_3)) = 2f_3^2 + f_3, \quad \hat{c}_4(f_4, e_4(f_4)) = 2f_4^2 + 2f_4,$$
$$\hat{c}_5(f_5, e_5(f_5)) = 3f_5^2 + 4f_5, \quad \hat{c}_6(f_6, e_6(f_6)) = 3.5f_6^2 + f_6,$$
$$\hat{c}_7(f_7, e_7(f_7)) = 2f_7^2 + 5f_7, \quad \hat{c}_8(f_8, e_8(f_8)) = 1.5f_8^2 + 4f_8.$$

We assume that both firms have quantified the per unit emissions on their supply chain network links associated with their fashion product. Hence, the ecolabeling cost function per firm only consists of the cost associated with marking the product with the emission information through a label. The ecolabeling cost functions are

$$l_1(d_{11}) = .02d_{11}, \quad l_2(d_{21}) = .01d_{21},$$

so that

$$\hat{l}_1(x) = .02x_{p_1}, \quad \hat{l}_2(x) = .01x_{p_2}.$$

The firms compete in the demand market R_1, and the consumers reveal their preferences for their products through the following demand price functions:

$$\rho_{11}(d, E) = -3d_{11} - d_{21} - .5E_1 + .2E_2 + 300,$$
$$\rho_{21}(d, E) = -4.5d_{21} - d_{11} - .5E_2 + .2E_1 + 300.$$

Hence,

$$\hat{\rho}_{11}(x) = -3x_{p_1} - x_{p_2} - .5(10.5x_{p_1}) + .2(8.17x_{p_2}) + 300 = -8.25x_{p_1} + .634x_{p_2} + 300,$$

and

$$\hat{\rho}_{21}(x) = -4.5x_{p_2} - x_{p_1} - .5(8.17x_{p_2}) + .2(10.5x_{p_1}) + 300 = -8.585x_{p_2} + 1.1x_{p_1} + 300.$$

Note that, in this example, the consumers at a demand market respond to the price of a fashion firm's product through the demands for both of the products, as well as the emissions generated by both firms.

Variational inequality (4.13) becomes, in the case of this example,

$$\left[\frac{\partial \hat{C}_{p1}(x^*)}{\partial x_{p_1}} + \frac{\partial \hat{l}_1(x^*)}{\partial x_{p_1}} - \hat{\rho}_{11}(x^*) - \frac{\partial \hat{\rho}_{11}(x^*)}{\partial x_{p_1}} \times x^*_{p_1}\right] \times [x_{p_1} - x^*_{p_1}]$$

$$+ \left[\frac{\partial \hat{C}_{p_2}(x^*)}{\partial x_{p_2}} + \frac{\partial \hat{l}_2(x^*)}{\partial x_{p_2}} - \hat{\rho}_{21}(x^*) - \frac{\partial \hat{\rho}_{21}(x^*)}{\partial x_{p_2}} \times x^*_{p_2}\right] \times [x_{p_2} - x^*_{p_2}] \geq 0, \quad \forall x \in R^2_+.$$

Under the assumption that $x^*_{p_1} > 0$ and $x^*_{p_2} > 0$, the two expressions on the left-hand side of the above inequality must be equal to zero, that is,

$$\left[\frac{\partial \hat{C}_{p1}(x^*)}{\partial x_{p_1}} + \frac{\partial \hat{l}_1(x^*)}{\partial x_{p_1}} - \hat{\rho}_{11}(x^*) - \frac{\partial \hat{\rho}_{11}(x^*)}{\partial x_{p_1}} \times x^*_{p_1}\right] = 0,$$

and

$$\left[\frac{\partial \hat{C}_{p_2}(x^*)}{\partial x_{p_2}} + \frac{\partial \hat{l}_2(x^*)}{\partial x_{p_2}} - \hat{\rho}_{21}(x^*) - \frac{\partial \hat{\rho}_{21}(x^*)}{\partial x_{p_2}} \times x^*_{p_2}\right] = 0.$$

Simple arithmetic calculations, using the corresponding functions for the numerical example, yield the following system of equations:

$$\begin{cases} 48.5x^*_{p_1} - .634x^*_{p_2} = 285.98 \\ -1.1x^*_{p_1} + 37.17x^*_{p_2} = 285.99. \end{cases}$$

A solution of the above system of equations, yields the equilibrium path flows as

$$x^*_{p_1} = 6.00, \quad x^*_{p_2} = 7.87.$$

with the equilibrium demands being equal to

$$d^*_{11} = 6.00, \quad d^*_{21} = 7.87.$$

The equilibrium link flows are, hence

$$f^*_1 = 6.00, \quad f^*_2 = 6.00, \quad f^*_3 = 6.00, \quad f^*_4 = 6.00,$$
$$f^*_5 = 7.87, \quad f^*_6 = 7.87, \quad f^*_7 = 7.87, \quad f^*_8 = 7.87.$$

Finally, the equilibrium prices of the two white ladies shirts are

$$\rho_{11} = 255.50, \quad \rho_{21} = 239.02,$$

with the associated emissions being

$$E_1 = 62.99, \quad E_2 = 64.31.$$

The profits of the firms are

$$U_1 = 872.82, \quad U_2 = 1,151.58.$$

The result shows that Firm 2 emits more than Firm 1, delivers the fashion product at a lower price than Firm 1, and obtains a higher profit. Note that Firm 1 is the

polluter with more emissions per unit. In order to maintain its total emissions within a competitive range, Firm 1 has to control its product quantity. Although the consumers are willing to pay more for the product from Firm 1, the profit of Firm 1 is still lower than that of Firm 2.

A Variant

We now consider the following variant of the above example. We remove the emission terms in both of the demand price functions so that the new demand price functions are:

$$\rho_{11}(d, E) = -3d_{11} - d_{21} + 300, \quad \rho_{21}(d, E) = -4.5d_{21} - d_{11} + 300.$$

A solution of the new system of equations, yields the equilibrium path flows

$$x^*_{p_1} = 7.27, \quad x^*_{p_2} = 9.61.$$

with the equilibrium demands being equal to

$$d^*_{11} = 7.27, \quad d^*_{21} = 9.61.$$

The equilibrium link flows are, hence

$$f^*_1 = 7.27, \quad f^*_2 = 7.27, \quad f^*_3 = 7.27, \quad f^*_4 = 7.27,$$

$$f^*_5 = 9.61, \quad f^*_6 = 9.61, \quad f^*_7 = 9.61, \quad f^*_8 = 9.61.$$

Now, the induced equilibrium prices of the two white ladies shirts are as follows:

$$\rho_{11} = 268.57, \quad \rho_{21} = 249.48,$$

with the associated emissions being

$$E_1 = 76.37, \quad E_2 = 78.52.$$

The profits of the firms are

$$U_1 = 1,005.00, \quad U_2 = 1,339.37.$$

We see from the two examples above, the value of information provided by ecolabeling, which results in lower emissions.

The variant example can also be interpreted, from a policy perspective, as an example in which the ecolabeling cost is actually a carbon tax. Producers would know how much they must pay out for their emissions in such a setting but consumers would be unaware since that information is not revealed to them.

Remark

Ecolabeling is a marketing tool, where the company carries a cost associated with the labeling and hopes to gain bigger returns through increased sales, just like in advertising or any other marketing activity. If successful, the ecolabeling increases the sale of eco-friendly clothes and reduces the environmental impact. The same effect is sought by governments and policymakers all around the world as a part of national and international efforts to reduce CO_2 emissions. However, national policy makers rely mainly on environmental taxes to reach this goal (Sterner and Köhlin 2003), which incurs a cost for the company but no direct effect on the customer. While ecolabeling in a positive way tries to influence the consumer to make an environmentally more informed decision, the tax is a market-based policy instrument that tries to reach the same goal by imposing a cost on the company side. The tax paid by the supply chain is often unknown for the end customer, particularly in an international supply chain where the tax might be paid by a third-tier supplier on the other side of the globe. Thus, from a policy maker's perspective, it is interesting to determine the difference in effect of the two approaches, particularly if the costs for the supply chain (cost of labeling and cost of tax) are at the same level.

4.3 The Algorithm and Case Study

The algorithm that we utilize for the computation of the equilibrium fashion product pattern satisfying variational inequality (4.13) is the Euler method (see, Dupuis and Nagurney 1993), which we have applied to solve several other competitive supply chain network models (cf. Nagurney and Yu 2012; Nagurney and Li 2014b, Nagurney et al. 2013a). For conditions of convergence, please refer to Dupuis and Nagurney (1993) and Nagurney and Zhang (1996).

The nice feature of the algorithm is that, in the context of our new model, the product flows can be determined explicitly, at each iteration, using a simple formula, because of the structure of the feasible set, which is the nonnegative orthant.

Explicit Formulae for the Euler Method Applied to the Fashion Supply Chain Network Variational Inequality (4.13)

At iteration $\tau + 1$, for all the product path flows x_p; $p \in P_k^i$; $i = 1, \ldots, I$; $k = 1, \ldots, n_R$, compute

$$x_p^{\tau+1} = \max \left\{ 0, x_p^\tau + a_\tau (\hat{\rho}_{ik}(x^\tau) + \sum_{l=1}^{n_R} \frac{\partial \hat{\rho}_{il}(x^\tau)}{\partial x_p} \sum_{q \in P_l^i} x_q^\tau - \frac{\partial \hat{C}_p(x^\tau)}{\partial x_p} - \frac{\partial \hat{I}_i(x^\tau)}{\partial x_p}) \right\}. \tag{4.22}$$

Once the equilibrium path flows are determined, according to the imposed convergence condition, the incurred link emissions and total emissions associated with each fashion firm and its profits can easily be determined.

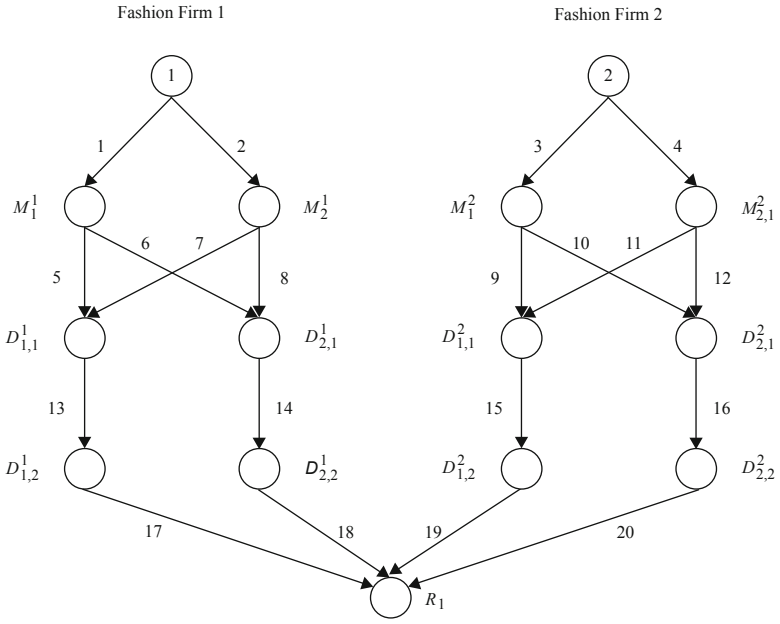

Fig. 4.3 The fashion supply chain network topology for the case study

We present a case study that builds upon our earlier work in sustainable fashion supply chain network competition (cf. Nagurney and Yu 2012). The supply chain network topology for this fashion economy is given in Fig.4.3. There are two fashion firms, Firm 1 and Firm 2, each of which has, at its disposal, two manufacturing plants, two distribution centers, and serves a single demand market R_1. The manufacturing plants M_1^1 and M_1^2 are located in the USA, whereas the manufacturing plants M_2^1 and M_2^2 are located off-shore with lower operational costs. The demand market is in the USA as are the distribution centers.

We implemented the Euler method, as described above, using MATLAB. The convergence tolerance was $\varepsilon = 10^{-6}$ and the sequence $a_\tau = .1(1, \frac{1}{2}, \frac{1}{2}, \frac{1}{3}, \frac{1}{3}, \frac{1}{3} \ldots)$. The algorithm was deemed to have converged when the absolute value of the difference between successive path flows differed by no more than ϵ. We initialized the Euler method by setting all the product path flows equal to 10.

Case Study Example 1

This example is inspired by Example 1 in (Nagurney and Yu 2012) but with a modification of the emission functions. Here we also add ecolabeling cost functions and consider more general demand price functions, which reveal the carbon emission information to the consumers through ecolabeling. The total cost and the emission functions for the links are given in Table 4.2, along with the computed equilibrium link flow solution. The product considered can represent a ladies short white nightgown. The carbon emissions are in kilograms.

Table 4.2 Total cost and emission functions with equilibrium link flow solution for case study Example 1

Link a	$\hat{c}_a(f, e_a(f_a))$	$e_a(f_a)$	f_a^*
1	$10f_1^2 + 10f_1$	$0.5f_1$	5.55
2	$f_2^2 + 7f_2$	$0.8f_2$	23.44
3	$10f_3^2 + 7f_3$	f_3	4.94
4	$f_4^2 + 5f_4$	$1.2f_4$	22.68
5	$f_5^2 + 4f_5$	f_5	2.33
6	$f_6^2 + 6f_6$	f_6	3.22
7	$2f_7^2 + 30f_7$	$1.2f_7$	9.63
8	$2f_8^2 + 20f_8$	f_8	13.81
9	$f_9^2 + 3f_9$	f_9	4.94
10	$f_{10}^2 + 4f_{10}$	$2f_{10}$	0.00
11	$1.5f_{11}^2 + 30f_{11}$	$1.5f_{11}$	9.55
12	$1.5f_{12}^2 + 20f_{12}$	f_{12}	13.13
13	$f_{13}^2 + 3f_{13}$	$0.1f_{13}$	11.96
14	$f_{14}^2 + 2f_{14}$	$0.15f_{14}$	17.03
15	$f_{15}^2 + 1.8f_{15}$	$0.3f_{15}$	14.49
16	$f_{16}^2 + 1.5f_{16}$	$0.5f_{16}$	13.13
17	$2f_{17}^2 + f_{17}$	f_{17}	11.96
18	$f_{18}^2 + 4f_{18}$	$0.8f_{18}$	17.03
19	$f_{19}^2 + 5f_{19}$	$1.2f_{19}$	14.49
20	$1.5f_{20}^2 + f_{20}$	$1.2f_{20}$	13.13

The ecolabeling cost functions are:

$$l_1(d_{11}) = .02d_{11}, \quad l_2(d_{21}) = .02d_{21}.$$

The demand price functions are:

$$\rho_{11}(d) = -3d_{11} - .5d_{21} - .5E_1 + .2E_2 + 450,$$

$$\rho_{21}(d) = -3d_{21} - .5d_{11} - .5E_2 + .2E_1 + 450.$$

We also provide the computed equilibrium path flows. There are four paths for each firm labeled as follows (cf. Fig. 4.3): for Fashion Firm 1

$$p_1 = (1, 5, 13, 17), \quad p_2 = (1, 6, 14, 18), \quad p_3 = (2, 7, 13, 17), \quad p_4 = (2, 8, 14, 18);$$

and for Fashion Firm 2

$$p_5 = (3, 9, 15, 19), \quad p_6 = (3, 10, 16, 20), \quad p_7 = (4, 11, 15, 19), \quad p_8 = (4, 12, 16, 20).$$

The computed equilibrium path flow pattern is:

$$x^*_{p_1} = 2.33, \quad x^*_{p_2} = 3.22, \quad x^*_{p_3} = 9.63, \quad x^*_{p_4} = 13.81,$$

$$x^*_{p_5} = 4.94, \quad x^*_{p_6} = 0.00, \quad x^*_{p_7} = 9.55, \quad x^*_{p_8} = 13.13.$$

The demand for Firm 1's fashion product is 28.99 and the price is 330.06, whereas the demand for Firm 2's fashion product is 27.62 and the price is 314.68.

Firm 1 generates 81.77 kg of carbon emissions and its profit is 6, 155.01. Firm 2 generates 108.62 kg in carbon emissions and has a profit of 5, 818.99.

Note that demand for Firm 1's fashion product is higher than that for Firm 2's product; while the price of Firm 1's product is also notably higher than that of Firm 2's product. Due to the effort of controlling its carbon emissions, Firm 1's product becomes more appealing in the demand market. It is interesting to observe that the shipment quantity between Firm 2's domestic manufacturing plant M_1^2 and its distribution center D_2^2 is zero, mainly because this transportation activity can cause serious pollution to the environment.

Case Study Example 2

Case Study Example 2 has the same data as Case Study Example 1 except that the consumers are more sensitive with respect to the carbon emissions generated by the fashion firms. The new demand price functions are given by

$$\rho_{11}(d) = -3d_{11} - .5d_{21} - E_1 + .2E_2 + 450,$$

$$\rho_{21}(d) = -3d_{21} - .5d_{11} - E_2 + .2E_1 + 450.$$

The new equilibrium path flow pattern is

$$x^*_{p_1} = 2.32, \quad x^*_{p_2} = 2.62, \quad x^*_{p_3} = 7.45, \quad x^*_{p_4} = 11.81,$$

$$x^*_{p_5} = 4.36, \quad x^*_{p_6} = 0.00, \quad x^*_{p_7} = 6.81, \quad x^*_{p_8} = 10.75.$$

The demand for the Firm 1's fashion product is 24.20 and the price is 315.59, whereas, the demand for Firm 2's fashion product is 21.92 and the price is 299.93.

Firm 1 generates 68.02 kg of carbon emissions and its profit is 5121.86. Firm 2 generates 85.80 kg in carbon emissions and has a profit of 4622.30.

The consumers' increasing environmental concerns lead to the decreas in the demands for the fashion products, as well as the prices of both products. Consequently, the profits of both firms drop dramatically, while the emissions generated by both firms reduce significantly.

Consumers' environmental consciousness has been an imperative motivation for Firm 2 to acquire and implement emission-reducing technologies. Firm 2 is now considering two options.

Table 4.3 Computed equilibrium demands, prices, profits, and total emissions for Examples 1, 2, 3, and 4

		Example 1	Example 2	Example 3	Example 4
Demands	Firm 1	28.99	24.20	24.17	24.13
	Firm 2	27.62	21.92	22.11	22.62
Prices	Firm 1	330.06	315.59	315.29	314.77
	Firm 2	314.68	299.93	301.15	302.31
Profits	Firm 1	6155.01	5121.86	5110.89	5091.95
	Firm 2	5818.99	4622.30	4658.51	4746.40
Emissions	Firm 1	81.77	68.02	67.94	67.82
	Firm 2	108.62	85.80	84.01	81.35

Case Study Example 3

Case Study Example 3 has identical data as in Case Study Example 2 except that Firm 2 now upgrades the manufacturing technologies at its domestic manufacturing plant M_1^2, resulting in new total cost and emission functions associated with the manufacturing link 3 as given below:

$$\hat{c}_3(f, e_3(f_3)) = 10f_3^2 + 10f_3, \quad e_3(f_3) = .5f_3.$$

Case Study Example 4

Case Study Example 4 has the same data as Case Study Example 2 except that Firm 2 implements advanced emission-reducing manufacturing technologies at its off-shore manufacturing plant M_2^2. The total cost and emission functions associated with the manufacturing link 4 are given by,

$$\hat{c}_4(f, e_4(f_4)) = f_4^2 + 7f_4, \quad e_4(f_4) = .8f_4.$$

The computed equilibrium demands, prices, profits, emissions, and utilities for Examples 1, 2, 3, and 4 are reported in Table 4.3.

Undoubtedly, the implementation of the advanced emission-reducing technologies could support Firm 2 to regain its competitive advantage. A comparison of the results in Examples 3 and 4 suggests that Firm 2 should first focus on its off-shore manufacturing plant, which will be more profitable.

4.4 Summary and Conclusions

Apparel and accessories are among the consumer products that are most frequently purchased as well as replaced. The globalization of these supply chains and their notable carbon emissions, ranked fifth among sectors in different countries, provide both challenges as well as opportunities for actions toward sustainability.

In this chapter, we develop a rigorous, computable fashion supply chain network model that captures such notable features as competition, brand differentiation, and ecolabeling. The ecolabeling has associated costs but provides valuable emission information to the consumers. We describe the competitive behavior of the fashion firms, along with their objective functions, and the constraints, define the governing equilibrium concept and derive alternative variational inequality formulations. We also provide qualitative results for the equilibrium pattern. We present an illustrative numerical example and a variant and also detail an algorithm for the computation of the fashion product flows on the supply chain network(s). The algorithm is easy to implement and, at each iteration, consists of explicit formulae for the determination of the path flows. We utilize the algorithm in a case study to solve larger numerical fashion supply chain network examples with ecolabeling.

The contributions in this chapter add to the growing literature on sustainable fashion supply chains, in particular, and to sustainable supply chains, in general. Importantly, the fashion supply chain network model with ecolabeling allows for the investigation of the impacts of ecolabeling on firms' and consumers' behavior and responses to such a policy. It also enables individual firms to assess investments in enhanced technologies that would reduce the emissions generated, the use of alternative modes of transportation, and even to assess the impacts of relocation of their manufacturing plants and distribution centers. Finally, a special case of our model captures carbon taxes.

Future research may entail investigating the trade-offs associated with ecolabeling vs. carbon taxes, among other environmental policy instruments in the fashion industry. Also, it would be interesting to evaluate the impacts of government encumbering some or all of the costs associated with ecolabeling. In addition, our model can be extended for fashion supply chain network design problems with the inclusion of different local environmental policies. Finally, it would be very interesting to conduct life cycle assessments of the fashion industry, for fast fashion and for luxury brands, in order to capture the impacts on the environment of consumers after they have purchased the fashion products.

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Appendix

Proof **Proof of Theorem 1**

Variational inequality (4.12) follows directly from Gabay and Moulin (1980); see also Dafermos and Nagurney (1987). We now observe that,

$$\nabla_{X_i} \hat{U}_i(X) = \left[\frac{\partial \hat{U}_i}{\partial x_p}; p \in P_k^i; k = 1, \ldots, n_R \right], \tag{A.1}$$

where for each path p; $p \in P_k^i$,

$$\begin{aligned}
\frac{\partial \hat{U}_i}{\partial x_p} =& \frac{\partial \left[\sum_{j=1}^{n_R} \rho_{ij}(d,E)d_{ij} - \sum_{b\in L^i} \hat{c}_b(f,e_b(f_b)) - l_i(\sum_{j=1}^{n_R} d_{ij})\right]}{\partial x_p} \\
=& \sum_{j=1}^{n_R} \frac{\partial \left[\rho_{ij}(d,E)d_{ij}\right]}{\partial x_p} - \sum_{b\in L^i} \frac{\partial \hat{c}_b(f,e_b(f_b))}{\partial x_p} - \frac{\partial l_i(\sum_{j=1}^{n_R} d_{ij})}{\partial x_p} \\
=& \sum_{j=1}^{n_R}\sum_{l=1}^{n_R} \frac{\partial \left[\rho_{ij}(d,E)d_{ij}\right]}{\partial d_{il}} \frac{\partial d_{il}}{\partial x_p} + \sum_{j=1}^{n_R} \frac{\partial \left[\rho_{ij}(d,E)d_{ij}\right]}{\partial E_i} \frac{\partial E_i}{\partial x_p} \\
& - \sum_{a\in L^i}\sum_{b\in L^i} \frac{\partial \hat{c}_b(f,e_b(f_b))}{\partial f_a} \frac{\partial f_a}{\partial x_p} - \sum_{l=1}^{n_R} \frac{\partial l_i(\sum_{j=1}^{n_R} d_{ij})}{\partial d_{il}} \frac{d_{il}}{\partial x_p} \\
=& \sum_{j=1}^{n_R} \frac{\partial \left[\rho_{ij}(d,E)d_{ij}\right]}{\partial d_{ik}} + \sum_{j=1}^{n_R} \frac{\partial \left[\rho_{ij}(d,E)d_{ij}\right]}{\partial E_i} \frac{\partial \left[\sum_{a\in L^i} e_a(f_a)\right]}{\partial x_p} \\
& - \sum_{a\in L^i}\sum_{b\in L^i} \frac{\partial \hat{c}_b(f,e_b(f_b))}{\partial f_a}\delta_{ap} - \frac{\partial l_i(\sum_{j=1}^{n_R} d_{ij})}{\partial d_{ik}} \\
=& \rho_{ik}(d,E) + \sum_{j=1}^{n_R} \frac{\partial \rho_{ij}(d,E)}{\partial d_{ik}} d_{ij} + \sum_{j=1}^{n_R} \frac{\partial \rho_{ij}(d,E)}{\partial E_i} d_{ij} \sum_{a\in L^i} \frac{\partial e_a(f_a)}{\partial f_a} \frac{\partial f_a}{\partial x_p} \\
& - \sum_{a\in L^i}\sum_{b\in L^i} \frac{\partial \hat{c}_b(f,e_b(f_b))}{\partial f_a}\delta_{ap} - \frac{\partial l_i(\sum_{j=1}^{n_R} d_{ij})}{\partial d_{ik}} \\
=& \rho_{ik}(d,E) + \sum_{j=1}^{n_R} \left[\frac{\partial \rho_{ij}(d,E)}{\partial d_{ik}} + \frac{\partial \rho_{ij}(d,E)}{\partial E_i} \sum_{a\in L^i} \frac{\partial e_a(f_a)}{\partial f_a}\delta_{ap}\right] d_{ij} \\
& - \sum_{a\in L^i}\sum_{b\in L^i} \frac{\partial \hat{c}_b(f,e_b(f_b))}{\partial f_a}\delta_{ap} - \frac{\partial l_i(\sum_{j=1}^{n_R} d_{ij})}{\partial d_{ik}}. \qquad \text{(A.2)}
\end{aligned}$$

By using the conservation of flow equation (4.1) and the definitions in (4.14), (4.15), and (4.16), variational inequality (4.13) is immediate. In addition, the equivalence between variational inequalities (4.13) and (4.17) can be proved with (4.1) and (4.3). □

We now provide some qualitative properties of the equilibrium solution. Since the feasible set K^1 is not compact, we cannot obtain the existence of a solution simply based on the assumption of the continuity of F. However, the demand d_{ik} for each fashion firm i's product, $i = 1, \ldots, I$ at every demand market R_k; $k = 1, \ldots, n_R$, may be assumed to be bounded by the market size. Consequently, in light of (4.1), we have,

$$\mathcal{K}_b \equiv \{x \mid 0 \leq x \leq b, \}, \qquad \text{(A.3)}$$

where $b > 0$ and $x \leq b$ means that $x_p \leq b$ for all $p \in P_k^i$; $i = 1, \ldots, I$ and $k = 1, \ldots, n_R$. Then $\mathcal{K}_b$ is a bounded, closed, and convex subset of K^1. Thus, the following variational inequality

$$\langle F(X^b), X - X^b \rangle \geq 0, \quad \forall X \in \mathcal{K}_b, \tag{A.4}$$

admits at least one solution that $X^b \in \mathcal{K}_b$, since $\mathcal{K}_b$ is compact and F is continuous. Therefore, following Kinderlehrer and Stampacchia (1980; see also Nagurney 1999), we have Theorem 2.

Theorem 2 ***Existence***
There exists at least one solution to variational inequality (4.13) (equivalently, (4.17)), since there exists a $b > 0$, such that variational inequality (A.4) admits a solution in $\mathcal{K}_b$ with

$$x^b \leq b. \tag{A.5}$$

Furthermore, we study the uniqueness of the equilibrium solution in Theorem 3.

Theorem 3 ***Uniqueness***
With Theorem 2, variational inequality (A.4) and, hence, variational inequality (4.17) admits at least one solution. Moreover, if the function $F(X)$ of variational inequality (4.17), as defined in (4.20) and (4.21), is strictly monotone on $\mathcal{K} \equiv K^2$, that is,

$$\langle F(X^1) - F(X^2), X^1 - X^2 \rangle > 0, \quad \forall X^1, X^2 \in \mathcal{K}, \; X^1 \neq X^2, \tag{A.6}$$

then the solution to variational inequality (4.17) is unique, that is, the equilibrium link flow pattern and the equilibrium demand pattern are unique.

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Chapter 5
Reverse Logistics as a Sustainable Supply Chain Practice for the Fashion Industry: An Analysis of Drivers and the Brazilian Case

Marina Bouzon and Kannan Govindan

Abstract In the face of environmental and social demands, companies have turned their focus to solutions that minimize environmental impacts and, at the same time, are economically and socially sustainable. In the fashion industry, in order to achieve a sustainable supply chain management (SSCM), among other initiatives, companies have to consider the implementation of used apparel collection programs, in other words, reverse logistics (RL) practice. In this matter, the objective of this study is to identify the most important drivers for RL development and to investigate the level of importance of each selected driver for the Brazilian apparel industry sector. First, international peer-reviewed publications on RL were considered to identify the drivers that allowed the design of a questionnaire to facilitate data collection. Second, with a prior list of 15 drivers, an empirical research was conducted involving three Brazilian textile companies to validate these drivers. The final list included nine influential factors. Subsequently, a Brazilian RL expert was consulted to analyze them. Analytical hierarchy process (AHP) approach was used to obtain the RL driver priority ranking. The main contribution of this research includes the fact that the most influential drivers for RL practice are policy- and economic-related issues, for the apparel textile sector. Due to the lack of specific legislation, Brazil is still in a green awakening process concerning textile end of life product management. Limited gains of scale and technology restrictions are the major impediments for the economic feasibility of RL in the apparel industry sector.

5.1 Introduction

Technological development, mass consumption, and shortening product lifecycles have augmented worldwide production. As a consequence, more raw materials are used and available landfills are filling up (Wassenhove and Besiou 2013). In order to solve this increasing problem, concepts such as sustainable supply chain management (SSCM) have emerged. In addition, in the past decades, the interest in product

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recovery, reverse logistics, and closed-loop supply chains has attracted not only the attention of companies and professionals but also the researchers (Sasikumar and Kannan 2008a, 2008b, 2009; Flapper et al. 2012; Nikolaou et al. 2013). In this context, the green supply chain management (GSCM) is considered as one of the major efforts aiming at the integration of environmental requirements with the SC systems (Govindan et al. 2014; Sarkis 2006). According to Zhu et al. (2008) and Diabat and Govindan (2011), GSCM goes from green purchasing to integrated life-cycle management supply chains flowing from supplier, to manufacturer, customer, and closing the loop with reverse logistics (RL).

In the GSCM domain, RL is considered the most difficult initiative to implement (Hsu et al. 2013). In the literature, numerous drivers, such as legislation, economic concerns, social responsibility, ethics, and stakeholder pressures have been proposed as the motivational factors that lead companies to engage in green activities (Andiç et al. 2012). In short, resource depletion, environmental concerns, increasing costs of landfilling, and substantial return policies of retailers have led to the growing importance given to RL by producers and their stakeholders worldwide.

Reverse logistics (RL) is the process of moving goods from their typical final destination for the purpose of capturing value or proper disposal (Rogers et al. 2002). Effective RL focuses on the backward flow of materials from customer to supplier (or alternate disposition) with the goals of maximizing value from the returned item or minimizing the total RL cost (Sasikumar and Kannan 2008b). RL is the joint responsibility of producers and consumers to minimize waste generation by means of reuse, remanufacturing, recycle, and safe disposal of unwanted items in order to enhance the absorptive and regenerative capacity of the planet, contributing to sustainability and circular economy issues.

In this context, the circular economy view is growing in importance among industries; thus closing the loop for many supply chains is becoming mandatory. Companies are concerned about closing the loop not only to be greener, but also to progressively guarantee their market survival in long term by remanufacturing and recycling used products. Industrials are increasingly becoming concerned about the shortage of some raw materials in the near future. The price of many raw materials—such as steel and cotton—have been increasing over time (Barrientos and Soria 2014). Therefore, searching for new technologies and practices to reuse these materials is no longer only a green issue but a business sustainability concern.

Most research on reverse logistics is focused on automobiles, metal scraps, sales packaging material, and waste paper recycling (Abraham 2011). Few studies on product recovery, reverse logistics, and closed loop supply chain have dealt with the apparel sector, even considering that textiles and garment manufacturing "are highly polluting and resource consuming industries" (Wong et al. 2012). One reason for this is the fact that end markets for textile waste are small and of low value in comparison to other waste streams (Sinha et al. 2012). Nevertheless, waste management and reinsertion of used products into the productive cycle is a growing concern in this sector. Many textile clothes have been thrown away as garbage all over the world. It has been either incinerated or ending up in landfills. It is estimated that 95 % of this garment could be reused or recycled depending on its state. In the UK, one of the best countries to perform garment recovery, 31 % of textile waste ends up in landfills

and 7 % is incinerated. It is even worse in the rest of the world. For example, in Sweden, there's a production of 8 kg per year per capita of textile waste, from which only 3 kg are collected. In the USA, it is even worse: only 8 % of garment waste is recovered (EPA 2011). Despite the apparent current relevance of the textile industry, little research has been conducted on the subject of closing the loop for the apparel industry sector.

According to Abdulrahman et al. (2014), concerning the prior research on the drivers for RL implementation, little attention has been paid to emerging economies. As a Brazil, Russia, India and China (BRIC) country, Brazil is the largest Latin America economy and the sixth largest world economy. RL is gaining importance in Brazil due to some factors: the new environmental policy, issued in 2010 (national policy on solid waste—NPSW), improving social conditions, economic issues as the recovery of the value of used products, and green marketing. However, at the same time, Brazilian organizations encounter the challenge of a poor logistics infrastructure (Arkader and Ferreira 2004; da Rocha and Dib 2002). For example, transport infrastructure is deficient: poor conditions of publicly operated highways lead to high vehicle maintenance costs and cargo loss in Brazil (Martins et al. 2012). Concerning the textile production in Brazil, the apparel sector is the greater generator of employment when compared to other sectors. There are about 1.2 millions of job positions in this sector, which produced 6,436,738 billions of units of clothing with a revenue of US $ 47 billions per year (ABRAVEST 2010). In 2010, Brazil represented the fourth position in the world production of textiles, manufacturing 2.9 % of the total world production. This production magnitude has its drawbacks for the environment; thus closing the loop for textile supply chains is becoming imperative.

Given these issues, this study aims to present an overview on RL drivers in the apparel sector, with a focus on the Brazilian context.

5.2 Theoretical Background

Although over the past years RL has received a lot of attention, it is still a relatively new concept (Van Der Wiel et al. 2012). RL is the process of moving products from their typical final destination for the purpose of capturing value or proper disposal. In this sense, RL comprises all the activities involved in processing, managing, reducing, and disposing of hazardous or nonhazardous waste from production, packaging, and use of products (Govindan et al. 2013; Rogers and Tibben-Lembke 1999, 2001).

While companies are increasingly being pressured to engage these initiatives for environmental, social, and economic reasons, alongside, there are many factors that influence the development of RL (Kapetanopoulou and Tagaras 2011). The profitability of RL is multidimensional because it depends on several aspects, such as: market price of the materials, technological innovation that could contribute to lowering the price of the recovery process, and the quantities of recovered materials (Van Der Wiel et al. 2012). In the domain of GSCM, RL is considered as the most difficult initiative to implement when compared to design for environment and green

purchasing (Hsu et al. 2013). It is also considered by firms as an undervalued part of the supply chain (SC) due to a variety of reasons such as low interest of top management, insufficient time commitment, lack of integrated corporate supply chain design target toward RL, and a lack of awareness of the high potential value of integrating operations (Abdulrahman et al. 2014). Considering this, knowing the factors that influence RL implementation and management is crucial for a holistic GSCM approach, and further on, for a sustainable supply chain management. In this sense, this section deals with RL practices, developing countries and the Brazilian scenario, RL in apparel industries, and RL drivers.

5.2.1 Reverse Logistics Practices

Due to the diversity of products in the reverse flow, there are various alternatives of reverse logistics activities namely as: reutilization, repair, renovation, reprocessing, cannibalization, or recycling (Thierry et al. 1995). The majority of returned products undergoes practices such as resell "as is", remanufacturing/refurbishment, recycling, send to landfills, or repacking and sell as new. Rogers and Tibben-Lembke (2001) suggest further options: donations, sent to central processing facilities, sold to brokers or outlet stores.

When a product reaches its end of life (EOL), there are a number of recovery options available and selecting a suitable strategy is mainly based on the quality of the parts and components and also the economic considerations (Mansour and Zarei 2008). RL consists of a series of activities such as disassembly of products, inspection, recycling, repair, refurbishing, remanufacturing, or final disposal during various stages in the SC (Chan et al. 2012).

RL practices can be classified as follows (Akdoğan and Coşkun 2012):

- Direct reuse: product reuse without involving in production process instead with slight cleaning and limited repair.
- Repair: products are returned to have it back in working order, requiring limited effort and, therefore, less quality than a new product.
- Refurbishing: returned products are brought up to specified quality level.
- Remanufacturing: returned products are carefully inspected, disassembled and broken or outdated parts are replaced with new ones in order to increase quality standards up to new products' quality.
- Cannibalization: the purpose is to recover limited parts of used products that are reused in other RL activities (e.g., repair, refurbish, remanufacture).
- Recycling: recycling is concerned about reusing the materials in production of new parts, thus the identity of product is lost.
- Incineration and landfilling: the last alternative is to incinerate or landfill the returned products because of the limited capacity of waste yards.

Figure 5.1 presents the many flows in RL operations, as well as the RL practices.

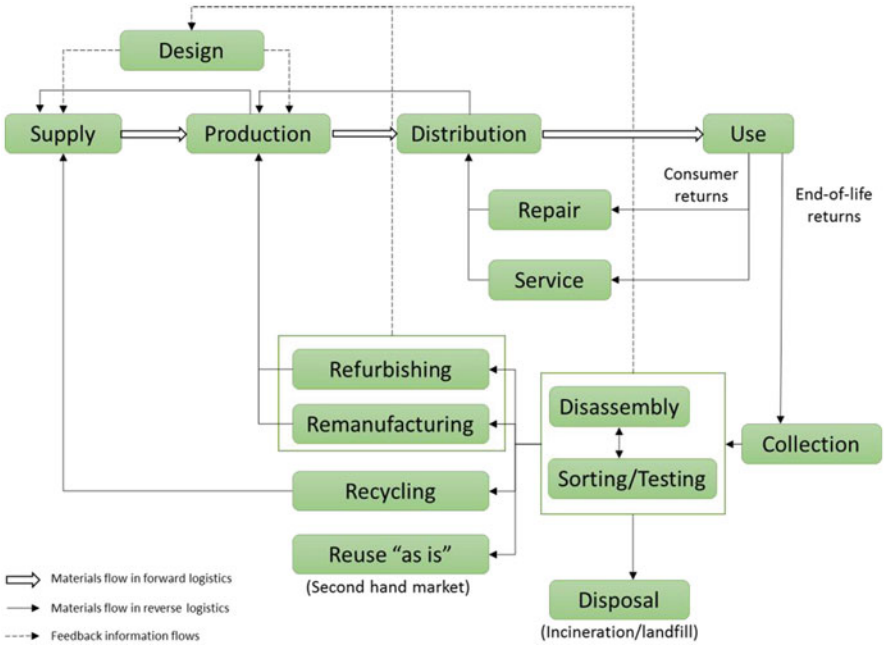

Fig. 5.1 Activities and flows in reverse logistics. (Adapted from Kannan et al. (2012) and Lau and Wang (2009))

5.2.2 RL in Developing Countries and in Brazil

Interestingly, most existing research on influential factors to RL implementation has mainly focused on developed countries, with relatively little attention being paid to developing countries (Abdulrahman et al. 2014), such as BRIC countries and in specific to Brazil. Moreover, researchers (Sarkis et al. 2011; Zhang et al. 2011) have stated that the scarcity of RL studies for developing countries is hardly surprising because while RL is a mandatory component of the supply chain in developed countries, RL is still in a state of infancy in emerging economies. Reverse logistics in developing countries seems to be still at an infant stage in most industry sectors (Lau and Wang 2009). Another reason for this fact is that, in a real sense, the benefits of RL implementation is not yet fully realized in the emerging economies (Abdulrahman et al. 2014).

Among the emerging economies, Brazil is in a stage of green awakening. Brazil is sixth largest world economy, but the country's magnitude has its drawbacks for the environment. In 2011, Brazil's population generated almost 62 million t of solid waste (Jabbour et al. 2014). Environmental degradation is a major issue that has been discussed by society, the Government, and businesses in Brazil (de Sousa Jabbour et al. 2013). RL is recently gaining importance in this country due to some reasons: the implementation of the National Policy on Solid Waste (NPSW), economic issues

as the recovery of the value of used products, green marketing, and improving social conditions.

Influenced by these reasons, the international brand Adidas launched a RL program in Brazil in 2012. In partnership with a specialized company, Adidas started to collect used shoes from their customers in their stores. When bringing back used shoes, the customer receives a voucher of 5 % of discount for the next purchase. The partner company, *RCR Ambiental*, transforms all residues from the EOL products into fuel for cement kiln. The program, named Sustainable Footprint, aims at minimizing the environmental impact caused by the inappropriate final disposal of used products and meet the requirements of the Brazilian environmental laws, such as the NPSW.

Nevertheless, in order to put in practice RL programs, many other Brazilian companies might face the challenge of a deficient logistics infrastructure to cope with the NPSW. Weaknesses in logistics infrastructure may act against the expansion of efficiency and effectiveness in the Brazilian business environment (Arkader and Ferreira 2004). For example, transport infrastructure is deficient: poor conditions of publicly operated highways lead to high vehicle maintenance costs and cargo loss in Brazil (Martins et al. 2012). Thereby, more effort from industrial and academia is needed to analyze the influential factors (or drivers) for RL adoption in developing countries such as Brazil.

5.2.3 RL in the Apparel Market

The worldwide production of waste is an increasing concern among countries. Natural resources are progressively running out. At the same time, the global need for energy is estimated to increase by 45 % by 2030, the need for fresh water by 30 %, and for food by 50 % (United_Nations 2012). These facts boost the need to improve waste management systems, closing the loop of the supply chains in order to minimize waste production and capture the value in used products.

For the apparel sector, the need for effective waste management is motivated by the increasing cost and decreasing availability of landfill space and the dwindling of natural resources (Larney and Van Aardt 2010). The emergence of 'fast fashion' retail models, characterized by frequent changes in style and low prices, has stimulated greater levels of consumption and, consequently, more rapid disposal of fashion apparel. In addition, when referring to the challenges in the apparel industry sector (H&M_Sustainability_Report 2012):

- It is estimated that 10 % of all pesticides in the world are used in cotton production;
- Conventional cotton used in a T-shirt needs as many as 15 bathtubs of water to grow;
- For producing a T-shirt, 4 m^2 of agricultural land is used; and
- 5 % of all waste in US landfills is textiles.

To cope with these environmental issues, clothes can be reused and recycled, minimizing the use of agricultural land, reducing the consumption of water for the production of new raw material, decreasing the use of pesticides and, finally, helping to empty the overloaded landfills. Some examples of products made from recycled textile waste include: non-wovens used for insulation, upholstery, oil filters, padding, hospital drapes and gowns, and a variety of absorbent products like disposable wipes, geotextiles, carpets, fiberfill, and spun-bonded fabrics from polyethylene (Larney and Van Aardt 2010). The reuse of clothing in the global market has been an area of interest to researchers internationally (Abraham 2011), but still, apparel is one of the largely unexploited consumer commodities with strong recycling potential (Larney and Van Aardt 2010).

Why is this opportunity not fully explored? The answer is that, generally, recycling is not economical (Larney and Van Aardt 2010). This is not a simple task for industries. Used clothes that are not suitable for resale may be reused as wipers and rags or remanufactured into secondary products. In both of these markets, there are significant challenges, such as decreased demand for rags and heterogeneous material composition (Sinha et al. 2012). In addition, textile and apparel manufacturers encounter various barriers to entering a recycling program, such as a shortage of markets for recycled products, a lack of equipment and technology, high costs, and competition with countries that do not participate in environmental practices (Larney and Van Aardt 2010). Recycling might be desirable, but, so far in most cases, it is insufficient to decrease production cost and improve financial performance, as it incurs costs and financial irrecoverable investments (Wong et al. 2012). Besides, especially in emerging economies, poor waste management infrastructure has enhanced an informal laboring sector of scavengers or waste pickers, who recover and sell valuable waste materials (Sinha et al. 2012). Another complicating factor is when returning textiles are badly damaged, making end markets for textile waste of low value in comparison to other waste streams.

Even considering these limitations, when analyzing from a long term point of view, RL can provide companies with revenues and strategic benefits such as branding performance. Companies whose products are subject to regeneration can save up to 60 % of the estimated cost of a completely new product (Grabara et al. 2014). RL practices can enhance the revenue by achieving green customers, who include environmental requirements in their buying decision process. Many companies today appeal to their customers that they are "environmentally friendly" (Grabara et al. 2014). For example, some apparel companies (such as H&M) have started to attach a green tag to their products when using organic or recycled materials.

Country context might also impel RL practice. In countries such as India, there is a significant presence of shoddy industries which convert postconsumer apparel imported from Europe into yarn and blankets for the domestic and export markets. Low labor costs mean that the time-intensive sorting and processing stages in manufacturing remain economically feasible (Sinha et al. 2012). This is an example as emerging economies with low-labor cost can obtain benefits from EOL apparel management if there are appropriate skills, infrastructure, and technology in place. Concerning

developed countries, some of them have considerably increased the textile recycling programs by improving technology, such as Japan (Larney and Van Aardt 2010).

Many technologies emerged in the last years. Recycled textiles can be made out of PET polyethylene terephthalate (PET) bottles and recycled rubber from motorcycle and bicycle tubes, for example. However, the challenge is how to mechanically or chemically recycle used clothes into new ones, closing the loop of the textile supply chains. In order to overcome these issues, it is necessary to obtain a comprehensive view of the drivers affecting the practice of RL.

5.2.4 Reverse Logistics Drivers

Drivers are considered motivational elements that lead companies to engage in some sort of activity. The main drivers of RL activities are not well understood yet (Akdoğan and Coşkun 2012). In the literature, many drivers have been suggested in understanding the motivational elements that lead companies to perform RL, as shows Table 5.1. Based on a systematic literature review process, 15 drivers for RL have been identified and categorized based on their meaning and similarities. The 15 encountered drivers with sources are listed in Table 5.1. The main categories are: Government and policy related issues (GP), SC partners and management related issues (SC&M), Market related issues (M), Technology related issues (T), and Economic related issues (E).

With the list of RL drivers, the next purpose is to evaluate the importance of these factors using the lens of the Brazilian textile industry sector.

5.3 Framework of the Study

The objective of this research is to identify the most important drivers for RL development and to investigate the level of importance of each selected driver for the Brazilian apparel industry sector. To fulfill this purpose, this investigation is twofold. Firstly, international peer-reviewed publications on RL were considered in order to identify the drivers that allowed for the design of a questionnaire to facilitate data collection. Secondly, an empirical research was conducted involving three Brazilian textile companies to validate these drivers and, subsequently, a Brazilian RL expert was consulted to analyze them. The detailed research framework is presented in Fig. 5.2.

According to phases in Fig. 5.2, a review was performed to select the RL drivers (Phase 1). Next, a questionnaire was developed based on Table 5.1 (Phase 2). For each driver, the respondents could choose between ‘yes’ or ‘no’ regarding the question: “Is this driver important for RL development?” Thereby, the questionnaire was sent to three professionals in Brazilian textile industries (Phase 3): two large industries, and one medium, described briefly in Sect. 4.1. The industrial professionals from

Table 5.1 RL drivers and sources

Driver	Sources
Category – Government and policy related issues	
1. Regulatory pressure for product return/recovery	(Alvarez-Gil et al. 2007; Andiç et al. 2012; Hsu et al. 2013; Kannan et al. 20142014; Krikke et al. 2013; Subramoniam et al. 2013)
2. End-of-life levies for the consumer at point of sale	(Rahimifard et al. 2009)
3. Corporate citizenship pressure	(Chan and Chan 2008; Hsu et al. 2013; Shaik and Abdul-Kader 2014; Van Der Wiel et al. 2012)
Category – Supply chain partners and management related issues	
4. Cooperation and integration with partners in the SC	(Ho et al. 2012; Subramoniam et al. 2013; Shaik and Abdul-Kader 2013; Xie and Breen 2012)
5. Top management awareness and commitment	(Janse et al. 2010; Xie and Breen 2012)
Category – Market related issues	
6. Competitive advantage by means of green marketing	(Andiç et al. 2012; Jayaraman and Luo 2007; Kapetanopoulou and Tagaras 2011; Van Der Wiel et al. 2012)
7. Green consumerism/consumers' environmental awareness	(Andiç et al. 2012; Chan et al. 2012; Hsu et al. 2013; Shaik and Abdul-Kader 2014; Subramoniam et al. 2013)
8. Competitors' pressures to adopt green initiatives	(Hsu et al. 2013; Shaik and Abdul-Kader 2014)
Category – Technology related issues	
9. RL management information system	(Chiou et al. 2012)
10. Eco-design and Design for X techniques	(Subramoniam et al. 2009; Subramoniam et al. 2013; Xie and Breen 2012; Kannan et al. 2014)
11. Recycling and remanufacturing technologies	(Kannan et al. 2014)
Category – Economic related issues	
12. Reduction on raw material consumption and waste disposal cost	(Akdoğan and Coşkun 2012; Rahimifard et al. 2009; Subramoniam et al. 2013)
13. Value recovery	(Chan et al. 2012; Janse et al. 2010; Kannan et al. 2014; Subramoniam et al. 2013)
14. Economic viability	(Srivastava 2008; Chan et al. 2012; Krikke et al. 2013; Kannan et al. 2014; Shaik and Abdul-Kader 2014)
15. Financial support	(Ho et al. 2012)

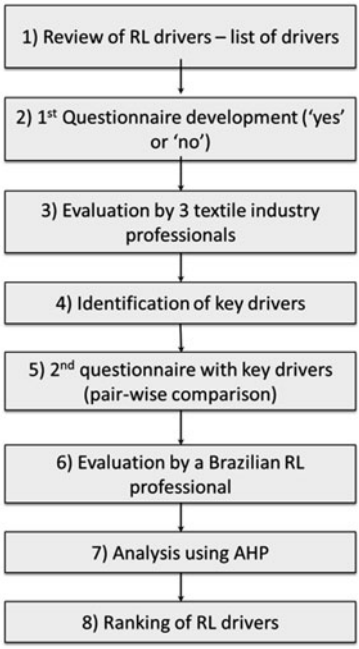

Fig. 5.2 Framework for identifying and evaluating the key drivers of RL in Brazil

the aforementioned companies answer the questionnaire validating the key drivers for RL practice in the textile sector in Brazil (Phase 4). These validated drivers were compiled in a new questionnaire (Phase 5) to be answered by an RL expert in Brazil (Phase 6). An evaluation was performed using analytical hierarchy process (AHP) method (Phase 7) in order to obtain the global weight of each driver and rank them accordingly (Phase 8). The main steps for AHP approach are described in the next subsection.

5.3.1 Solution Methodology

AHP is the multiple criteria decision making (MCDM) tool, which deals with the formulation of multi criteria problems and can handle both tangible and intangible factors (Jiang et al. 2011). The steps involved in the AHP are:

Step 1 Identify the list of drivers related to RL study from the assistance of the literature survey.

Step 2 Develop a questionnaire to collect the data for making a pair-wise comparison with the assistance of an RL Brazilian expert on the basis of a Saaty scale (see Table 5.2).

Table 5.2 Saaty scale. (Haq and Kannan 2006)

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgment slightly favor one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
Reciprocals of above	If activity i has one of the above non-zero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i	A reasonable assumption
1.1–1.9	If the activities are very close	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities

Step 3 Determine the local weight of each driver and check for consistency using Consistency Index (CI), random consistency index (RCI), and consistency ratio (CR) described below. If the CR < 0.1, then the decision is acceptable. Otherwise, the pair-wise comparison matrix should be modified to remove the inconsistency.

Step 3.1 Procedure for consistency check: Calculation of consistency ratio follows the below three steps (Govindan et al. 2014): (i) find the relative weights and λ_{Max} for each pair-wise comparison matrix of order n; (ii) find the consistency index for each matrix of order n by the formulae: $CI = (\lambda_{max} - n)/(n - 1)$; RCI can be found from Table 5.3; (iii) Finally, calculate the consistency ratio using the formulae: $CR = CI/RCI$.

Step 4 Determine the global weight of each barrier and rank them accordingly.

Table 5.3 Average random consistency index (RCI) based on matrix size (n) (Adapted from Saaty (2000)

n	1	2	3	4	5	6	7	8	9	10
RCI	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

5.4 Results and Discussion

This section presents the results of the empirical research performed in Brazil. For that, the studied companies, the RL selected drivers, and the ranking of key RL drivers are presented and discussed in the following subsections.

5.4.1 The Studied Companies

For confidentiality reasons, the studied companies are called A, B, and C.

Company A The first selected Brazilian textile company was founded in 1968 in Southern Brazil. Currently, the company A employs 8800 workers and produces female, male, and children garment. Concerning the sustainable supply chain management, the company has an environmental management system, which deals with reduction of solid, liquid, and gas residues. Some of the company's initiatives for a greener production are:

- All equipments that produce vapor, hot air, or thermal fluids use natural gas as fuel, reducing the emission of gases and eliminating the production of toxic gases.
- Machines that produce dust or fibril operate with filters impeding these particles to remain suspended in the air. In addition, in the knitting sector, specific equipment collects all suspended particles and acclimatizes the area.
- Regarding solid residues, the company A operates a selective collecting waste system, separating paper, plastic, metal, glass, and textile residues, which are forwarded to recycling processes.
- Used fluorescent lamps are sent for decontamination to a certified company.
- Used oil is sent to a certified company for re-refining.
- The company A has its own landfill site, monitored by specialized laboratories.
- Liquid effluents are sent to an effluent treatment station owned by the company, with efficiency superior to 97 %.
- Concerning the storage of chemical products, the company uses containment basin scaled according to the Brazilian legislation in order to prevent leakage.
- Concerning the noise pollution, when buying new machinery, the company A tests the equipment before purchasing it, in order to verify if the noise level is accepted by the legislation. Furthermore, in some cases, the machines receive sound attenuators.
- Recently, the company A started to use oxybiodegradable bags.

- An inventory of emissions of greenhouse gases was performed, which pointed out that the amount of trees planted and preserved by the company offered a surplus of carbon neutrality, based on the evaluation parameters of IPCC—Intergovernmental Panel on Climate Change.
- Finally, the company A supports environmental educational projects, receiving students to show its environmental management system.

Other environmental initiative of the company A includes the production of clothes out of PET polyester yarn since 2011. This is a polyester fiber produced from 100 % recycled material from PET bottles. Still, the company has not started yet a collecting program for its used garment in the market. However, the idea is already in discussion in the company.

Company B The second industry is a 50 years-old large company headquartered in Santa Catarina state in Brazil, with about 3400 employees. The company is one of the largest clothing companies in Brazil. It manages the distribution channels with a multichannel approach that comprises multibrand stores, wholly owned stores, a franchising network, and a value network. The company is the largest company in the childrenswear segment and owner of the brand that represents the third biggest garment franchiser in Brazil. According to its annual report of 2013, the company incorporates into its strategic planning proposals aimed at sustainability. The company has invested in many initiatives for greening the manufacturing processes, but, so far, no reverse logistics practice is formalized.

Company C With about 80 employees, the third company is a small womenswear company founded in 2000 with three stores in Southern Brazil. Nowadays, the company C is spread among eight states. Differently from the companies A and B, the company C outsources the textile and clothes production. The core business is the fashion design and the management of the brand, selling their products in their own stores. Up until the present moment, the company C has not started any kind of EOL product management or reverse logistics practice.

5.4.2 Selected Reverse Logistics Drivers

From the 15 drivers gathered from literature and listed on Table 5.1, nine key drivers were selected by three Brazilian textile industrials. The drivers considered as important for more than one manager were selected according to the Brazilian context for RL implementation and development. The list of key drivers is presented in Fig. 5.3.

The final list of nine selected RL drivers were evaluated by a RL expert, based on the scenario of the Brazilian textile industry sector. Next subsection presents the company, followed by the AHP analysis.

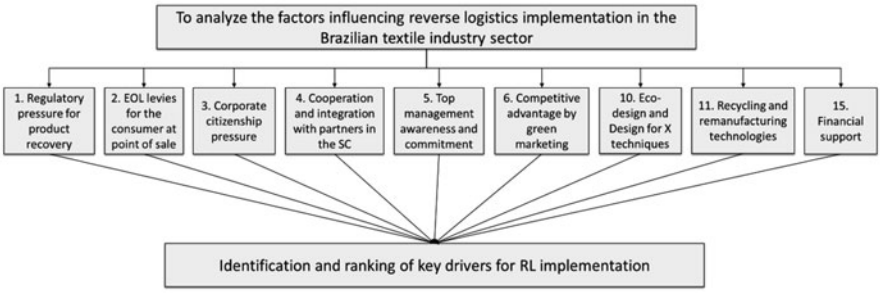

Fig. 5.3 Key drivers for Brazilian context for AHP evaluation

Table 5.4 Pair-wise comparison matrix for driver

		1	2	3	4	5	6	10	11	15
1	Regulatory pressure for product return/recovery	1	5	7	7	5	8	7	7	2
2	End-of-life levies for the consumer at point of sale		1	3	2	3	5	3	3	0.2
3	Corporate citizenship pressure			1	0.3333	0.2	1	2	0.333	0.125
4	Cooperation and integration with partners in the SC				1	0.3333	3	3	3	0.1429
5	Top management awareness and commitment					1	3	2	3	0.25
6	Competitive advantage by means on green marketing						1	2	2	0.1667
10	Eco-design and Design for X techniques							1	1	0.1429
11	Recycling and remanufacturing technologies								1	0.1429
15	Financial support									1

5.4.3 Ranking of Key Reverse Logistics Drivers

The results of the AHP analysis are shown in Table 5.3 and 5.4. Table 5.3 shows the pair-wise comparison matrix obtained from the RL expert judgment for the key drivers. Table 5.4 depicts the detailed AHP weights for each driver with the consistency ratio value, and the driver ranking. The ranking is based on the weight values of the AHP method. Normally, the global weights for the criteria are obtained by multiplying the relative weight of the criteria values with the relative weights of each sub-criteria. However, for this analysis, we decided to compare all sub-criteria (drivers) among each other, as they were few, thus obtaining directly their global

Table 5.5 AHP weights and ranking for each driver

Driver	Sorted weight value	Rank
1. Regulatory pressure for product return/recovery	0.3256	1
2. End-of-life levies for the consumer at point of sale	0.11	3
3. Corporate citizenship pressure	0.03232	8
4. Cooperation and integration with partners in the SC	0.0685	5
5. Top management awareness and commitment	0.09092	4
6. Competitive advantage by means of green marketing	0.03931	6
10. Eco-design and Design for X techniques	0.03006	9
11. Recycling and remanufacturing technologies	0.03763	7
15. Financial support	0.2656	2

Max. Eigenvalue (λ_{Max}) = 10.174, CI = 0.14673
RCI = 1.45, Consistency ratio CR = 0.10119

weight. The following sections discuss the results obtained by means of the AHP method.

5.5 Discussion

It can be inferred from Table 5.4 that the driver regulatory pressure for product return/recovery (1) ranks first. Legal issues are critical when implementing RL and green practices in an SC (Govindan et al. 2014; Abdulrahman et al. 2014). Introduction of new or improved regulations that relates to product and waste disposal may make it mandatory for the companies to recover used products (Kannan et al. 2014; Krikke et al. 2013). Financial support (15) driver ranks next. Many authors (Krikke et al. 2013; Subramoniam et al. 2013; Govindan et al. 2014; Shaharudin et al. 2014) state that RL can improve economic efficiency. In addition, the availability of initial capital for investment in RL operations is crucial for its implementation (Ho et al. 2012). End-of-life levies for the consumer at point of sale (2) driver took the third place in the ranking. Some researchers (Rahimifard et al. 2009) consider that tax revenues at point of sales drives customers to return their EOL products. Some international apparel companies, such as H&M, have already started to attract their clients to bring back any kind of used garment. They accept any type of used products, even from other brands, back to their stores, offering rewards such as discounts in new purchases or purchasing vouchers (H&M_Sustainability_Report 2012). Top management awareness and commitment (5) driver rank forth. RL implementation is facilitated when top managers are conscious about its relevance and committed to RL implementation (Janse et al. 2010; Xie and Breen 2012).

Next is cooperation and integration with partners in the SC (4) driver. Strategic partnerships with supply chain partners might boost RL practice. Cooperation and

relation with business partners in the SC, such as shared responsibility for returned products, can help the RL implementation (Ho et al. 2012; Subramoniam et al. 2013; Shaik and Abdul-Kader 2013; Xie and Breen 2012). Additionally, companies need to collaborate with external RL members, such as scavenger and decomposer organizations, in order to establish a complete SC recycling system (Wu et al. 2012). The sixth driver is competitive advantage by means of green marketing (6). Marketing objectives such as having a green image is a growing concern among industries (Kapetanopoulou and Tagaras 2011; Van Der Wiel et al. 2012). RL can be a differentiator by means of gaining market and competitive advantage as a strategic weapon (Andiç et al. 2012; Jayaraman and Luo 2007; Kapetanopoulou and Tagaras 2011; Van Der Wiel et al. 2012).

Recycling and remanufacturing technologies (11) driver achieved the seventh priority. In general, many recycling and remanufacturing strategies are evolving toward continuous improvement by the researchers (Kannan et al. 2014), which increases interest in RL operations. Interestingly, contrasting with the results from this analysis, some authors (Larney and Van Aardt 2010) posit that the willingness to recycle textile and apparel waste is a stronger driving force than regulations or cost-saving initiatives. However, on the other hand, textile companies will start to be interested in recycling activities as soon as it is mandatory by law and/or it is economically efficient. Still on the recycling topic, it is important to mention that the most important impediment to recycling apparel is still the lack of equipment and technology (Larney and Van Aardt 2010).

Corporate citizenship pressure (3) driver comes next, as the eighth priority in the ranking. Firms are increasingly under pressure to behave in a socially responsible manner, by meeting legal, ethical and economic responsibilities placed on them (Hsu et al. 2013; Van Der Wiel et al. 2012; Shaik and Abdul-Kader 2014). Finally, the driver Eco-design and Design for X techniques (10) took the last place. In this matter, in order to achieve sustainable development, enterprises must redesign products and adapt new technology for processes (Wu et al. 2012). Design for remanufacturing, or recycle, or disassemble are techniques that can enhance the chance of getting an EOL product back because RL costs are reduced (Subramoniam et al. 2009, 2013; Xie and Breen 2012; Kannan et al. 2014).

5.6 Conclusions and Future Research Directions

Due to the urgent concerns of environmental and societal considerations, sustainable supply chain management became a highly important research topic, along with studies of EOL product management, reverse logistics activities, and so forth. In the apparel industry, disposable products under the fast fashion concept has become a trend and, at the same time, a threat for the environment due to the more rapidly creation of waste. In this scenario, reverse logistics is currently considered a primary issue, acting on the EOL product management and closing the loop for textile supply chain. In these connections, this study attempted to analyze the drivers of RL

practice for the fashion industry, with the specific case of Brazil, proposing a priority ranking of influential factors by means of AHP approach. The drivers of apparel RL were collected from literature resources and validated by three industrials from the fashion sector in Brazil. Finally, an RL expert, using AHP for obtaining the ranking priority, evaluated the key drivers selected by the industrials. The study provides some valuable results: the most influential drivers for RL practice are policy and economic related issues. For the Brazilian scenario, the decision on whether or not to implement RL for the apparel industry sector is based on regulation pressures from the government and economic benefits. In this sense, it becomes clear why Brazil is still in a green awakening process concerning textile product EOL management. No specific law has been issued so far for the textile industries. Due to the lack of available technology for recycling, RL is not economically viable yet. In summary, limited gains of scale and technology restrictions are the major impediments for the economic feasibility of RL in the apparel industry sector. Another relevant outcome is the managerial implication of the driver priority ranking. This is a starting point to understand the developing countries reality for product recovery, particularly in the fashion industry. In this growing trend of disposable fashion, the implementation of used apparel collection programs is becoming crucial in order to achieve a sustainable fashion supply chain management.

Concerning future paths for research on RL, there is a necessity to dig out more options and opportunities to explore the optimal management techniques, thus further explorative study is needed in the scenarios of apparel industry sector in emerging economies. In this sense, from a practical perspective, it is relevant to consider the most important drivers for RL that can be controlled and managed by apparel companies in Brazil. These factors are: EOL levies for the consumer at point of sale; top management awareness and commitment; and cooperation and integration with partners in the SC. Future studies may investigate the effect on revenues for Brazilian apparel companies brought by the use of discount vouchers when customers return used products to stores, as the H&M and Adidas cases cited in this work. Another possible line of study concerns the integration of the reverse supply chain. How integration techniques for forward supply chain can be applied for reverse channel management in the apparel sector? Furthermore, a multicriteria decision making tool can be developed aiming at finding the best EOL solution for the textile industry sector in Brazil, considering the EOL options, outsourcing and joint venture options, available technology, and current legislation scenario.

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Part III
Empirical Studies

Chapter 6
Apparel Manufacturers' Path to World Class Corporate Social Responsibility: Perspectives of CSR Professionals

Marsha A. Dickson and Rita K. Chang

Abstract This study examined world class corporate social responsibility (CSR) as it is practiced by apparel manufacturers to provide an understanding of what world class practices in CSR include and who the manufacturers are that are performing them, and to provide guidance to encourage and support a broader range of manufacturers to embrace greater CSR. Interviews with CSR professionals with extensive experience in the practices of apparel manufacturers' world class CSR programs were described, with dominant practices involving a focus on workers, incorporation of management systems, and taking ownership for conditions in their factories. The interviews also provided information about the benefits that accrue to manufacturers pursuing world class CSR and how buying companies can support these efforts. The research is valuable because it provides buying companies criteria by which to assess their manufacturers' CSR programs and guidance for how they can support improved CSR.

6.1 Introduction

Corporate social responsibility (CSR) refers to business practices addressing the well-being of workers and the environment. It has been associated with human and workers' rights, health and safety of workers, environmental stewardship, consumer well-being, and product affordability and quality (Dickson and Eckman 2006), and contributes to sustainability (Dickson et al. 2009). When it comes to managing CSR in the apparel industry, most research has focused on Western brands and retailers with well-known brand name products rather than companies in their supply chains based in developing countries (Huq et al. 2014). However, based on experience working with the United Nations Global Compact, Hall (2007) stresses the need to understand the leading CSR practices of a small group of "world class" corporations based in emerging markets. These leading companies can have CSR programs as sophisticated as those of companies based in the West (Hall 2007). In the apparel

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industry, the world class CSR activities of apparel manufacturers can serve as a model for the many other companies globally that are currently unaware or uninterested in pursuing CSR but might be motivated to do so in the future. Furthermore, having defined criteria for world class CSR for apparel manufacturers would contribute to more sustainable supply chain management and assist sourcing professionals in distinguishing between prospective suppliers.

No research was found that focused on the world class CSR activities of apparel manufacturers. Huq et al. (2014) describes why four garment manufacturers have adopted social sustainability practices (i.e., social responsibility management), what barriers they face in adopting those, and how to facilitate adoption. Yet, the Bangladeshi firms were selected on convenience rather than their outstanding performance, and the managers interviewed admitted to cheating so that their factories appeared to be more compliant to their buyers' codes of conduct than in fact they were. Likewise, Welford and Frost (2006) provided an overview of CSR practices pursued by factories of apparel and other products in China and Southeast Asia and the benefits and obstacles they encountered. Interviews were conducted with CSR managers for brand name companies, factory managers, and other experts in CSR, but again the intent was to explain the *general* practices, not the *best* practices of leading companies. In many cases, awareness of CSR was limited; the most predominant view was that CSR was a nuisance involving costly minimum level compliance to buyers' codes of conduct. The CSR managers did note, however, that several factories had distinguished themselves with exemplary CSR practices including providing generous benefits and above minimum wages, premium overtime pay, and regular bonuses (Welford and Frost 2006). The authors did not investigate what management practices were followed to assure these improved conditions.

The purpose of this study was to examine world class CSR as it is practiced by apparel manufacturers. Four specific objectives were addressed:

1. Define the practices of world class CSR.
2. Profile apparel manufacturers practicing world class CSR and the extent they exist in the global supply base.
3. Determine whether there are business benefits and a competitive advantage for world class CSR.
4. Understand the role of buying companies in expanding world class CSR in their supply chains.

6.2 Review of Literature

This research drew upon two theories for examining world class CSR and how it can be progressively improved and expanded. Total responsibility management (TRM), developed by Waddock and Bodwell (2002), explains the various policies and practices companies carry out to manage CSR. Zadek's (2004) Path to corporate responsibility provides a model for how companies move through five phases of action on their way to increasing their social responsibility. The current research

used these theories as a starting point for defining world class CSR and how it expands and improves.

6.2.1 Total Responsibility Management

Companies that desire to become more responsible implement a variety of activities, all of which Waddock and Bodwell (2002) have proposed are part of TRM. TRM consists of three main components: inspiration, integration, and innovation. Inspiration encompasses vision-setting and leadership commitment, whereby commitment to CSR is evident at each level of management and throughout the entire company. This vision and commitment are influenced by engaging stakeholders and developing foundational values (Waddock and Bodwell 2002). Stakeholders include customers, suppliers, employees, nongovernmental organizations (NGOs), stockholders, media, activists, and governments among others (Dickson et al. 2009; Waddock and Bodwell 2002). While the TRM framework revolves around a variety of stakeholders, it is centered on the employees, "recognizing that investing in a workforce is an investment in the capacity of an organization and its suppliers to meet the social objectives it has established" (Waddock and Bodwell 2002, p. 118). Directly affected by labor practices, employees are the most knowledgeable of where improvement needs to be made and are responsible for enacting the company's vision. Broader stakeholder engagement allows companies and stakeholders to cultivate transparent relationships so that opinions and feedback can be given in a mutually responsive manner (Waddock and Bodwell 2002).

In addition to stakeholder engagement, establishing foundational values is also part of the inspiration process and guides companies in setting long-term goals and making ethical decisions (Waddock and Bodwell 2002). These values are usually expressed in the form of a code of conduct, which is commonly influenced by the Universal Declaration of Human Rights and the labor conventions of the International Labour Organization's Declaration on Fundamental Principles and Rights at Work (Dickson et al. 2009).

Integration occurs when a company begins to instill and implement its vision and values throughout the entire business, by building human resource capacity and integrating the vision and values into its management systems (Waddock and Bodwell 2002). Education and rewards are used to implement the vision, so companies train their employees on the need for social responsibility and continually reinforce the ways they can make a positive impact. In addition, in order to instill and implement the company's vision and values throughout the entire business strategy, companies create divisions or departments dedicated to supporting these values of social responsibility (Dickson et al. 2009).

Innovation encompasses the improvement systems and indicators companies use to continuously develop and advance their socially responsible practices (Waddock and Bodwell 2002). Some companies create performance assessment systems that measure the extent of compliance with their companies' codes of conduct. Once

companies have collected information about their progress, they use that data to evaluate and improve their CSR efforts.

A second aspect of innovation is that companies are transparent and accountable. While stakeholder engagement strives to increase transparency between the company and external stakeholders, initiatives such as annual social responsibility reports or detailed websites make the company more transparent and accountable for its actions. It also serves as a way for stakeholders to provide feedback on what they find to be successful or needs to improve (Dickson et al. 2009).

6.2.2 Path to Corporate Responsibility

In building the process to manage social responsibility, companies often progress along what Zadek (2004) calls a path to corporate responsibility, which consists of five stages: (1) defensive, (2) compliance, (3) managerial, (4) strategic, and (5) civil. In the defensive stage, the mindset of the company is generally, "It's not our job to fix that" (Zadek 2004, p. 126). The company may have received unexpected criticism about its unethical operations from civil society activists, media, investors, or others. Public relations and legal teams work to devise public responses, which are usually either complete rejections of accusations or denials about the relationship between the company and the complaint (Zadek 2004).

A company in the second stage, compliance, recognizes that the criticism can affect its reputation and knows that a corporate policy must be created (Dickson et al. 2009). The company believes "We'll do just as much as we have to" and gears its public statements toward critics in a form of "We ensure that we don't do what we agreed not to do" (Zadek 2004, p. 126). During the 1990s' wave of sweatshop accusations, companies created codes of conduct in response to stakeholders' call for basic labor and environmental standards and required their suppliers be monitored against those codes (Dickson et al. 2009).

Companies realize that leadership systems are necessary to further their commitment to social responsibility in the third stage, the managerial stage. Zadek (2004) describes the mindset of this stage as "It's the business, stupid" (p. 126). Managers are given the responsibility for focusing on compliance and are held accountable for resolving issues. Divisions, executive positions, and full-time positions are created to help a company better address social responsibility (Dickson et al. 2009).

In the strategic stage, companies begin to understand that aligning their business strategies with social responsibility can serve as a competitive edge, helping to overcome current issues and also assist with long-term success (Zadek 2004). For instance, companies taking innovative approaches to solving labor problems may choose to start publicly reporting their efforts to get credit from customers and investors for their work (Dickson et al. 2009).

Companies begin to think, "We need to make sure everybody does it," in the final civil stage (Zadek 2004, p. 127). Apparel companies work together to help make social responsibility become an industry standard, from which companies can profit for

the long-term and from not experiencing "first-mover" disadvantages of conducting costly practices. With increased collaboration also comes an increased participation in multistakeholder initiatives, where companies and stakeholders engage with each other to further the cause and need for social responsibility (Dickson et al. 2009).

A major limitation of TRM and the path to corporate responsibility is that they were developed on the basis of large corporations headquartered in the United States and Europe. This research examines whether the path to and management of CSR applies to apparel manufacturers in the same way as their buyers.

6.2.3 Empirical Research on Apparel Manufacturers and CSR

A small body of literature has studied apparel manufacturers, providing initial insight into their CSR practices, the obstacles they face with CSR, what motivates their CSR actions, and the characteristics of those manufacturers that are better managing CSR. Well-known brands and retailers have subjected their large tier 1 manufacturers to social auditing, training and capacity building programs, and the requirements of multistakeholder initiatives such as the Fair Labor Association and Ethical Trading Initiative. In turn, Merk (2014) contends that some of these large manufacturers have reluctantly implemented CSR programs, others have actively engaged in behaviors to mislead buyers about their compliance, while others have taken more proactive and positive approaches, such as adopting their own CSR strategies and working in collaboration with their buyers for improved performance. Large tier 1 manufacturers have become increasingly competitive in the global garment industry by upgrading the services they offer and the quality of their outputs, which has resulted in long-term relationships with major brands and retailers. However, Merk (2014) argues that "Despite a wide range of CSR practices, working conditions remain substandard" (Merk 2014, p. 274).

CSR performance varies by company. Frenkel and Scott (2002) observed that two companies with strong and similar management practices differed in their approach to CSR, with one only reacting to their buyer's demands. Yet, Distelhorst et al. (2014) found that by adopting lean manufacturing methods, Nike suppliers were able to reduce serious violations of code of conduct by 15 %, although the reduction varied by countries/regions. Compliance was increased in Southeast Asia but in China compliance was not significantly improved. In a survey and interviews with apparel manufacturers based in China, 60 % reported having little or no understanding of CSR. The majority associated CSR with complying with laws, and did not have any policy or department focused on CSR (Cooke and He 2010).

The costs of engaging in CSR have been noted by Chinese and Indian apparel manufacturers (Cooke and He 2010; Huq et al. 2014; Stigzelius and Mark-Herbert 2009). Factories in India who were pursuing certification for CSR with SA8000 faced increased costs due to having to comply with higher wage standards and paying for audits required for certification (Stigzelius and Mark-Herbert 2009). Chinese manufacturers noted that compliance added costs and buyers were unwilling to share

in the costs of compliance (Huq et al. 2014). There were disincentives as well, including a lack of financial benefits from buyers (Cooke and He 2010; Stigzelius and Mark-Herbert 2009). Downward pressure on prices and shortened lead times from buyers presented further obstacles for apparel manufacturers attempting to implement greater social responsibility (Huq et al. 2014; Welford and Frost 2006). Chinese suppliers' commitment to buyer codes of conduct diminished with pressure to produce low-cost products coupled with transactional business relationships where suppliers were threatened that orders would be lost if they did not comply (Jiang 2009).

Additional obstacles preventing apparel manufacturers from implementing CSR related to managers and supervisors lacking skills for handling CSR issues (Welford and Frost 2006), inconsistent interpretation of standards by buyers and their auditors, lack of agreement with buyers on the standards they sought to impose (e.g., reduced overtime), cheating (mock compliance) of suppliers (Huq et al. 2014), and lack of government enforcement of regulations and support for CSR (Cooke and He 2010; Huq et al. 2014). Huq et al. (2014) noted higher prices and larger orders, as well as a harmonized code of conduct, focus on capacity building rather than auditing, a continuous improvement approach where buyers and suppliers work together, and enforcement of laws would assist manufacturers in facing these obstacles. This leads us to the motivations that apparel manufacturers have reported for implementing CSR.

While Hall (2007) asserts that emerging market TNCs operating world class CSR programs are often motivated by the difficulties endemic to their host developing countries, the motivation may be simply to gain competitive advantage (Cooke and He 2010; Porter and Kramer 2006). Empirical research has focused on a variety of possible business benefits from CSR. Improved working conditions helped Chinese and Bangladeshi manufacturers compete for workers by being a more attractive employer (Cooke and He 2010; Huq et al. 2014; Welford and Frost 2006), increased worker morale, and reduced absenteeism and employee turnover (Stigzelius and Mark-Herbert 2009; Welford and Frost 2006).

Improved productivity is a possible motivation for pursuing CSR (Huq et al. 2014; Stigzelius and Mark-Herbert 2009). In comparing two apparel manufacturers based in Mexico produced for Nike, Locke and Romis (2010) found that the factory implementing lean production involving worker participation and empowerment had better wages and working conditions, and was also more productive and profitable than the comparison factory. Additional possible business benefits noted in the literature involved hopes to receive more orders and fewer audits from their buyers (Stigzelius and Mark-Herbert 2009), and a better reputation with buyers (Cooke and He 2010).

Buying companies have an important role to play in motivating apparel manufacturers to implement CSR activities. Although Chinese manufacturers in one study did not report strong pressure from their buyers for them to engage in CSR (Cooke and He 2010), stakeholders based in Hong Kong and Mainland China believed CSR was carried out by apparel manufacturers because it was required of them by Western buyers (Tsoi 2010). Indian and Bangladeshi apparel manufacturers adopted CSR practices primarily because their buyers required it (Huq et al. 2014; Stigzelius and Mark-Herbert 2009).

How buying companies work with their suppliers reflects an emerging area of research aimed at improving CSR effectiveness (Dickson 2013). Buying companies work with their suppliers on CSR in two different ways. The traditional compliance model involves a top-down approach whereby powerful brands and retailers develop codes of conduct for their manufacturers and make heavy use of audit data to force their suppliers to improve their labor standards or lose their business (Locke et al. 2009); it has resulted in only slight and uneven improvements in factory working conditions (Frenkel and Scott 2002; Locke et al. 2009).

In contrast, a collaborative approach (also referred to as "commitment-oriented") involves more of a partnership between buyers and supplier who use the code of conduct to benchmark continuous improvement of working conditions with factory auditors who conduct root-cause analysis and take part in joint problem solving, information sharing, and the distribution of best practices that mutually benefit workers, manufacturers, and their buyers (Frenkel and Scott 2002). Tsoi (2010) found that partnering with factories and increasing trainings offered were ways that stakeholders believed CSR would be improved. Research has demonstrated that as compared with traditional compliance approaches, collaborative/commitment-oriented approaches delivered more effective CSR results for Nike's suppliers (Lim and Phillips 2008; Locke et al. 2009) and for Adidas' suppliers (Frenkel and Scott 2002).

Working in partnership with manufacturers on CSR seems to have added positive benefits as well. Collaborative approaches to CSR have been connected with greater efficiency, better scheduling and planning, and improved product quality as well as improving worker turnover, and reduced monitoring costs (Frenkel and Scott 2002; Locke et al. 2007). Capacity building necessary for lean manufacturing aligned social compliance goals with core business goals (Distelhorst et al. 2014).

As a final theme, there are business characteristics that appear to be related to improved CSR. These characteristics include longer contracts (Jiang 2009), the attitudes of owners that had been educated overseas (Huq et al. 2014), and production for reputation conscious buyers (Oka 2010). There are inconsistent results on whether the size of the factory makes a difference. In comparing two apparel manufacturers based in Mexico that were producing for Nike, Locke and Romis (2010) found that the higher achieving of two factories was smaller. However, other research found that smaller companies had more difficulty complying with codes of conduct as compared with larger companies (Welford and Frost 2006) that were more likely to be professionally managed and generally more modern and safer than smaller companies (Merk 2014).

6.3 Methods

To define world class CSR and identify ways it can be supported, this study incorporated a qualitative approach involving interviews with a convenience sample of CSR professionals based in the USA, Europe, and Asia and leading CSR efforts for multinational apparel corporations and consultants/other professionals working collaboratively with companies to enhance CSR. CSR professionals' perspectives on

world class CSR among apparel manufacturers were valuable because the scope of factories they work with provides them with deep knowledge of how manufacturers differently implement CSR, enabling them to make comparisons across numerous factories. Their views also matter because many are in the position to reward manufacturers practicing world class CSR.

Thirty CSR professionals were invited to participate and 18 accepted for a 60 % response rate. Interviews were conducted via face-to-face conversations, telephone, or Skype. Interviews ranged from 40 to 100 min, with most lasting approximately 45 min. The sessions were audio recorded and then transcribed verbatim for data analysis.

An interview schedule was created by the researchers to address the research objectives. Questions asked the CSR professionals to discuss world class CSR along broad topics related to managing social responsibility, the CSR-related interactions their companies have with world class manufacturers and the extent that world class CSR existed among manufacturers in their supply chain or base of clients. In cases where professionals did not believe that any apparel manufacturers were operating world class CSR, they were asked to express their views in terms of the ideal practices those companies would carry out. The interviews also explored the idea of competitive advantage and whether there were business benefits for world class CSR.

The qualitative data were coded using both deductive and inductive approaches. Using a deductive approach, examples of specific management practices associated with the two theories were coded (e.g., the presence of management systems and foundational values, a focus on workers, tracking performance data, publishing a public report on CSR performance). Additionally, an inductive approach identified additional common themes through multiple readings of the interview transcripts.

For each theme in the data, frequency of mentions throughout all 18 interviews were recorded in order to determine which were discussed more prevalently and were more indicative of a common definition of world class CSR and how it can be supported and expanded. However, to control for redundancy, if a theme was mentioned multiple times in one interview, that theme was counted only once. Due to space limitations, we present only findings that were cited by a majority of those interviewed.

6.4 Results

6.4.1 The Practices of World Class CSR

CSR professionals described a variety of business practices that reflected world class CSR as implemented by apparel manufacturers. In presenting those, each is related to the component of TRM (inspiration, implementation, or innovation) that it best reflects with broad topics associated with TRM listed in italics and bullets indicating subtopics that were coded during data analysis (see Table 6.1).

Table 6.1 CSR practices of "world class" apparel manufacturers

Practices	Frequency ($n = 18$)
Inspiration: vision setting and leadership systems	
Stakeholder engagement processes: Engaging and empowering workers	16
Foundational values: Aligned and compliant with international standards	14
Adhering to government legislation	12
Values/leadership commitments/responsibility vision: Owner and management commitment and values	14
Visionary and strategic	13
CSR—both social and environmental	13
Community focused	11
Integration: changes in strategies and management practices	
Integration into policies and practices: Management systems	18
CSR staff or committee	15
Building human resource capacity: Strong management	13
Training and capacity building	10
Innovation: assessment, improvement and learning systems	
Accountability for results and impacts: Taking ownership of CSR	18
Transparency: Open, transparent, trustworthy, and honest	16
Publishing CSR reports	11
Indicators of performance: Performance assessment	15
Profits and reinvestments into CSR activities	12
Improvement: innovation and learning External stakeholder engagement	12
Focus on continuous improvement	10

6.4.1.1 Inspiration

Engaging and empowering workers in the manufacturers' factories was the most frequently mentioned inspiration theme defining world class CSR. This theme focused on worker engagement, education on rights, respect for workers, provision of grievance procedures, and the creation and engagement of worker committees. As one professional stated, workers have to be "recognized as a huge piece" in CSR, going on to explain:

> Management should really believe in worker-labor management relations. So that means. . . having a good grievance system in place, and really having opportunities for workers to express their positives and not-so-positives without any kind of negative retaliation. So it would be management acknowledging the value that the workers bring.

Having foundational values based on international standards and laws was also considered important for world class CSR. However, world class manufacturers were expected to go beyond compliance with a code of conduct. As one CSR professional asserted, "I'll emphasize I think that when you talk about the ideal factory, you're talking about something that is not envisioned by anybody's code of conduct."

Commitment of owners and top management contributed to the vision of world class apparel manufacturers and allowed CSR to be integrated into the company. One professional reminded that this commitment was important "to allocate resources and put pressure on middle management to build policies and systems and procedures." Several noted the changing management attitudes among younger generations of factory ownership. One professional had observed that:

> The 35-year-old Taiwanese apparel manufacturer who got his MBA in Michigan and who comes home to take over the family business, has a very different attitude towards, for instance, interfacing with workers than the father who grew up in China, fled to Taiwan during the war, and went back to establish a factory when that was possible.

The responsibility vision of world class manufacturers was forward thinking and strategic. As one professional explained, "[in] the top group you have this executive vision. It's part of the company's values, part how the company does business. It's important to them. They're doing it for themselves." The vision of world class apparel manufactures extended to both social and environmental concerns, as well as to investing in the larger community beyond the factory walls.

6.4.1.2 Integration

Integration of CSR into the policies and practices of the company, particularly its management systems, was cited by all CSR professionals as essential to world class manufacturers' implementation of CSR. Such systems included those used in operating human resources departments, occupational health and safety and environmental management systems, manufacturing processes, and production management systems. A CSR professional described how the ideal manufacturer's management team would be central to such systems:

> First and foremost, you know, CSR in these factories is actually good management. So, you know, we have socially responsible factories that have qualified health and safety engineers on staff and who have set up systems to make sure that safety standards that are issued from the head office actually kind of trace to the work floor. . . . I hesitate to even call this social responsibility. This is just basic common sense, good management.

Employing strong managers in CSR with accountability for achieving improvements and building their capacity to implement CSR was another practice believed to be important for world class apparel manufacturers, along with training workers. However, in addition to CSR staff, focus on capabilities of strong managers covered all

factory functions. In describing a world class manufacturer, one CSR professional explained "So they've got a highly invested, very sophisticated management team, quite articulate, very educated, very smart business people." Another explained why building worker capabilities were also important, "The workers need to understand what their rights are."

6.4.1.3 Innovation

The most significant innovation element of world class apparel manufacturers was the ownership and accountability they proactively take for CSR; it was cited by all those interviewed. Self-governance was a term used by many and an approach they took with their best factories. One CSR professional offered that "instead of this program and this process being driven by, you know, each of their respective customers, it's being driven and owned by them." It was also noted that world class apparel manufacturers were open and honest about the issues they discovered in their factories, rather than trying to hide them. Describing this, one CSR professional explained,

> [The] world class manufacturer is open with its customers about its impacts and where it is along a continuum of meeting internationally recognized standards. So in other words if there are problems, they are aware of them and willing to discuss them openly with their customers first and foremost.

This openness was considered to facilitate trust between buyers and suppliers. For a majority of CSR professionals, the manufacturer would be so transparent as to publish public reports about their CSR efforts.

Performance assessment, involving internal audits and tracking effectiveness of the CSR work on key performance indicators (KPIs), was also a practice of world class manufacturers. One CSR professional stated,

> Ultimately what you'd want to see is facilities that have the capability to report the positive impact of the implementation of the systems. Because of this we identified this series of problem, and we resolved them.

Reinvesting profits back into the company to improve its CSR performance was an example of one specific and important KPI.

Engaging external stakeholders was another approach to innovation. Engaging with a variety of stakeholders such as NGOs and government allows manufacturers to tap others' perspectives and learn new strategies. Participating with multistakeholder initiatives, such as the Fair Labor Association that brings together companies, universities, and civil society to work toward improved working conditions, was a particular stakeholder engagement approach several CSR professionals mentioned.

Finally, a continuous improvement approach to CSR was pursued by world class apparel manufacturers. One CSR professional explained,

> It's very hard to ensure compliance. I think, you know, if you really get down in these codes of conduct, to really do everything all the time, is very difficult. So the key is not—to me

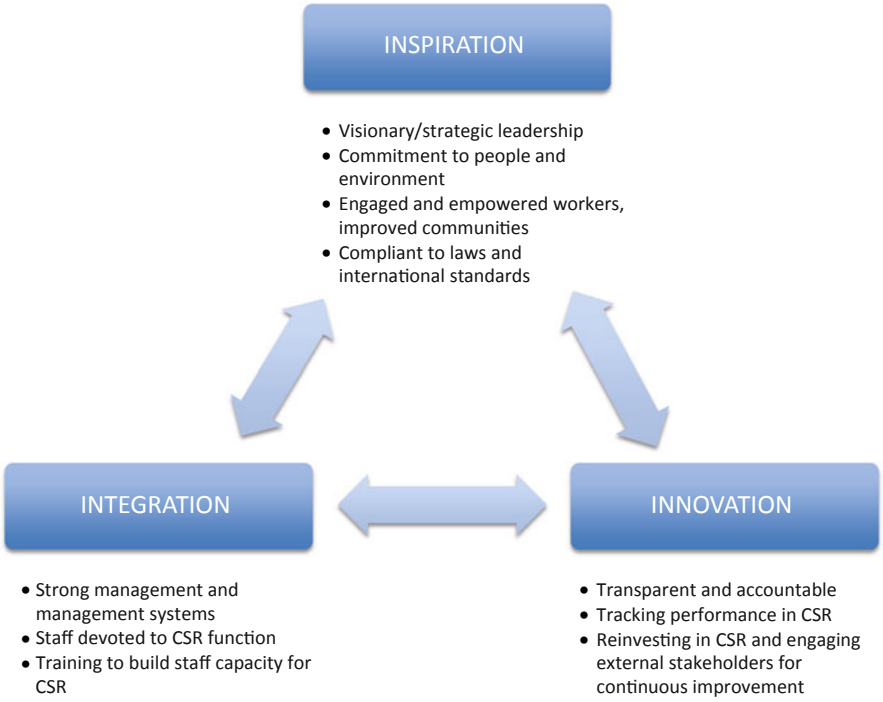

Fig. 6.1 Inspiration, integration, and innovation for world class CSR

it's not being perfect all the time, it's having this system that tracks how you're doing and gets you back on track when you're off.

6.4.2 Relationships Between Inspiration, Integration, and Innovation

Figure 6.1 illustrates the key components of inspiration, integration, and innovation as practiced by manufacturers in world class CSR. This research did not identify the component that serves as the starting point and it could be any of the three. For example, world class CSR could be spearheaded by the company leadership at the inspiration level. Alternatively, it could originate from a strong culture of management systems (integration) or in response to a workplace crisis (innovation). However, once world class CSR is part of the manufacturer's value proposition, feedback and change occurs across all three components.

Table 6.2 Competitive advantages and business benefits for implementing world class CSR

Theme	Frequency ($n = 18$)
Yes, there is a competitive advantage	14
No, there is not a competitive advantage	4
What are the competitive advantages for the manufacturer?	
More volume and greater profit	13
Decreased overtime and increased productivity	12
Improved efficiency and increased quality	12
Decreased employee turnover rate	11

6.4.3 *Profile of Apparel Manufacturers Practicing World Class CSR*

It is valuable for buying companies to be able to target world class manufacturers so they can support and assist in expanding the base of manufacturers that are considered world class. There were only two characteristics CSR professionals agreed described world class apparel manufacturers. World class manufacturers were large (n = 11), often operating multiple production facilities and were incentivized and supported by their governments (n = 10) through regulation and enforcement of laws, and broader initiatives in support of workers (e.g., ILO Better Work). CSR professionals believed that the manufacturers practicing world class CSR existed; however, we were unable to precisely pin down the extent they were found in their apparel supply or customer bases. The most common response (7 of 13 CSR professionals) was a very small number such as two manufacturers or 1–2 % and perhaps up to 5 % of the base. The largest numbers cited was from 10 to 20 % of factories, a range that captured an additional four responses.

6.4.4 *Business Benefits and Competitive Advantage for World Class CSR*

A competitive advantage was believed to exist for those manufacturers carrying out world class CSR (see Table 6.2). One advantage mentioned was increased order volumes or making more money on the business they do. One CSR professional explained,

> And so there is a premium to be paid for this. It's a premium that's not just involved with social responsibility. It's involved with quality and workmanship and other things like that, but there is a premium to be paid.

Additional business benefits related to reducing the cost of business by reducing overtime and improving efficiency, productivity, and quality. These benefits were

Table 6.3 How brands can help manufacturers take the next step

Theme	Frequency ($n = 18$)
Buyers with high expectations	13
Develop stronger and equal relationships with manufacturers	13
Build capacity for CSR	13
Provide incentives or punishment	12

often discussed together, supporting the assertion that well-managed factories are managed well in all their functions. One CSR professional elaborated, stating, "A well-run factory cannot help but be an efficient factory and a compliant factory. I think they really go hand in hand."

6.4.5 Role of Buying Companies in Expanding World Class CSR

Maintaining high CSR expectations of factories was a key role that buyers could play in supporting and expanding world class apparel manufacturers as was having good and long-term relationships with their manufacturers (see Table 6.3). While the need for reputation sensitive brands to choose the best manufacturers to conduct business with was mentioned, the bulk of the discussion referenced the brands lagging in CSR efforts by not compelling their suppliers to be leaders or in some cases even looking away when noncompliances were found. This inaction provides disincentives for improved CSR because manufacturers can more easily conduct business with lenient buyers. One CSR professional explained that,

> You'll find the better factories are the larger ones with all the good brands and the brands who want protection, you know, for the status of their brands. . . . So you're going to find that factories that are making for the Nikes, the Levis, the Adidas, the Gaps, are going to be your leaders. The smaller they get and the more iffy your clientele base is, then the tougher it is for you to implement CSR.

Another CSR professional mentioned that "So as long as factories do have those kinds of customers saying I don't care, they won't change."

A strong relationship between buyers and their manufacturers was also important to encouraging world class CSR and was described as long-term relationships with buyers providing significant orders to the manufacturer, maintaining good dialogue with each other giving space for manufacturers to talk about the challenges they face, and working together to address them. One CSR professional explained,

> I think that the bottom line for most suppliers is knowing that there's going to be long-term production with the brand. There's going to be volume. It's all financially driven—volume and a long-term commitment. A lot of suppliers aren't going to bother if they know [you are] just going to be with them for a season or two and you're only going to give them minimal orders. They can't plan their business around that, so why should they even bother with anything else? They need to worry about getting more business.

Providing training, having supplier forums, and coaching manufacturers helped to build their capacity to address CSR issues. One CSR professional explained, "Show them how to do it, teach them how to do it, work with them to help them find the right tools."

Providing incentives, or if necessary punishment, was another form of support buyers could provide. Using CSR performance in making sourcing decisions was specifically mentioned as was providing more business. As noted earlier, much conversation focused on what needed to be done rather that what was being done by brands to support their manufacturers. As one professional explained,

> There are some things that haven't found common adoption, and are not even really meaningful parts of the conversations between buyers and their suppliers and I think those include things like incentives, without which nothing will change in the long term.

6.5 Discussion

This study sought to examine world class CSR as it is practiced by apparel manufacturers. The first two objectives provided an understanding of what world class practices in CSR include and who the manufacturers are that are performing then. The third and fourth research objectives provided information that can be used to encourage and support a broader range of manufacturers to embrace greater CSR.

6.5.1 World Class CSR

Interviews with CSR professionals with extensive experience in the practices of a global base of apparel manufacturers, described CSR programs that contained many of the elements of TRM (Waddock and Bodwell 2002) and had similarities to previous research. World class manufacturers are inspired by the forward-thinking vision of top leadership and recognize the value of workers not just as employees, but also valuable resources in which to invest in, to support, and to respect. Laws and international standards are viewed as only minimum standards of performance. These manufacturers engage in considerable activity to implement the CSR vision by having highly qualified managers with the right skills implement the right systems to assure a consistent approach to the CSR work as well as all other aspects of the factories' work, including quality control and production efficiency. The emphasis on strongly qualified management aligns with previous research (Welford and Frost 2006). Also like previous literature, we noted the changing management style brought by those educated overseas (Huq et al. 2014). Through training, these apparel manufacturers also enlist the support of workers in implementing CSR.

In interacting with their buyers, apparel manufacturers pursuing world class levels of CSR take ownership of their work, tracking performance, being honest with their buyers about what they find, and being accountable for finding remedies, including

sometimes making costly investments into their companies. Their work is shared publicly so that stakeholders can know about the CSR work and make suggestions.

Unlike the practices assembled by Waddock and Bodwell (2002) in TRM, apparel manufacturers do not broadly engage external stakeholders when establishing foundational values. This is understandable given that one reason that CSR is pursued is because reputation-sensitive buyers require it (Cooke and He 2010; Oka 2010; Stigzelius and Mark-Herbert 2009; Tsoi 2010) and then enforce it through the traditional compliance approach (Frenkel and Scott 2002; Locke et al. 2009). In addition, since world class manufacturers are serving buyers with the highest expectations, the codes of conduct would be imposed on them as part of the business relationship. In addition, no mention was made of these manufacturers internally rewarding managers and workers for CSR implementation.

Unlike Merk (2014) who observed large manufacturers becoming increasingly competitive with the products and services they offer while offering substandard working conditions, CSR professionals observed that improvements in products and services correspond to improvements in CSR. This difference in perspective is likely due to the fact that CSR professionals understand the complexities involved with achieving better conditions, which requires a constant and continuous improvement approach to facilitate CSR.

Although the CSR professionals were asked to profile world class apparel manufacturers by business characteristics, geography, and other elements, beyond identifying them as larger companies that are supported by their governments there was no consensus on other characteristics or where they are located. The finding related to size corresponds with previous research (Welford and Frost 2006). The value of supportive governments is not surprising given that the lack of government support and enforcement of laws were reported as obstacles to CSR (Cooke and He 2010; Huq et al. 2014).

In discussing the practices of world class CSR, a much different type of apparel manufacturer was described than has been reported on in previous studies where apparel manufacturers were found to have little awareness of CSR, viewed it as a nuisance, and even cheated to avoid complying with buyers' expectations (Huq et al. 2014; Merk 2014; Welford and Frost 2006). Given the very small proportion of global apparel manufacturers viewed as carrying out world class CSR, the differences with previous literature are understandable—without purposefully studying manufacturers with the very best CSR practices, they are likely to be overlooked.

6.5.2 Encouraging and Supporting Broader Engagement with CSR

The CSR professionals interviewed believed there is a competitive advantage for apparel manufacturers practicing world class CSR, which parallels Porter and Kramer's (2006) argument for social responsibility. Several benefits related to internal business performance were mentioned that match previous research, including increased

productivity and quality and reduced employee turnover (Distelhorst et al. 2014; Frenkel and Scott 2002; Locke et al. 2007).

More volume and greater profits was the most frequently mentioned business benefit, like previous research that had found that apparel manufacturers hoped to receive more orders as a result of good CSR (Stigzelius and Mark-Herbert 2009). However, in discussing the role buying companies can play in supporting and expanding world class CSR, our findings indicate that buyers are infrequently delivering this much valued business benefit. Given that past research has raised concerns about the lack of financial benefits (Cooke and He 2010), pressure to produce products at low cost (Huq et al. 2014; Jiang 2009; Welford and Frost 2006), and the high costs of CSR (Cooke and He 2010; Huq et al. 2014; Stigzelius and Mark-Herbert 2009), this is an especially important finding. Apparel buying companies need to follow through and actually help make the competitive advantage tangible by giving those socially responsible manufacturers more orders.

Developing deeper and more equal partnerships with their manufacturers was another key step believed important for buyers to take to support world class CSR, which corresponds with the collaborative approach to working with manufacturers on CSR that is more effective in improving working conditions (Frenkel and Scott 2002; Locke et al. 2009). In contrast to Locke et al.'s (2009) suggestion that buyers use increased auditor presence at factories, this study suggests that world class factory actually should require *less* third-party interaction and more of its own ownership of CSR practices. While buyers may want to provide trainings to build capacity, as suggested by Tsoi (2010), when it comes to handling specific issues the more sustainable approach might be to trust those performing at high levels to identify and tackle the problems in their factories, and provide reports about their efforts and effectiveness.

6.5.3 A Proposed Path to World Class CSR

Zadek's (2004) path to corporate responsibility provided one theoretical perspective for considering how to support and expand progress toward world class CSR. That path placed heavy emphasis on external stakeholders (i.e., the media, activists) in moving brand name companies toward greater social responsibility. For instance, when transitioning from the managerial to the strategic stage, brands are able to easily feel competitive advantages from having fewer media reports on poor working conditions (Zadek 2004). In contrast, the path a manufacturer takes is much more heavily dependent on its buying customers and brand relationships. As brands increase their dedication to social responsibility and include social responsibility as a standard for responsible sourcing, we can expect that their manufacturers will also improve their policies and practices of social responsibility.

In considering the findings of this research and the body of literature on apparel manufacturers and CSR, we propose the "Apparel Manufacturers' Path to World Class CSR" (see Fig. 6.2). This path steps away from the heavy use of policing

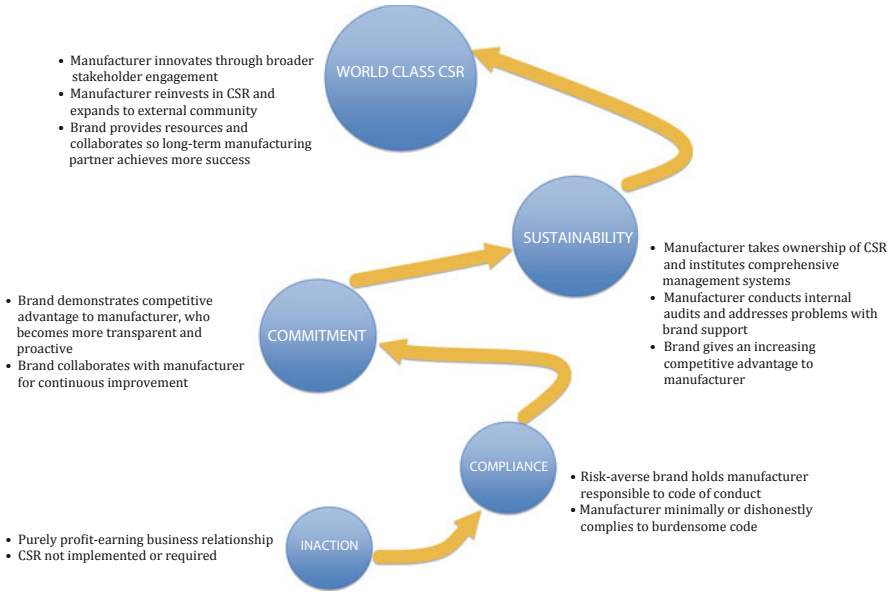

Fig. 6.2 Apparel manufacturer's path to world class CSR: a brand-manufacturer collaboration

methods in the traditional compliance model to a more collaborative approach that is supported and expanded by buying companies through the relationships they have with their manufacturers. In the first stage of this path, "Inaction," the manufacturer and brand have a purely profit-earning business relationship, whereby CSR plays no role in the condition of the business terms. The manufacturer is most likely not incorporating socially responsible policies and practices in its business activities. In deciding whether or not to source from a manufacturer, the brand does not consider the manufacturer's level of compliance with labor standards. The brand does not acknowledge or penalize the manufacturer based on its social responsibility but implicitly rewards inaction with continued business.

In the second stage, "Compliance," in attempts to reduce its risks and accountability should a problem arise, the brand begins to monitor the manufacturer and hold it responsible for upholding the brand's code of conduct. The manufacturer does only what is minimally required, seeing this mandatory requirement as a burden that is costly and not worth the investment. In order to keep the business relationship with the brand, the manufacturer minimally complies or falsifies its compliance to the brand's code of conduct.

For an apparel manufacturer to progress to the "Commitment," stage, the brand needs to help educate the manufacturer that a competitive advantage exists for CSR and jointly works with them to achieve improved results. The manufacturer begins to move beyond dishonest or minimum practices, starting to become more transparent, honest, and trustworthy in order to demonstrate its commitment to social responsibility. The manufacturer is more proactive in implementing the policies and practices

that are required to comply with the brand's code of conduct. The brand responds by preferring this manufacturer over less socially responsible manufacturers.

In the fourth stage, "Sustainability," the manufacturer takes ownership of its CSR practices, realizing that conducting social responsibility is not solely for the short-term benefit of more orders from the brand; rather, it helps improve and develop the workers, community, and business as a whole. The manufacturer works to ensure that the right people and systems are in place. Management systems embed social responsibility throughout the entire manufacturing company's policies and practices. The manufacturer conducts internal assessments of its own factories' performance and brands work with them to overcome obstacles. The competitive advantage is tangible as brands place more orders at premium prices with the manufacturer, allowing the manufacturer to see the positive financial impacts from these orders, as well as the positive business benefits achieved in their manufacturing processes.

Finally, in the "World Class" stage, the manufacturer has already established its socially responsible policies and practices, and now begins to innovate. For example, it may carry out studies with external stakeholders to improve certain aspects of its performance or perhaps even join a multistakeholder initiative to interact with external stakeholders and learn how CSR efforts can be further improved. These profitable manufacturers will reinvest in CSR and expand their efforts beyond the factory walls to the broader community where they are located. The brand not only assists with providing resources to these long-term partners for the implementation of these projects, but it also collaborates with the manufacturer to evaluate, ameliorate, and innovate the results for more successful outcomes.

6.6 Future Research and Conclusion

As with any research, this study has limitations, which would be valuable to address in future research. It utilized the perspectives of CSR professionals, many of whom represent large and well-known apparel brands and retailers. Their definition of world class CSR could be different from those held by representatives of other groups, such as manufacturing companies or NGOs. Therefore, it would be helpful to replicate this study with both groups to understand the characteristics they believe define world class CSR. Surveys and case studies with apparel manufacturers practicing world class CSR could focus on validating the Path to World Class CSR. Furthermore, the study was limited because it did not allow us to know whether apparel manufacturers practicing world class CSR actually have better compliance records than those that are not. If a brand with manufacturers practicing world class CSR would allow it, the compliance records of those suppliers could be compared with those they believe are close to and far from achieving world class CSR.

Until buyers and manufacturers raise the bar to hold higher expectations about CSR and how it is carried out, world class manufacturers will face challenges realizing a full competitive advantage. The industry needs to develop a critical mass of like-minded companies that are serious about eliminating the poor labor practices

and working conditions in the global apparel industry. This research provides criteria that buying companies can use to aid in selecting manufacturers that are on the path to improved CSR. It also provides guidance for how buying companies can support their manufacturers' progress. We urge brands and retailers to follow this guidance and to, as described by one of the CSR professionals, "show them that there's a buck in it."

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Chapter 7
Sustainable Supply Chain Management in the Slow-Fashion Industry

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Abstract This chapter maps and analyses the supply chain of four micro-organisations operating in the slow-fashion industry utilising the Seven-R framework. It focuses on the challenges these companies are facing, as well as aspects these organisations are handling well within their supply chain. The chapter briefly outlines current events, issues, and challenges faced in the slow-fashion industry before presenting a comprehensive literature review of sustainable supply chain management (SSCM). This chapter utilises a case study approach and analyses its findings by following and extending the Seven-R Framework. The concluding remarks highlight key implications of this chapter and emphasise on potential areas of further study.

7.1 Setting the Scene: Sustainable Supply Chain Management, Sustainable Fashion, and Micro-Organisations

Traditionally, supply chain management (SCM) is defined as the combination of key business processes 'from end-user through original suppliers, that provides products, services, and information that add value for customers and other stakeholders' (Lambert et al. 2006, p. 2). The goal of SCM is to overhaul and improve existing organisational processes, in order to enhance the company's long-term performance and the overall supply chain. This can be accomplished by implementing strategically managed business processes across the organisation (Mentzer et al. 2002). With globalisation, emerging SCM becomes a complex process (Hagelaar et al. 2004) in which issues of the environment and social aspects become key determinants (Beske et al. 2008). A shift from traditional to sustainable supply chain management (SSCM) can be observed, especially with increasingly more suppliers involved within the sourcing process (Beske et al. 2008; Walker and Jones 2012).

SSCM shows strong similarities to traditional SCM; however, SSCM incorporates not only issues surrounding the economic benefits of an organisation but also social and environmental concerns. Thus, SSCM can best be described as 'the management of material, information and capital flows [. . .] while taking goals from all

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the three dimensions of sustainable development, i.e. economic, environmental, and social, into account' (Seuring and Müller 2008, p. 1700). Although SSCM is not a new phenomenon *per se*, the literature available surrounding this topic is limited in nature (Gold et al. 2010; Ashby et al. 2012). The key focus of previous SSCM research predominantly focused either on environmental performance (De Burgos Jiménez and Céspedes Lorente 2001) or green product development (Baumann et al. 2002). Stated alternatively, past studies, whilst instructive, have predominantly concentrated on environmental aspects within SCM. Although both environmental and social aspects are associated with SSCM, various authors emphasise that the social dimension within SSCM is under researched (Seuring and Müller 2008; Ashby et al. 2012). Similarly, previous studies focus on SCM in large organisation (e.g. Beske et al. 2008; Walker and Jones 2012), whilst the majority of fashion research looks either at the fast fashion industry or the luxury market (Joy et al. 2012). The context of this research focuses on the slow fashion industry, which provides the counterpart to the fast fashion industry. Fast fashion is often described as those garments that can be acquired on the high street and is characterised as: cheap, mass-produced, fashionable, has a fast stock turnaround and 'mimic[s] current luxury fashion trends' (Joy et al. 2012, p. 273). Slow fashion on the other hand, whilst being fashionable and at times 'cheap' (depending on the price sensitivity of the consumer), is neither mass-produced, nor does it have a fast stock turnover (Fletcher 2008; Bourland 2011). Organisations operating within the slow fashion industry generally produce a new collection twice a year (BSR 2012); by contrast, the fast fashion industry turns their stock around every 2–3 weeks, which approximates to 20 fashion lines per annum (BSR 2012). The growth of the 'slow fashion movement' and the increased interested in the topic from practitioners and academics, as well as the lack of research currently available highlight the importance of this research (Caniato et al. 2012; Pookulangara and Shephard 2013). Moreover, a further justification for this research project is the fact that it focuses on various under researched fields: the creative and cultural industries, SSCM, and micro-organisations (Chaston and Sadler-Smith 2011).

This research utilises the Seven-R framework to investigate the SSCM in micro-organisations operating in the slow fashion industry. The Seven-R framework is a construct that can be used to measure a company's pollution prevention by focusing on: reduce, reuse, recycle, restyle, rewear, redesign, and reimagine. In this manner, an organisation is able to investigate their supply chain and highlight aspects that are particularly well managed and/or have a lower impact on the environment, and those that may need improving.

Micro-organisations lack research compared to large organisations and small and medium-sized enterprises (SMEs), yet they account for 32 % of the UK's employment and make up 18 % of the annual turnover (Ward and Rhodes 2014). A micro-organisation can be defined 'as an enterprise which employs fewer than ten persons and whose annual turnover and/or annual balance sheet total does not exceed € 2 million' (Europa 2007). Further characteristics of micro-businesses include: first, having a limited financial budget, which depends on the owner-manager's financial backing as the sole risk taker (EC 2013). Second, the companies are seen to be innovative, in terms of, for example their designs and production processes (EC 2013).

Third, they are sensitive to competition, especially if large organisations provide a comparable product and/or service at lower cost (Chironga 2012; EC 2013). Fourth, they seek to employ workers that have transferable skills sets (EC 2013). Last, the owner-manager, as the sole risk taker, not only plays a vital role in determining the organisation's direction but also is the key decision-maker (Kelliher and Reinl 2009). Moreover, in sustainability terms, micro-organisations have a significant impact on the natural environment (Seidel et al. 2009; Wilson et al. 2012), which provides further justification for this research and highlights its importance.

In the UK fashion industry, the notion of sustainability and SSCM first emerged in the 1960s, when people became more conscious about the natural environment (Peattie 1995; McCormick 2001; Brown 2011; SustAinability 2011). However, during this period, slow fashion, which is often referred to as *eco* or *green* fashion, was seen as being 'crusty and granola and tie-dyed and hippie and all that kind of stuff' (Brown 2011). The 1980s and early 1990s brought anti-fur campaigns, which led to a majority of brands eliminating fur from their collections, ensuring 'good animal welfare conditions' (BSR 2012, p. 1). The 1990s further renewed interest in ethical and ecofriendly clothing, due to media attention focusing on labour practices (Brown 2011). These labour practice issues are still current today with news outlets reporting about the Rana Plaza incident in Bangladesh in which more than 1100 workers lost their lives (Parveen 2014). Factory accidents such as the Rana Plaza incident are not single occurrences, the previous year, in 2012, 300 workers lost their lives in a burning factory in Pakistan (Ruhman et al. 2012). These accidents are partly caused by a consistent decrease in pricing of fashion garments (Pasquinelli 2012), whereby manufacturers are pressured into continuously lowering their prices (Skov 2008), which the supply chain has to bear. In this way, the 'fashion appetite' (Sharma and Hall 2010, p. 2) on the consumer side has both 'environmental costs and implications' (Sharma and Hall 2010, p. 2), which might be considered as issues that need to be challenged, but are not likely to change in the near future (Tynan 2013). Thus, two conclusions can be drawn so far: First, it can be said that there is a consumer trend to demand more sustainably produced clothing (Lacy 2013; DPA 2014), and second, due to increased media coverage and pressure from nongovernmental organisations, consumers, and the government, businesses put a stronger emphasis on sustainable production (De Brito et al. 2008; Deloitte 2013), which links to the importance of investigating SSCM.

The early 2000s see the slow fashion movement emerge (Fletcher 2007), which is often described as the 'farmers' market approach' (Johansson 2010, p. 28) to clothing production. In other words, an integral part of slow fashion is to incorporate aspects of the triple bottom line (TBL; Elkington 1994) into the manufacturing processes, thereby paying workers fair wages (Tran 2008), produce environmentally friendly garments by utilising organic materials or sustainable techniques (Shephard and Pookulangara 2014), and create collections that can best be described as timeless (Joy et al. 2012; Shephard and Pookulangara 2014). Slow fashion provides manufactures with the opportunity to investigate their supply chain in a holistic manner, thereby focusing on a cradle-to-cradle approach, which incorporates the decision-making process from the early stages in a garment's life cycle to educating consumers about end-of-life treatment (Clark 2008). Thus, organisations have

started to focus more on economic and environmental changes and examine their supply chain accordingly (Wu and Pagell 2011), by also looking at a collaborative approach that sees stakeholders as enablers to further guide organisations towards sustainability (Lozano 2007). Moreover, 'current research lacks approaches from a SME supplier perspective to understand how—and to what extent—sustainability related demands are integrated' (Acosta et al. (2014).

With this in mind, this chapter seeks to explore the two following research questions:

1) Which aspects of the supply chain are managed well according to the Seven-R framework?
2) What challenges do micro-organisations face within their SCM?

This research investigates sustainable practices in slow-fashion micro-organisations utilising the Seven-R framework, which was previously used in a similar context by Ho and Choi (2012) to analyse a Hong Kong-based fashion organisation. The framework provides a point of reference in analysing a company's efforts to include sustainability practices into their organisational processes. Due to the individual components' loose interpretation, which is highlighted in the following sections, it can be easily applied to the SME context. Moreover, Ho and Choi (2012) emphasised that the framework is not 'mutually exclusive' (p. 168) and can be expanded and/or reduced.

7.2 The Rise of Sustainability in the Slow Fashion Industry

Issues surrounding sustainability are not new phenomena and have received increased attention from practitioners and academics for the past decades (Chabowski et al. 2011). The concept of sustainability and sustainable development emerged from the Brundtland Commission's report *Our Common Future*—a milestone for sustainable development (WCED 1987)—emphasising the necessity of 'meeting needs of the present without compromising the ability for future generations to meet their needs' (UN 2011). Stated alternatively, sustainability is the ultimate goal that embraces the human needs for survival and well-being (US-EPA 2010).

Although initially organisations have resisted changes in the environment, more recently companies have felt the need to adapt and transform their supply chain to not only obtain economic benefits but also integrate social and environmental aspects into their supply chains (Elkington 1998; Wu and Pagell 2011). This, as previously highlighted, is due to increased interest and pressure from, for example the media, consumers, and governmental organisations (Deloitte 2013). Interestingly, these TBL aspects have predominantly been investigated as standalone concepts without considering their potential relationship between one another (Carter and Jennings 2002). In the same vein, the textile and apparel industry has seen changes in consumer behaviour towards not only more environmentally friendly products but also eco-innovation and design (Gam and Banning 2011). It can be said that the green movement has extended to a wider range of organisations in the fashion industry, which emphasises more on sustainability (Black 2008).

Within the UK fashion industry, the TBL has gained greater importance with people working in the industry becoming more aware of the effects clothing production has on the natural and social environment (Walsh 2009; Goworek 2013). Looking at the individual dimensions more closely, one can see that *economic performance* relates to the manufacturing processes of goods and/or services. To be 'sustainable', the production process must be able to produce goods and/or services on a continuous basis, must be financially viable and prevent any *imbalance* that could damage or destroy the agricultural and/or industrial production within a country (Harris 2003). *Social performance* focuses on improvements that can be made, in order to strengthen a society, in terms of investments in public facilities, including, but not limited to, leisure facilities, schools, and community centres, thereby making the company's surrounding location more attractive for people to live in (Holmberg 1992; Harris 2003). Moreover, it is concerned with the actual working conditions and environment employees operate in, and ideally, ensure that these conditions meet the regulatory standards and requirements (Hubbard 2009). *Environmental performance* looks at the impact an organisation has on the natural environment, thereby focusing on raw materials used and the production processes involved to create a garment (Harris 2003). Concentrating business activities around the TBL helps to raise awareness about the implications the production has on the environment (social, economic, and environmental) and raises motivation amongst employees and stakeholders towards sustainability as an environmental and economic performance tool (Bowden et al. 2001; EC 2001; Siebenhühner and Arnold 2007). Thus, incorporating these bottom lines into business processes leads to sustainable development, which is 'a dynamic process, [that] enables all people to realise their potential and [. . .] simultaneously protect and enhance the Earth's life support systems' (Chambers et al. 2008, p. 3). However, due to the apparel industry being change-intensive (Kunz 2005) and following the principle of seasonality and fashion trends (Doeringer and Crean 2006; Easey 2009; Gibson and Stanes 2010) incorporating sustainable practices may be challenging and not always feasible for micro-organisations (Hillary 2004; Battisti and Perry 2011).

In summary, it can be said that although sustainability has received increased interest in the past decades (Chabowski et al. 2011), past research has predominantly focused on environmental and economic aspects, rather than the social strand (Ashby et al. 2012). Moreover, the fashion industry, as one of the greatest polluters has seen dramatic changes (UNEP 2013) not only in consumer behaviour but also in terms of organisations actively seeking to adapt to the changing environment and incorporate sustainability aspects into their supply chain (Walker and Jones 2012).

7.3 SSCM —A Brief Overview

Traditionally, the term supply chain describes an organisation's overall processes starting from the selection of raw materials to the finished products, to the distribution channels used to reach the consumer. In other words, a traditional supply

chain comprises of five parts: raw material, industry, distribution, consumer, and waste (Ho et al. 2009). SCM then seeks to coordinate the individual parts of a supply chain with the goal to improve an organisation's overall performance in the long term (Mentzer et al. 2002; Lambert et al. 2006). In comparison to traditional SCM, SSCM incorporates additional environmental and social aspects. The previous section has highlighted that issues concerning the natural and social environment emerged as hot topics in today's fashion industry, thus more and more organisations start to examine their current supply chain procedures (Minney 2011; Winter 2014). The aim is to not only surpass challenges in regards to increased raw material prices but also to actively engage with global challenges, such as climate change (Wu and Pagell 2011). Recent events (Ruhman et al. 2012; Parveen 2014) have elicited changes in the fashion industry, whereby action was taken by various retailers, including, but not limited to, John Lewis, The Arcadia Group, and Marks & Spencer, to improve working conditions and prevent similar accidents from happening again (Davies 2013). Tragedies in the supply chain are not the only motivational drivers behind the sustainability agenda, further motivators include, but are not limited to: shortages of raw materials (Srivastava 2007), increased wastage, particularly at landfills, as the average consumer bins 30 kg of clothing and textiles per capita per annum (EFF 2008; WRAP 2012), regulatory requirements, and pressure from increasingly knowledgeable consumers (Srivastava 2007).

Lozano (2007) highlights that especially in organisations that have sustainability at their core, collaborations with members of the supply chain and other stakeholders can be beneficial for solving challenges that can be related to climate change. This highlights that research into the social dimension of SSCM is vital. In this manner, various authors (Bowen et al. 2001; Zhu et al. 2010) mention anchor companies as playing an important role in SSCM. Anchor companies can best be described as global or international companies that, in this case, have their headquarters in the UK (Meechan 2014; Welsh Government 2014). These anchor companies can act as role models in implementing sustainable practices across the whole supply chain. Stated alternatively, if an anchor company decides to change their supply chain and focuses more on TBL aspects, all members involved in this supply chain, ideally, also change their behaviour and processes in order to comply with the guidelines set out by the anchor company. Improvements are then incorporated steadily with the individual members helping, guiding, and supporting one another on the way (Carter and Easton 2011; Ahi and Searcy 2013). An example of an 'anchor company' that seeks to change behaviour is Tesco (UK), who works together with London-based 'sustainable brand' *From Somewhere* in an attempt to make use of *waste* materials in one of Tesco's textile warehouses (Pasquinelli 2012). The waste material results from fast seasonal fashion trends in a change-intensive industry, challenges which large companies try to overcome through these collaborations (Kunz 2005). The venture with Tesco and *From Somewhere* emphasises how large organisations are increasingly aware of the environmental impacts their actions have and how to counteract them to become a 'good corporate citizen' (Sheehan 2013). It shows that in today's economy individual corporations have more options to practice sustainable development than might have been feasible in the past, especially within the

fashion industry by utilising 'think-tanks' (Gam and Banning 2011). A noteworthy observation of the current literature is that there seems to be a lack of information in regards to SMEs and their ability to incorporate supply chain initiatives (van Hoof and Thiell 2014), which further highlights the importance of this research.

It can be said that there are various reasons for organisations to implement sustainability practices into their supply chain, such as reducing waste generation and discouraging, in this case, throwaway fashion (Vachon and Klassen 2008). Whilst these aspects increasingly gain importance the most vital aspect underlying the implementation of these sustainable practices is the creation of a competitive advantage and, in the long-term, economic benefits (Yang et al. 2010; Ho and Choi 2012). To achieve sustainability within a supply chain, organisations have the opportunity to participate in reverse logistics (Abraham 2011). Reverse logistics is 'traditionally defined as the process of moving product from its point of consumption through channel members to the point of origin to recapture value or ensure proper disposal' (Schatteman 2003, p. 267). This implies that the main focus of reverse logistics lies with the end of the product's life cycle, thereby, through design, seeking to improve, what has been described as the Three-R abilities: the reduction of waste, the reuse of materials, and the recycling of the product when it reaches its end in the life cycle (Alumur et al. 2012). Thus, it can be said that the scope underlying the SSCM can range from reactive monitoring schemes to proactive practices, which can incorporate aspects of the Seven-R framework (Srivastava 2007).

To reiterate a previous point further, a key framework that enables investigations into SSCM is the Three-R (reduce, reuse, and recycle) framework (Almur et al. 2012), which was extended by two further components (Etsy and Winston 2009)—redesign and reimagine—to reach its final stage of the Seven-R framework by incorporating restyle and rewear (Ho and Choi 2012). The Seven-R framework was utilised by Ho and Choi (2012) in a similar context to this research, focusing on a single case study of a Hong Kong-based fashion company. Within this research the framework is applied to a multiple case study approach, focusing on four UK-based micro-organisations. Data was collected in form of an extensive, comparative case study approach, utilising various methodological tools: employee shadowing, semiotics, social media analysis, semi-structured interviews, and questionnaires. A case study approach was seen as appropriate as it is 'an empirical inquiry that investigates a contemporary phenomenon within its real-life context' (Yin 2003, p. 13). Stake (1995) mentions that this kind of research is concerned with the complexity and particular nature of an organisation and is of particular use where the research topic needs to be studied within its context. Thus, this specific research method allows not only for a broader understanding (Punch 2005) of the individual companies but also for an in-depth analysis of the stakeholders' perceptions.

In summary, it can be said that sustainable supply chain initiatives focus on all aspects related to the manufacturing processes, the usage and distribution of a product, the logistics behind individual processes, and activities relating to waste management (Srivastava 2007). Stated alternatively, sustainable supply chain models enable an organisation to identify areas in which waste occurs, whilst furthermore highlighting emerging opportunities to reduce current waste through reusing and

recycling materials as well as re-manufacturing goods (Ho et al. 2009). The Seven-R framework provides a baseline for investigating a micro-organisation's SSCM, highlighting aspect that are well established and challenges that are faced.

7.4 The Seven-R Framework

The Seven-R framework acts as a guideline to analyse components that have been highlighted within the pollution prevention framework that 'shifts the emphasis from controlling pollution once it has been created to preventing its creation in the first place' (IISD 2013). In other words, the Seven-R framework can be utilised to identify areas in the supply chain that might lack attention (Vachon et al. 2001).

The Seven-R framework focuses on: recycling, reusing, reducing, redesigning, reimagining, rewearing, and restyling. 'Recycling' takes economic and regulatory factors into account (Srivastava 2007) and is concerned with the processes by which materials and fabrics are collected and broken down into useful raw materials, which can then be reused within new products (Ho and Choi 2012). The recycling process can take on various forms: on the one hand old textile fabrics can be recycled, shredded, and eventually reused to produce a new garment, and on the other hand consumer waste, such as plastic bottles can be utilised to create new fashion items (Humana Nova 2014). It is noteworthy to highlight that within the UK alone 1 million tonnes of textile fabrics are binned each year, of which 50 % would be recyclable. Nevertheless, statistics indicate that of these 50 % only 25 % are reused or recycled within the UK (EFF n.d.). 'Reuse' focuses on extending a product's useful life by utilising it again in its original form (Ho and Choi 2012). Within the UK government initiatives such as Waste & Resources Action Programme (WRAP) actively encourage the reuse of fashion items, providing workshops that bring together local authorities and the general public to learn about various options available to extend the life cycle (WRAP 2014). 'Reduce' on the one hand focuses on limiting the actual waste materials produced, whilst on the other hand it can also refer to the carbon footprint of a piece of clothing. In other words, not only pattern design and cutting can reduce waste but also 'thinking critically about materials [. . .], which is not an isolated solution, but part of a considered and linked chain of positive choices along the supply chain' (Turner 2012). Moreover, Ho and Choi (2012) highlight that sourcing raw materials locally or even producing within the country may reduce the carbon footprint of a piece of clothing. 'Redesign' is linked to what is known as sustainable design in the fashion industry and emphasises on the *timelessness* of a garment. This implies, the piece of clothing is not bound to seasonality, thus, does not go *in* and *out* of fashion (Joy et al. 2012; Aakko and Koskennurmi-Sivonen 2013). 'Reimagine' links to the production process as a whole and the implementation of new innovative techniques that could enhance the supply chain (Thompson 2012). 'Rewear' is focusing on giving a product an extended life cycle by, for example encouraging a second hand culture (Ho and Choi 2012). 'Restyle' is linked to extending a product's useful life through adding decoration or tailoring it to the person's needs (Ho and Choi 2012).

In summary, this research focuses on the slow fashion industry and micro-organisations, which have been identified as key contributors to environmental pollution (BSR 2012; Wilson et al. 2012). The Seven-R framework not only provides an opportunity to identify areas that, thus far, have been managed well by organisations but also highlights potential challenges they may face. Identifying areas of need furthermore enables organisations to actively engage in and change processes by showcasing innovative behaviour (Choi et al. 2001). Moreover, the Seven-R framework has been utilised previously within a similar context, and has been extended from the Five-R to the Seven-R framework. Thus, this research seeks to apply the framework to a different context to previous studies and extend the model by two further R's: reclaim and reconfiguration.

7.5 The UK Micro-organisation Case Studies: Organisations 1, 2, 3, and 4

Organisation 1 Is owned and run by a single designer and was established in 2007. Currently one full-time and four part-time staff are employed at the firm. Organisation 1's expertise is with women's wear and has been described as a sustainable fashion specialist within the city. Their main focus is on upcycling and recycling techniques. The company produces all its garments within the UK and is exporting globally. Organisation 1 does not have a physical store space and distributes its garments through an array of channels, including online direct sales, marketplace websites, and third party stores.

Organisation 2 Is in its 12th year of existence. Since established in 2002, the organisation has grown steadily and now employs ten full-time workers. The company focuses on the children's wear industry, and more specifically, specialises in kids' shoes. The manufacturing site is in the UK, with the key customers of this organisation being in China, Taiwan, and Singapore. Organisation 2 has both business-to-customer and business-to-business sales. With no physical store, the method of distribution is through their own online portal.

Organisation 3 Is a co-operative that is run and owned by one designer. It was established in December 2012, in conjunction with the Mary Portas fund and governmental support, helping to revive the high street. The shop currently provides employment for four members of staff on a full-time basis. Organisation 3 does not produce any specialised collections, but rather provides a manifold of garments and accessories, ranging from high-end upcycled collections to traditional African-fusion inspired clothes, to vintage bags and jewellery. Organisation 3 is customer facing and based in a city centre location, just off the main high street.

Organisation 4 Is a co-operative, which was founded in August 2012, with only personal funds utilised. The company is equally owned by a group of ten people and managed by one individual designer. The company does not employ any workers *per*

se, but is operated by the founding members. The physical store space is located in a shopping mall just outside of the main pedestrianized high street. Organisation 4 specialises in women and children's wear.

7.6 Seven-R Framework Applied to Slow Fashion Micro-organisations

Before providing a detailed analysis of the Seven-R framework, it is vital to highlight that within this research's context the owner-manager of the individual micro-organisations plays a key part within the supply chain. The introduction emphasised that the owner-manager is not only the sole risk taker of the business but also the decision-maker (Kelliher and Reinl 2009). This has various implications: First, the overall supply chain is developed and designed by one individual, who, in this context, not only decides upon the direction of the business, but also is part of the supply chain. Stated alternatively, the owner-managers only work with like-minded brands and organisations that complement their own values, vision, and goals. Second, the implementation and development of 'sustainable practices' into the business' supply chain solely depends on the owner-manager and their attitude towards 'change'. Depending on how the owner-manager understands and interprets the term 'sustainable fashion', various options are available: Some owner-managers may further enhance their knowledge about sustainable techniques, such as upcycling or recycling, others may feel more strongly about learning about certified raw materials. Third, the data has indicated that relationships with supply chain members (suppliers, agents, and other micro-organisations) and stakeholders (employees, consumers) are vital to the owner-managers, which is a key indicator that the social component plays a major role within these micro-organisations. This links to a previous point: thus far, there is not only a lack of research on the social component in SSCM (Ashby et al. 2012), but also the implementation of SSCM in SMEs is under researched (van Hoof and Thiell 2014). Furthermore, whilst the Seven-R framework provides an opportunity to analyse, in this case, the effectiveness of a SSCM in slow-fashion micro-organisations, the model lacks an R that focuses on the role of the owner-manager, their involvement, and attitude towards sustainability. Within this research, data indicated that the owner-managers' attitude, knowledge, and information they have about sustainability plays a key role in the overall process.

Table 7.1 provides the analysis of the four case organisations according to the Seven-R framework. The second column highlights the findings, the third column provides answers to the first research question: what these micro-organisations are currently doing well, whilst the last column highlights the challenges faced by these businesses.

Recycling All four case organisations produce their garments and accessories locally (within the UK), with three out of four also sharing their facilities with other members of the creative and cultural industry. All studios were equipped with dedicated recycling facilities. Moreover, the owner-managers ensured that the packaging

Table 7.1 Findings

Seven-Rs	Findings	Research question 1	Research question 2
Recycle	Provide recycling facilities in studio Utilise both upcycling and recycling techniques UK-based manufacturing and shared facilities—low carbon footprint Recycled packaging material	Use production techniques that are less harming to the environment Utilise recycled packaging material	Unable to identify origin of raw material
Reuse	Opportunity to provide upcycling and recycling workshops Build collaborations and relationships with stakeholders and supply chain members—allows to exchange 'waste products' and thus extend usefulness of raw material	Develop relationships with supply chain members and stakeholders	Collaboration processes not fully developed
Reduce	Local production and sourcing (where possible) Acquired specialised sewing machine that reduces thread waste Machines have power-saving device, which further helps to reduce electricity	Sourcing process and collaborations	Not all raw material can be sourced locally No control over facility energy efficiency
Re-design	Pattern cutting machines allow for precise cut outs and reduce waste Collections incorporate recycling and upcycling techniques, thus every collection is unique as the raw materials are continuously changing Innovative design that allows fast sewing techniques	Sustainable design	Raw materials used for collections are continuously changing Inefficient design
Re-imagine	Active involvement of society and stakeholders	Long-term relationships that allow co-creation of value	Struggling to create a lean straight-line supply chain process
Re-wear	Actively promote swop-shops and community workshops that educate stakeholders about after 'useful' life options available Actively involved with charity that collects clothing and other accessories to be send to Cambodia, helping children in needs	Promote and educate sustainable fashion	Lack of clarity what entails sustainable fashion

Table 7.1 (continued)

Seven-Rs	Findings	Research question 1	Research question 2
Re-style	Work together with stakeholders to gain best consumer experience	Promote and educate sustainable fashion	Lack of clarity what entails sustainable fashion
Reclaim	Utilise factory waste materials Incorporate traditional tailoring techniques	Rescue material from landfill Recollect traditions	Lack of collaborations
Reconfiguration	Close relationship with their supply chain members and stakeholders Actively involve them in business decisions Owner-manager creates the organisation as version of themselves	Building and maintaining long-term relationships Keep communication constant	Lack of guidelines

material utilised is not only recyclable, but also produced from recycled materials. In the same vein, the majority of the case companies employed sustainable production techniques: upcycling (making a new, different product out of an old one) and recycling (mending and changing existing products). Whilst these practices fit in well within SSCM, a challenge that emerges is the fact that the origin of recycled fabrics cannot always be determined. In terms of the sustainable fashion industry, which prides itself on producing garments that are not only less harmful to the environment, but also produced in good working conditions (Liggett 2010; Barnard 2014), this cannot be guaranteed for the raw material.

Reuse The data highlighted that the case companies promote and facilitate upcycling and recycling workshops, which are geared towards stakeholders interested in extending the useful life of their garments. Through these workshops the owner-managers establish close relationships with various stakeholder groups that provide the opportunity to co-create value (Lusch and Vargo 2006). Stated alternatively, incorporating the social component of the TBL plays a significant role for these micro-organisations, providing them not only with a competitive advantage through co-creating value (Lusch and Vargo 2006), but also by establishing a bond with their stakeholders, which can lead to greater brand loyalty (Hallawell 1999; Yang and Peterson 2004). Although this aspect is positive not all of the focal companies have managed to establish close relationships built on mutual trust. Identifying the perfect fit between the organisations and stakeholders that can co-create value and thus enhance the competitive advantage is challenging and takes a long time (Vernette and Hamdi-Kidar 2013).

Reduce The companies are not only based in the UK, but also produce and source (where possible) locally. Throughout the data collection, it became apparent that the owner-managers saw this as their key competitive advantage and highlighted that this is the main reason for them to classify their businesses as being sustainable. Moreover, the majority of participants have sewing machines that automatically cut off threads to reduce wastage, as well as have a built in electricity saving device. The data indicated that these micro-organisations foster long-term relationships, which can start as early as the initial idea of when the business is born to a more mature stage. These relationships provide the organisations with valuable opportunities by collaborating and working together closely with their stakeholders and members of the supply chain. Although each company seeks to utilise energy efficient machinery and locally produced raw materials this is not always possible. The plastic packaging for one of the garment producers for example cannot be produced locally, but has to be imported from Asia. Moreover, only one out of the four organisations owns their premises and is able to make a conscious decision on which electricity providers or light bulbs to use. Thus, whilst the owner-manager would like to be more environmentally conscious, this is not always possible, due to either restrictions in the ownership agreement or availability of resources on the market.

Redesign The garment design is influenced by the owner-managers educational background and focuses strongly on sustainable design, which emphasises on the

timelessness of a garment. This implies the piece of clothing is not bound to seasonality, thus, does not go *in* and *out* of fashion (Joy et al. 2012). Moreover, specialist machinery allows accurate pattern cutting that leaves hardly any waste materials. This implies that these micro-organisations decrease their environmental impact by reducing the materials they are using within their production processes. However, due to their main production methods (upcycling and recycling techniques) the owner-manager has to continuously work on varying designs and amend them according to the raw materials available. This means that the actual design and production process needs continuous time investment, which implies financial costs.

Re-imagine In order to continuously redevelop their fashion collections the individual owner-managers seek to actively involve their stakeholders and society in broader terms in their production processes. Through workshops, pop-up events, tradeshows and festival visits these micro-organisations engage with people interested in their brand and seek to involve them in feedback sessions, which are sometimes incentivised by give-away competitions. However, data indicated that the interactions between stakeholders and the organisations lessen over time and might even come to a complete hold once incentives are stopped. Moreover, owner-managers find it challenging to decide which suggestions to take into account. From the in-depth research it became apparent that the daily routines and the overall business processes felt unguided, which left the overall supply chain unstructured. In other words, they struggle to create lean supply chain processes as they continuously redevelop their garment collections and implement changes to the products.

Re-wear Each owner-manager believes that sustainable fashion is more than simply designing upcycled and recycled garments. The findings indicated that they have a passion for creating garments that not only provide pre-loved items with an extended life cycle, but also seek to encourage people to wear their fashion items longer. Thus, the majority of the case companies get involved in promoting the UK's second-hand culture by putting on swop-shops, whereby stakeholders can exchange unwanted garments. Moreover, one organisation went into partnership with the Hope Agency, a charitable organisation helping Cambodian children in need. This specific owner-manager encourages her stakeholders to donate clothing and soft toys for this specific cause. Thus, it can be said that all owner-managers seek to educate their stakeholders about what 'sustainable fashion' means to them, which can range from producing fashion with sustainable techniques, providing workshops on upcycling, or extending the usefulness of individual garments by donating them to charitable organisations. This highlights that sustainable fashion can mean different things to different people. Although the owner-managers all promote rewearing garments, they also actively encourage stakeholders to purchase their newest collections.

Re-style Similarly to reimagine, restyle implies that stakeholders are incorporated in production processes to co-create value (Lusch and Vargo 2006), not only in terms of the garments, but also in terms of the overall shopping experience. However, as has previously been mentioned, the owner-managers are the sole risk takers and decision-makers in the organisations, whilst they take suggestions and advice into account, the final decision lies with the owner-manager. This implies that it depends

on their understanding of the term sustainable fashion and hence their decisions on what they see as appropriate and complimenting their current fashion lines.

Reclaim This theme emerged throughout the data collection and, to our knowledge has not previously been discussed. Reclaim implies incorporating factory waste, such as off-cuts or faulty material, into the new garment collections as 'highlight' pieces. It also refers to 'reclaiming' traditions, in that the UK used to be a hub for the textile and fashion industry, however, the majority of factories and cotton mills closed down with the industrial revolution leading to globalisation. The owner-managers seek to incorporate traditional manufacturing techniques into their garment collections, as they feel proud of their heritage and believe that the job of a traditional seamstress should not die out. Although, theoretically speaking, incorporating 'reclaim' into the production process is beneficial as it adds heritage and thus a competitive edge to the product, due to their size and financial opportunities these micro-organisations struggle to establish long-term collaborations.

Reconfiguration Reconfiguration focuses on the social aspect associated with the individual micro-organisations. Through close relationships with their supply chain members and stakeholders the owner-managers seek to co-create value, which ultimately leads to higher sales turnovers. In other words, by incorporating their various members into the decision-making processes the owner-managers make them a vital part of the business, create brand loyalty and provide greater satisfaction to their stakeholders, due to them (members of supply chain and stakeholders) being able to voice their opinion and bring their ideas into the production process. A challenge that these micro-organisations face however is to be able to guide the process of value co-creation. As previously highlighted change can occur at any time, which implies that there are no set guidelines and structures in place that provide any party involved with information on how to act in or contribute to the process.

7.7 So What?—Discussion of Findings

There are various observations that can be made from the analysis: First, a traditional supply chain was described as comprising of five parts: raw material, industry, distribution, consumer, and waste (Ho et al. 2009). Throughout the analysis it became apparent that the product, design, and sourcing process seem to be key parts of a micro-organisation's supply chain. In other words, the supply chain within a micro-organisation incorporates the following aspects: initial design considerations of a product, the material choices, the sourcing and production process, the initial product, its distribution, the consumer, and the end-of-life treatment. Although the order of the individual stages can be changed, this research highlighted that in order to produce sustainable fashion garments decisions on design, sourcing and the product itself need to be accounted for. This implies that within this research four stations, which, depending on the owner-manager, can be interchanged, extend the traditional

five components of a supply chain. It is noteworthy to highlight that the owner-manager, as the sole risk taker influences all parts of the supply chain and makes the final decisions. Although all stages were present within the four micro-organisations, their positioning varied within their individual supply chain mapping.

Second, similar to what has previously been described, the owner-manager plays a central role within any part of the Seven-R framework. This finding is not surprising, as micro-organisations have been characterised as being strongly influenced by their sole risk taker, who guides the direction of the business and, in this case, refers to the owner-manager (Kelliher and Reinl 2009). It is their innovations, ideas, and product designs that bring the business forward (EC 2013) and guide the overall direction of the organisation. In other words, the owner-managers are the drivers and motivators in either shifting their supply chain towards SSCM, or initially set up their business following sustainability aspects and practices. Although, as has been highlighted, the organisational processes are often unguided and lack structure, the owner-managers are open to suggestions and can adapt to changes in the environment quickly, which provides them with a competitive edge.

Third, the owner-managers seek to incorporate their stakeholders (employees and consumers), as well as their supply chain members (suppliers and agents) into the SCM process. This observation links to gaps in the literature: the fact that social aspects within SSCM (Seuring and Müller 2008; Ashby et al. 2012) are lacking, as well as what the extent of sustainability related demands are that are integrated in an SME's supply chain (Acosta et al. 2014). This research distinguished between two groupings that are engaged with the individual micro-organisations: stakeholders and supply chain members. Stakeholders in this research comprise of employees and consumers, who have the opportunity to be involved in both the up- and downstream process of value co-creation (Vernette and Hamdi-Kidar 2013). This implies that within the upstream co-creation process, stakeholders are asked to contribute ideas and suggestions during the product development phase. Thus, the organisation makes use of their stakeholders' input before the product is sold on the market (Vernette and Hamdi-Kidar 2013). Contrariwise, downstream co-creation focuses on suggestions made and feedback given by stakeholders once the product is readily available on the market and stakeholders had the opportunity to experience its functionality (Vernette and Hamdi-Kidar 2013). Supply chain members on the other hand are predominantly asked for advice on packaging and materials rather than the actual products. Stated alternatively, the individual owner-managers actively engage their stakeholders and supply chain members in the product creation processes. Linking this back to the Seven-R framework, micro-organisations incorporate these two groupings at various stages in the pollution prevention process, including, but not limited to reuse, redesign, reimagine, restyle, and reconfiguration. Thus, one can see a triangular relationship, in which the owner-manager seeks advice from outside groups whilst taking charge of the supply chain and the implementation of pollution prevention practices. Whilst the owner-manager makes the final decisions in terms of what they feel compliments their companies' values and goal settings, they also seek advice and guidance from them. Although these three parties are in constant communication it is noteworthy to highlight that the owner-managers act as anchor companies (Meechan 2014) in that

they stimulate and drive change. These owner-managers see sustainability not simply as an add-on strategy, but rather as the core of their business. The owner-managers are conscious to incorporate sustainable production techniques and purchase machinery that helps reduce energy levels. Whilst the owner-managers do not keep track of any improvements that result from changes implemented, they ensure that their partners comply with their regulations, values and guidelines. Thus, it can be said that sustainability or the way they interpret it as individuals and as businesses is an integral part of who they are, thus in order for these owner-managers to establish relationships, especially their supply chain members need to comply with their values, which has also been remarked in the literature (Friedman 2008). Moreover, without the active involvement of stakeholders and incorporating their ideas and suggestions into their organisational processes, these micro-organisations would not be who they are. Stated alternatively, the social aspect provides the four case companies with a unique selling proposition that not only allows them to produce garments and accessories that cater for their consumers' needs, but also create loyalty to their brand and overall organisation by making stakeholders and supply chain members part of the business.

Within their research, Ho and Choi (2012) highlighted that companies 'must take a top-down approach and have their leadership committed to sustainability targets' (p. 171). This research however has indicated that within these four micro-organisations the social dimensions of SSCM plays a significant role: Rather than a top-down approach the owner-managers seek out a bottom-up approach that allows the incorporation of stakeholders and supply chain members into their overall organisational processes. The data indicated that the owner-managers and their various groups involved in the organisations build a seemingly symbiotic relationship, in which all members gain benefits, which may include, but are not limited to consumer and employee satisfaction, and higher sales turnover for organisations.

Last, this research has indicated that there might be two further Rs that concentrate on pollution prevention: reclaim and reconfiguration. Reclaim focuses on going back to the roots, which implies incorporating traditional techniques into the production processes, as well as focusing strongly on heritage. Heritage can be seen as a competitive edge, which, especially since the various factory incidents in the fashion industry (e.g. Parveen 2014), has increased in importance. Moreover, reclaim strongly links with the social aspect of SSCM as it seeks to provide job opportunities and business for local people and factories. Furthermore, this R highlights collaborations and waste reduction in that it outlines the materials used in the production process (offcuts, waste). Reconfiguration solely focuses on the social aspect of SSCM. Although it could be argued that reconfiguration is not directly related to pollution prevention, the contrary is argued: the involvement of stakeholders and supply chain members allows these micro-organisations to not only work closely together with their potential consumers and thus cater for their needs and wants more effectively, but also it allows these micro-organisations to educate these two groupings about sustainability and 'sustainable fashion'. Thus, in an ideal case, reconfiguration leads to a change in consumer behaviour.

In summary, Fig. 7.1 provides a simplified visualisation of what has been discussed: The dark grey shaded box on the left hand side symbolises all available tools

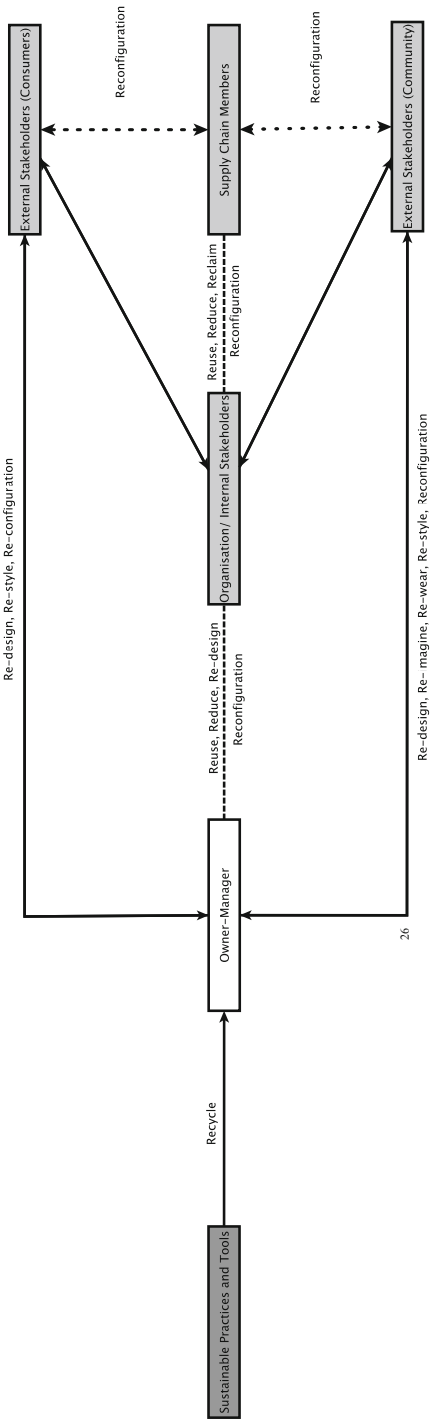

Fig. 7.1 SSCM in micro-organisations—Micro-SSCM

and practices to these micro-organisations, which include, but are not limited to eco-labels, certified materials, and sustainable production techniques. This box links to the owner-manager, who is the sole risk taker and decision-maker of these micro-organisations and thus the key to successfully implement any measures relating to pollution prevention. Due to the organisation being described as the extension of the owner-manager themselves a dotted line was utilised to indicate this relationship with the organisation/internal stakeholders. The boxes on the right hand side split the 'external stakeholders' into various sub-categories: supply chain members, which are dealing directly with the organisation and whom the owner-manager has the most control over. This, as highlighted, is due to the owner-manager being able to choose whom they are working with. The second grouping is external stakeholders, which is composed of consumers and the community in more general terms. Contrariwise to the supply chain members, the owner-manager does not have any control over their involvement in the business. The relationship between the micro-organisations and the Nine-R framework is shown by imposing the individual categories on top of the various arrows (Fig. 7.1). The graphic highlights that the individual owner-manager provides the direction for the business, influences both, the Nine-R framework and a micro-organisation's supply chain. In other words, the owner-manager influences and in a way controls all aspects of the supply chain, as well as is in charge of which pollution prevention practices are implemented. Reconfiguration was purposefully separated from the other components of the Nine-R framework, as it focuses on the social component of the supply chain. Both stakeholders and supply chain members provide guidance and feedback to the owner-manager, which, depending on their own personal values, are incorporated into the supply chain.

7.8 Further Investigations

The fashion industry is one of the only industries that is still truly competitive (Easey 2009; Europa 2013) with micro-organisations playing a key role in the overall economy (Ward and Rhodes 2014). The fashion industry is described as one of the most polluting industries (Egan 2011; BSR 2012), which also has seen the emergence of government initiatives supporting the implementation of sustainable practices. This chapter has highlighted that within this research there is a strong link between the owner-manager, stakeholders, and supply chain members. The owner-manager incorporates the latter two into the decision-making process through a bottom-up approach. Whilst this aspect contributes to the literature in that it indicates how important the social component is within SSCM, further research could look at this relationship in more detail, and thus, investigate if the various members are equally involved, or if they are only incorporated at certain stages in the supply chain. Moreover, future research could investigate whether the move to a more sustainable supply chain also increases the development of knowledge networks, in terms of closer collaborations with other stakeholders. Furthermore, within this specific context, this research suggests that in micro-companies the Seven-R framework could be modified and amended to combining 'recycling' and 'reusing', and 'restyle' and 'rewear'

within one component. Furthermore, as highlighted two further components are added: 'reclaim' which links to the sourcing of materials, as well as actively encouraging people to bring the brand's unwanted garments back to the organisation and 'reconfiguration', which puts further emphasis on the social component of SSCM.

7.9 Conclusion

This chapter has highlighted that changes in the fashion industry are emerging: governmental initiatives and introducing ethical practices are part of the new landscape. This emphasises the importance of further investigating issues surrounding SSCM. This research has contributed to existing literature by investigating various understudied fields: micro-organisations, the creative and cultural industries, and SSCM. This chapter has reviewed the Seven-R framework to establish challenges in SSCM. Focusing on four case studies in the UK context provided a further insight to an under researched field. As suggested, further research should be conducted to investigate the relationship between the social component of SSCM and the individual stages in the supply chain process.

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Chapter 8
Mass Market Second-Hand Clothing Retail Operations in Hong Kong: A Case Study

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Abstract Textile waste is one of the major problems in fashion and clothing industry. It is believed that the proper use of second-hand clothing products, which helps to promote the environmental sustainability, plays a significant role in changing the purchasing behavior and disposal habit of the consumers. This study presents a case study on a Hong Kong mass market second-hand clothing retailer to better understand the existing second-hand clothing business operations. The findings of this study generate important insights on the potential and possible direction of second-hand clothing business development in a marketplace like Hong Kong.

8.1 Introduction

Textile waste is one of the major problems in fashion and clothing industry (Claudio 2007), especially for overcrowded cities like Hong Kong. According to the report from the Hong Kong Environmental Protection Department (2011), the daily average domestic and commercial textile waste in Hong Kong is 197 t. Sustainable practices to reduce textile waste are, thus, needed to improve this situation and reduce the landfills pressure (Woolridge et al. 2006).

In the recent literature, Goldsmith (2012) addresses that textile recycling is a sustainable fashion practice. Textile recycling can be further divided into three categories: they are up-cycling, down-cycling, and reusing. For the second-hand clothing, the related products are usually classified as reusing which represents selling, exchanging, or giving away the used clothes or fashionable items. According to Textile Exchange (2012), this practice saves the energy and water, and reduces the release of carbon that is produced in the garment making processes from raw material to a new fashion piece. It is believed that the proper use of second-hand clothing products, which helps to promote the environmental sustainability, plays a significant role in changing the purchasing behavior and disposal habit of consumers.

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In western countries, this environmental-friendly business has been well developed. Starting from the 1960s and the 1970s, second-hand clothing became a fashion trend. They are now being retailed formally in permanent retail stores, vintage clothing shops, consignment stores, and charity shops. Recently, this kind of business has got more prevalent and also expanded to online selling platforms, such as eBay and ASOS.com. Wilson and Thorpe (2000) even describe second-hand clothing purchasing business as a "multimillion-dollar global trade." In Hong Kong, however, it is a different story that the second-hand clothing has only started being accepted since the 1990s (Palmer and Clark 2005). The degree of prevalence is far away from that in western countries and the commitment of this ecopurchase from Chinese is at a low level (Chan 2001). Despite this, there are studies which indicate that the second-hand clothing follows an international fashion trend and is influencing the fashion conscious of Hong Kong people, especially the younger generations (see, e.g., Palmer and Clark 2005).

Motivated by the importance of second-hand fashion retailing and the global awareness of environmental sustainability, this study examines via a case study on the existing mass market second-hand clothing business model in Hong Kong.

The organization of the rest of this paper is listed as follows. In Sect. 8.2, we conduct a literature review on the second-hand clothing related studies. In Sect. 8.3, we present a case study on a Hong Kong second-hand clothing retailer and analyze our findings. We conclude and discuss the future research direction in Sect. 8.4.

8.2 Literature Review

Second-hand purchasing is defined as getting the preowned items from specific methods or exchange places (Guiot and Roux 2010). Second-hand clothing, thus, refers to some used apparel items that are given away and being resold and reused (Goldsmith 2012). These all imply that second-hand business is run by collecting and recycling. Savaskan et al. (2004) state that a retailer, a manufacturer, or a third party can be the items collector (even though the supply chain's performance will differ). In the scenario when the retailer leads the second-hand apparel collection program, they can collect the second-hand items back and transfer the products to manufacturers for remanufacturing. Alternatively, the returned fashion items can be directly reused as consumer goods by the retailers and resold to the consumers. It is obvious that the second-hand clothing retailers are those adopting the latter measure. Note that the nature of the vintage clothing is a bit similar to but actually different from that of the second-hand fashion items. To be specific, vintage clothing is referred to the clothing item which was launched from the 1920s to the 1980s while second-hand clothing can be the modern and contemporary used items (Cervellon et al. 2012). Thus, age of the fashion item is the difference between vintage clothing, and second-hand clothing.

In the existing literature, it is observed that consumers' view on the "green" fashion purchase is a prevalent topic over the past few years. For example, Reiley and

DeLong (2011) conduct an exploratory study to address the perception of the vintage and new clothing wearers towards the desire of uniqueness in the US. They adopt the "Desire for Unique Consumer Products" (DUCP) scale developed by Lynn and Harris (1997) to measure the degree of desire for unique consumer products. Interestingly, the vintage wearers have a higher desire for unique appearance when compared with the new clothing wearers, and they believe that they are the fashion leaders due to the wide variety of fashion product sourcing and their own mix and match unique style. Besides, Cervellon and Wernerfelt (2012) examine the perceptions and behaviors of consumers towards the sustainable fashion supply chain. They also explore the role of the online communities for green knowledge sharing. They select two American green forums as the data source and analyze the findings based on their observation on the discussions and interactions in these online communities over two different periods (from 2007 to 2008 and from 2010 to 2011). Based on the analysis on the green knowledge content, they find that consumers are more subjective in the period of 2007–2008 but they become more objective (e.g., relying on the scientific facts) in the 2010–2011 period. In addition, nowadays, consumers are more interested in sharing information and knowledge on a sustainable supply chain including the detailed ingredients of fabrics, the manufacturing processes, as well as how the fashion products can be reused. Recently, similar to Cervellon and Wernerfelt (2012), Shen et al. (2014) evaluate how the consumer perception of the sustainable fashion has changed over time. Different from Cervellon and Wernerfelt (2012), Shen et al. (2014) adopt a cross-time approach and collect the secondary data from two online fashion forums from 2004 to 2012 to statistically visualize the number of discussions related to sustainable production, green marketing, green information sharing, and green attitude. The role of the retailers with respect to the consumer green fashion practice is discussed rather thoroughly in Goworek et al. (2012). To be specific, Goworek et al. adopt a qualitative approach, which includes focus groups, home tasks, and workshops studies, to explore the consumer attitude towards sustainable fashion clothing. In addition, they discuss different measures for the fashion retailers to promote and increase the consumers' sustainability mindset. Their finding reveals that people are relatively unaware of the environmental impact caused by the clothing. In addition, they are not willing to dispose the garment through a sustainable way. Thus, Goworek et al. further propose potential strategies for the fashion retailers to change the current disposal habit and purchase decision of the consumers. Their proposed strategies include partnering with the charity organizations to promote reusing the second-hand clothing, providing sustainability guidelines on the company websites and "QR codes" in stores, supplying the fashion products which are manufactured by the sustainable textiles, as well as offering clothing repair services.

Apart from investigating the perception on the green fashion purchase, recent literature also addresses the reasons explaining why consumers shop for second-hand fashion products. Guiot and Roux (2010) propose a scale for measuring the shopping motivation and examine the features and the motivations of the second-hand shopping in France via a comprehensive study. They find that seeking for uniqueness is the overall motivation for consumers conducting the second-hand purchasing

while the economic motivation (i.e., pay less) for shopping the second-hand products leads to product recycling. Guiot and Roux further categorize four types of second-hand shoppers as (i) polymorphous enthusiasts, who widely use most of the second-hand products and frequently pay attention to the second-hand shopping channels; (ii) thrifty critics, who reuse and recycle the second-hand products from the private/personal sales; (iii) nostalgic hedonists, who address their nostalgic pleasure generated from the second-hand products such as jewelry; and (iv) regular specialist shoppers, who usually make purchase in the second-hand stores. Cervellon et al. (2012) investigate the reasons for vintage purchase and second-hand purchases in France through a quantitative approach. They find that the vintage clothing consumption is driven by critical factors such as fashion involvement, nostalgia proneness, and uniqueness seeking. Regarding the second-hand clothing consumption, they reveal that it is directly induced by the selling price but indirectly induced by ecoconsciousness.

Since the sourcing of the second-hand clothing depends on the disposal habit and donation preference of the consumers, the evaluation on this aspect generates valuable insights on the second-hand clothing business operations. Mhango and Niehm (2005) present the business trade of the Malaswi second-hand clothing market. They find that the sources of the second-hand clothing in Malaswi are mainly from consignment, donation, and purchase from the developed countries like the US and Canada. Morgan and Birtwistle (2009) explore the consumer's fashion product disposal habits and the methods to increase the sustainable purchase. Their statistical results illustrate that the young female fashion innovators are not interested in textile recycling because they believe that their effort have very little impact towards environmental sustainability. In order to raise the social awareness of the textile recycling, they suggest that media can positively change the consumer disposal habits by providing transparent information on the benefits associated with sustainable purchases, and educate consumers with different recycling options. In addition, they advocate that for the second-hand clothing collectors, they should provide the most convenient way for people to donate their clothing. Recently, Lang et al. (2013) study a sustainability issue on the clothing disposal behavior in the US through an empirical analysis. Their analysis shows that there is a more frequent clothing disposal when people have: a higher fashion trend sensitivity level, a higher fashion shopping frequency, higher incomes, a higher product quality consciousness, and a lower price consciousness. Joung and Park-Poaps (2013) conduct a comprehensive empirical study on the cloth-disposal methods and the underlying reasons. By analyzing the data collected by 232 college students, they find that people resell and donate clothing mainly due to their environmental consciousness, while reuse and discard are driven by people's economic awareness. Besides, the donation behavior is motivated by the charity factor and discarding behavior is motivated by convenience.

In order to have a better understanding on how the second-hand clothing stores can differentiate from one another, McColl et al. (2013) study the commercial vintage fashion and examine the positions of the vintage retail stores with respect to their product sourcing, customer service, communication, and trading format. They define vintage fashion as "*garments and accessories which are more than 20 years old,*

which represent a particular fashion era, and which are valued for their uniqueness and authenticity." Based on the interview with vintage store managers, they find that the second-hand clothing should be in a good condition and the brand should be rare in the market. Besides, building a long-term relationship between the business owner and the customers is a key to success. They argue that the vintage shop owners/managers should be knowledgeable and skillful and these qualities create competitive advantages. For example, these vintage shop owners should know the fashion styles of the customers very well and be able to source the clothing for them. In order to promote their second-hand clothing business, McColl et al. believe that the word-of-mouth marketing strategy is an effective method. Also, the visual merchandising measures, such as the window displays and the store interior design, are also critical.

It is known that the traditional Chinese culture does not favor ones' wearing of others' used clothes (Cervellon et al. 2012). However, Hong Kong was a colony of the United Kingdom for 99 years. In the case study of Palmer and Clark (2005), British affected all the political, social, environmental, and cultural aspects of Hong Kong. As an international city, Hong Kong is also affected by different cultures from other countries. For example, in the 1990s, Japanese youth culture influenced Hong Kong youngsters' fashion conscious for buying recycle apparels. At the same time, Hong Kong's first noncharity-based second-hand shop, Man and Earth was opened. It provided artistic types of used clothes for young customers who looked for unique and unusual fashion pieces. In 1996, Hong Kong celebrities started to sell their used clothes in high price for charity purpose. On the other hand, high-income group Hong Kong women tend to purchase second-hand clothing outside the city, e.g., from other countries such as the US. Palmer and Clark (2005) conclude that second-hand clothing is an international fashion trend and influences the fashion consciousness of Hong Kong people.

It is apparent that numerous existing studies in the literature focus on the environmental sustainability practices conducted by fashion companies and the motivation of the consumers towards the second-hand products. However, only very limited studies explore the business development of the second-hand clothing retailers. Therefore, this study contributes to the literature by filling this gap and provides insights on how the second-hand fashion retailing operations could be developed in a city like Hong Kong.

8.3 Case Study

In order to gain a better understanding of the actual second-hand clothing business operations in Hong Kong, an interview was conducted with a Hong Kong second-hand clothing retailer, called Company Z.[1] In addition, secondary source of data was

[1] Company Z is a real company in Hong Kong with an artificial name.

also collected. Note that case study is chosen as the research method here because this chapter is exploratory in nature (Yin 2009). Case study helps reveal some more qualitative insights around the topic and lays the foundation for future studies.

8.3.1 Company Background and Operations

Company Z is a Hong Kong new vintage house founded in 2012. It is a cross-culture operation that the owners are from Japan and Hong Kong. In Japan, vintage house and second-hand clothing stores are easily found. Purchasing and exchanging the used products are a part of their life. However, in Hong Kong, most of the commercial second-hand clothing stores are selling luxury handbags or clothing and it is difficult to reach the younger generation and the mass market. The mission of Company Z is to reduce waste, promote recycle, and cultivate consumers to develop reuse habits even for casual and nonluxury items. Through the exchanging practice, it is hoped that people can correct their overconsumption habit and concern more the environmental protection. Therefore, Company Z aims to be an environmental-friendly second-hand clothing shop. It provides second-hand clothing exchange service and the customers/donators will gain some credits which can be redeemed for the items such as handbags and even televisions. There is a redeem restriction in which each customer can exchange at most 20 items every day.

Second-hand clothing store retailers control the second-hand merchandise assortments and business model in the market and affect the choice of consumers. Through the interview with one of the shop owners, information such as the store operation concept and perception on the existing and future projected second-hand clothing market in Hong Kong were gathered.

Company Z is a unique second-hand clothing shop which adopts the product exchange system and gains profits for its daily operations through a systematic membership program. There are several kinds of membership in which customer can enjoy different rights.

For example, a customer who purchases a one-week membership has to pay a relatively higher fee (about USD20) compared to the one-month membership fee (about USD40 per month which means USD10 per week). Besides, all members have to pay an administration fee, and a discount price will be offered if they are introduced by the existing members. Company Z relies on both the membership fee and administration fee to run its business. It is interesting to note that Company Z does not sell any products through cash but people can get the fashion items via barter. In other words, customers are able to get the second-hand clothing if they donate the clothing and join the membership scheme.

Members who more faithfully participate in the product exchange program (e.g., they join a membership for more than 6 months) will be able to redeem more products from each donated item. All goods are provided by their members, and therefore, Company Z does not need to source any products. In addition, Company Z targets the customers who are respectful, courteous, and care about the future ecological health

and treasure the world-limited resources. The majority of Company Z's customers are younger females aged between 20 and 30. Company Z adopts a low-cost business operations model. Thus it is not able to support the expensive advertisement, and it relies on the words-of-mouth to promote the company. Company Z believes that the acceptance of preown fashion depends on personal values and education level, and marketing promotion cannot generate enough influences and change their purchasing habit. Besides, it does not run any online business since it is better to view the used-products personally in store.

Company Z also commented that running the second-hand clothing shop is difficult because this market is hard to promote. There are excessive consumerism culture and profit-oriented business culture in the market like Hong Kong. Hence, it is difficult for consumers and merchants to build a beneficial relationship. Moreover, most people still think that it is troublesome to conduct second-hand exchange practice. Some of them question the quality of these second-hand clothing and even believe that buying second-hand clothing will harm their personal status. Although the higher level of education and better flow of world information have helped the Hong Kong new generation to build a positive attitude towards the consumption and purchase of second-hand clothing, the second-hand clothing shopping is still not popular in Hong Kong. Furthermore, there are still some dishonest traders in the market, which will affect customer's confidence on the second-hand products. These are the barriers of second-hand clothing market development.

Regarding the perception of second-hand clothing market in western countries, Company Z described it as a mutual market. There are numerous choices of clear and well-developed trading standards, merchandise assortments, processes and platforms. Yet, the choice of product varieties in Hong Kong market is narrow and limited. The product prices fluctuate a lot and even with unfair trading. Company Z also argued that the major reason attributed to this phenomenon is that there is a lack of cohesiveness, respect, and assistance.

In the future, Company Z predicted that resource is still limited and commodity price is dramatically increasing to an unreasonable level due to the unusual speculation in property market which is not favorable for the second-hand clothing market development. However, it is quite certain that environmental sustainability concern will continue to grow as it is a global trend.

8.3.2 Analysis

After conducting the interview with Company Z, we analyze the findings and the insights as follows:

i. For the existing Hong Kong second-hand clothing market, the majority of the Hong Kong consumers do not have the habits of buying the second-hand clothing. Also, the prevalence of consumerism, increasing commodity price and profit

driven business culture are not favorable for the development of the second-hand clothing business in Hong Kong.

ii. Product quality and product price are the most important basic requirements that the consumers treasure on their purchase of second-hand clothing products. To be specific, second-hand clothing needs to be clean, tidy and with little differentiation (in these aspects) from the new clothes. Therefore, filtering and cleaning processes are essential. As reflected by the case study, it is found that the majority of the second-hand clothing consumers in Hong Kong are young adults who have a relatively low income level. This implies that the other commercial second-hand clothing business owners should determine the price of the products carefully in which it will affect the purchasing intention of the youngsters towards the second-hand clothing (Cervellon et al. 2012).

iii. Gender of the target consumers should also be taken into the consideration. Females are more interested in participating in the fashion related issues (O'Cass 2000). Getting familiar with the consumers (in terms of their age and gender) helps the second-hand clothing business owners to decide which types of clothing products they should seek for.

iv. Having a "green" attitude is essential over the second-hand shopping practice. Fortunately, with the influence of the global trend, the assistance of the information flow through the Internet, as well as the education on the resources scarcity problem, Hong Kong consumers become more concerned about eco-health and wastage problem, and are more acceptant and willing to participate in the second-hand shopping.

v. An interactive relationship between customers and second-hand shop owners is also an important factor to support the second-hand clothing business. This is because second-hand shops rely on garments donation from consumers while it is promoted though the words of mouth. In order to establish a better relationship with the customer, an interactive business model, such as donation with membership program and consignment program, is needed (see Mhango and Niehm 2005). These innovative programs can better draw the attention of the young people and motivate them to reusing the fashion clothing actively.

A summary of the findings and the insights on the case study of Company Z are summarized in Table 8.1.

8.4 Conclusion and Future Research

This study presents a case study on a Hong Kong second-hand clothing retailer. It helps us better understand the existing second-hand clothing market and culture. It firstly analyzes the advantages and the barriers of this business operated in Hong Kong. Even though most people think that it is troublesome to donate/exchange the fashion products and may perceive that second-hand clothing purchase will harm their social status, it is still believed that the level of these adverse factors for the second-hand clothing business development will be weakened when the people are educated

Table 8.1 Summary of findings and insights from the case study

Aspects	Insights and findings
Advantages of starting second-hand business	1. Second-hand clothing can be a low-cost business 2. Second-hand clothing is a global trend
Target customers	Young female adults
Factors affecting current Hong Kong second-hand clothing market development	Unfavorable factors: 1. Most consumers do not have second-hand clothing shopping experience 2. Prevalence of consumerism 3. Increase of commodity price 4. Profit driven business culture Favorable factors 1. Hong Kong is an international city that is affected by global trend 2. The raise of fashion information flow through the Internet 3. Consumers are educated to be environmental-friendly
Tangible elements of a second-hand clothing shop	1. Product quality (clean and tidy) 2. Relatively low price
Intangible elements of a second-hand clothing shop	1. Promote the "green" practices and help customers to develop a "green" attitude with the use of Internet 2. Establish an interactive relationship with the customers through business model such as membership schemes and consignment
Concerns of the second-hand clothing retailers	1. Filtering and clearing processes 2. Marketing research and effectiveness testing

to develop a "green" attitude. Moreover, it also reveals that second-hand clothing retailers should pay attention to the second-hand product quality and determine the business operation model carefully. Consignment or membership program can help establish an interactive relationship with the customers. The findings of this study generate important managerial insights on the potential and possible direction of second-hand clothing business development in a market like Hong Kong.

As a remark, based on the interview analysis, it is noted that Company Z is able to run a relatively low-cost business model that the owners do not need to tighten much capital for sourcing merchandises if they can better connect with customers or other textile disposal organizations. However, the second-hand shop owners should address the following challenging issues carefully in which they are the threats to their future business development:

i. Supply of the second-hand clothing: business owners should ensure that there is a stable supply of the second-hand clothing and it is necessary to seek ways to motivate the customers to give away their garments even though they are not interested in the second-hand shopping. Joung and Park-Poaps (2013) find that people are motivated to discard their clothing if they cannot access the second-hand clothing collector easily. Thus, it is important for the second-hand clothing businesses owners to have more drop-off sites and to let people know their presence.
ii. Increasing rental and advertisement costs: despite Company Z commented that it is more beneficial for the customers to view the clothing personally in store, selling through the online marketplace and the social networks should not be ignored as they all help to provide an alternative channel for getting and selling the second-hand clothing. The cost of establishing the online stores and the social network channel is also much lower than operating a bricks-and-mortar store in a market like Hong Kong. This measure helps support the low-cost operations model. Furthermore, the electronic words-of-mouth and other online advertisement supported by social media are also effective for the mass market second-hand fashion retailers to promote their products and business philosophy.

In the future, it is interesting to explore the business operations of the Hong Kong luxury-brand second-hand clothing shops (i.e., which sell the "designer labels" fashion products) and compare the customer behaviors' similarities and differences towards the luxury-brand and nonluxury-brand second-hand clothing shops. In Hong Kong, it is observed that the luxury-brand second-hand clothing shops sell not only the preowned products but also the brand new items. Thus, it is also valuable to investigate the customer perception towards this kind of second-hand clothing shops, the optimal price setting of these luxury-brand second-hand products, as well as the risk level of such business operations. Furthermore, it is interesting to explore how second-hand clothing shop owners could establish a long-term relationship with the consumers and how to motivate them to donate and buy the fashion products continuously to achieve a self-sustainable business.

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Chapter 9
Constraints and Drivers of Growth in the Ethical Fashion Sector: The Case of France

Mohamed Akli Achabou and Sihem Dekhili

Abstract This chapter explores the extent to which ethical issue is valuable in the case of fashion sector. In particular, it examines the main barriers to ethical fashion consumption. The industry context of fashion items is of particular interest due to its significant global supply chain complexity and the variety of impacts and challenges across the supply chain from raw materials to design, manufacture, packaging, logistics, consumer use, and postuse disposal. Findings from an empirical study involving 1086 French consumers indicate that despite the increasing concerns of individuals about the ethical issue, French consumers have little interest in ethical fashion. The main barriers to the purchase of ethical fashion items are related to the consumers' lack of knowledge and disinterest, and the style attribute. In effect, consumers perceive ethical fashion products as old fashioned and with lower quality or not in line with their style of dress.

Furthermore, our study indicates that three sociodemographic variables—gender, age, and income—have a considerable effect on consumers' purchasing behavior towards ethical fashion products.

9.1 Introduction

In recent years, the marketing literature has underscored the growing awareness of western consumers to the need for ethical principles in their purchasing decisions (Jägel et al. 2012; Bernues et al. 2003). This new concern involves seeking out less toxic and more sustainable products (Lamb et al. 1994), referred to by some authors as ethical consumerism (Smith et al. 2010).

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However, some studies (Devinney et al. 2011) relativize this trend and point to the wide gap between what consumers claim to believe and their actual behavior. Thus, in France, the *Centre d'Analyse Stratégique* (2011) indicated that while 80 % of French people say they are willing to adopt more responsible consumer behavior, less than a quarter actually put this into practice. The Ethnicity (2013) report indicates that nowadays French consumers are more interested in the origin of raw materials and where the products are made than on their impact on the environment or the social guarantees embedded in the production process. The report concludes that the economic and financial crisis has forced consumers to make choices, with environmental issues taking second place. According to Adomaviciute (2013), the ethical attribute is considered more as an extra advantage. Against this background, we may question whether environmental and social excellence guarantees real differentiation for a company within its market. In this study, we look at the ethical fashion[1] sector in France, which has found it very hard to develop despite the considerable effort made in terms of the offer. Several ethical brands have recently shut down (Ideo, les Fées de Bengale), while the Ethical Fashion Show, created to promote ethical fashion, has now been moved to Germany. It is, therefore, of interest to explore the reasons for the sector's relative failure: Is it because consumers find it difficult to get hold of products or because French consumers are simply not interested in ethical issues in the case of fashion items? It is also important to determine which growth drivers could help the sector to develop.

9.2 Literature Review

9.2.1 Responsible Consumption: Obstacles and Incentives

Consumers in the developed world are increasingly aware of the issues linked to sustainable development (Urien and Kilbourne 2011). This awareness has led to the emergence of new buying behavior and responsible consumption. For Hansla et al. (2008), consumers decide to adopt responsible behavior because they worry about the negative impact of environmental issues on themselves (selfish motives), others (altruistic motives), and nature (biosphere motives). Consumers driven by selfish motives are ready to pay a premium if the "green" products offer personal benefits (health, symbolism, or status) (Ottman et al. 2006; Snelgar 2006).

Consumers driven by altruistic motives are concerned with social justice and the wellbeing of others (Stern et al. 1993) as well as a desire to contribute to solving environmental problems (Huang and Rust 2011).

[1] Ethical fashion involves a form of production that takes working conditions into account and uses specific raw materials (e.g., organic cotton) avoid harming the environment (Joergens 2006).It is also described as "fashion with a conscious" as it concerns labor conditions and the environment (Shen et al. 2012).

Apart from the motives that drive consumers to opt for sustainable products, the management literature mentions several barriers that may inhibit consumers' appreciation of this category of products. These are chiefly of a demographic, religious, or cultural nature (Doran 2009), or involve barriers pertaining to price, quality, perceived product value, and market availability (Hira and Ferrie 2006). For Rodhain (2013), being a responsible consumer requires effort in terms of price (more expensive products), image (some products offer no added social value), hedonism (some alternative products are less practical and/or give less pleasure), and time (finding the products and the information about their features, understanding the meaning of the labels, etc.). Auger et al. (2008) argue that consumers are not willing to sacrifice the functional attributes of a product for their ethical attributes.

Moreover, consumer behavior may differ depending on the product categories. In effect, consumers are often willing to make an effort for generic products such as fair-trade food items (Auger et al. 2008). Recent research has shown that the growth in consumers' ethical concerns has less impact on certain product categories. For instance, Achabou and Dekhili (2013) found that in the luxury clothing sector, consumers view products made from recycled materials in a negative light. Consequently, we remain far from the "all green" postulated by the literature and the media (The Co-operative Bank 2009).

9.2.2 Ethical Issues in the Fashion Sector

Fashion is often considered as at the opposite end of the spectrum to fair and ethical, and has been described as follows: "Fashion—a symbol of futility in a society of consumer paroxysm—maintains values that in principle are not fair (everyone does not have access) and not ethical... fashion is synonymous with short term and versatility and dedicated to brief seasonal cycles)" (DIIESES 2007, p. 5).

Fashion is also linked to a number of environmental issues. According to Nagurney and Yu (2012), the textile industry pollutes around 200 t of water per tonne of production. In addition, the trend has been towards increasingly short fashion cycles and poor-quality products that considerably reduce product length of use and subsequently increase the quantity of textile waste (Pookulangara and Shephard 2013; Bianchi and Birtwistle 2012). In the UK, for example, textile waste grew by around 2 million t a year between 2005 and 2010 (Kirsi and Lotta 2011). In addition, cotton crops alone account for over 25 % of global pesticide use (Nagurney and Yu 2012).

The fashion industry is also associated with major social issues. While delocalization strategies adopted by leading brands have helped improve profitability, they have also led to deterioration in working conditions for subcontractors in both the South and the North (Vercher 2010). Despite the existence of monitoring methods, such as codes of conduct, several ethical scandals have been reported in the supply chains of many global fashion retailers (e.g., Zara, Gap, and Nike) in recent years (Perry and Towers 2013). Choi et al. (2012) mention that, in terms of labor rights,

a lot of garment factory employees in developing countries are working in highly polluted environment, during over 16–18 h every day for low salary.

This has prompted several international NGOs (e.g., Clean Clothes Campaign) and national associations (e.g., Éthique sur l'étiquette) to run campaigns denouncing such practices. Under pressure, leading brands (e.g., Reebok, Nike, H&M, and MUJI) and retailers (e.g., Carrefour and Tesco) have begun to introduce social responsibility measures in their supply chains (Shen et al. 2012; Vercher 2010). Perry and Towers (2013) state that there is a real business argument which can encourage fashion companies to implement CSR practices: a high profile consumer industry, a bad publicity, consumer boycotts, and loss of brand value.

Growing awareness of environmental and social issues linked to the fashion industry has also resulted in the emergence of firms specializing in ethical fashion. In fact, different ecopractices have been used. According to Caniato et al. (2012), the most important methods are as follows: (i) use of organic fibers; (ii) reuse and recycling of materials such as old clothes, manufacturing scraps, bottles, and tyres; (iii) vintage practices and second hand; (iv) clean technologies, both old and new, and even information technologies; (v) green certifications (e.g., Global Organic Textile Standards); and (vi) green product and process design, considering the product characteristics, the materials used, and the production technologies.

Certain examples of implementing ecopractices in the fashion sector have been highly successful. The most striking success story is that of Patagonia, especially in the USA, thanks to its efficient and innovative products and its management strategy based on sustainable development (Teulon 2006). Other firms, however, find it far more difficult to grow or even to keep their business going. This is the case for many ethical fashion firms in France. Despite the efforts of various entities (e.g., the Agrobiotex programme[2]) and designers (product diversification), the ethical fashion market has found it hard to develop (RSE news 2013). In fact, many businesses have even closed down in the last few years. Reports and press articles have attributed the situation to various barriers that reduce consumers' appreciation of ethical fashion products. Cotelle et al. (2011), for example, blamed a lack of information and the absence of visibility and understanding of labels. Eder-Hansen et al. (2012) pointed to poor consumer awareness of the environmental issues surrounding the textile industry. For instance, despite the many environmental issues linked to cotton production, it has always maintained the image of a natural and "green" fiber (DIIESES 2007). The price barrier is also important, as consumers often believe that ethical garments are too expensive. Finally, Hansen et al. (2012) speak about the "style" barrier, in other words, the widespread belief that sustainable garments are neither elegant nor fashionable, and that the design and appearance of an ecogarment is outdated or even frumpy.

Studying the behavior of young British and German consumers with respect to fashion items, Joergens (2006) noted that the main criteria when choosing a fashion

[2] Launched in 2005 by the competitiveness cluster, Up-Tex (High Performance Textiles), in order to develop textiles from agroresources using ecoefficient processes.

item are brand, originality, and price. The author observed that the ethical dimension remains secondary. This confirms the conclusions by Butler and Francis (1997), who argue that the environmental factor may be important for consumers, but that other factors such as price and style are likely to be the main criteria. Kim and Damhorst (1998) suggested that while there is increased awareness of environmental issues in the fashion industry, this may well clash with the philosophy of rapid change of style that characterizes industrialized societies.

9.3 Method

To answer our research questions, we performed a quantitative online survey in March–April 2013, with a sample of 1086 French consumers. A convenience sampling method was used. Our sample population was made up of very different age groups and socioprofessional categories. The details of their characteristics are presented in Table 9.1.

We gave the respondents a questionnaire made up of closed questions.[3] They were asked about their consumption practices with respect to fashion items (frequency, main criteria when choosing an article, favorite sales outlets, what happens to old, unwanted items) and the main barriers to the appreciation of ethical fashion items. A 5-point Likert scale was used to this end. The respondents could also justify their answers if they so wished. Thus, some verbatim has been included to enrich the discussion of our findings.

Most respondents (73.1 %) said they buy their fashion items from specialized shops. The other distribution channels mentioned were: big-box stores (25.2 %), catalogues (10.4 %), Internet (36.5 %), and second-hand clothes shops (25 %). Regarding what they do with old clothes, 55.6 % of the respondents said they give them to relatives, 83.8 % to charities, 30.3 % recycle[4] them, 18.3 % resell them, and 14.9 % throw them away. Of the 1089 respondents, 493 had bought an ethical fashion item at least once, in other words 45.3 % of the sample.

9.4 Results

In an introductory question, the respondents were asked to explain what ethical fashion meant for them. The concept was associated with a number of ideas. Consumers considered it as a fashion category that does not exploit animals: "products with no animal content," "no animal exploitation (no leather, silk, fur)", "no animal suffering," and one that does not exploit humans: "a decent wage for the person who makes

[3] The Toluna QuickSurveys website was used as a support to design and deliver the questionnaire.
[4] Old clothes re used by consumers to make some new products (e.g., fashion accessories, hand bags, gloves, and cushions).

Table 9.1 Characteristics of respondents who participated to the study

Variables	Number of respondents	Percentage (%)
Gender		
Female	714	65.6
Male	375	34.4
Age		
Less than 20 years	36	3.3
20–35 years	609	55.9
36–50 years	256	23.5
51–65 years	172	15.8
65 or more years	16	1.5
Occupation		
Employee	410	37.6
Executive	281	25.8
Independent contractor	169	15.5
Student	84	7.7
Without occupation	116	10.7
Retired	29	2.7
Monthly income		
<1000€	302	27.7
1000–3000 €	591	54.3
3000–6000 €	144	13.2
6000 € and more	52	4.8
Total number of respondents	1089	100

it," "clothes made by people who are not exploited for that," "a garment that respects human beings," "like fair-trade coffee, a fair minimum wage, ethical working conditions and respect for people, with no child labor." Very few respondents, however, linked ethical fashion with environmental issues: "a garment that respects the planet, its production has the least impact possible on our planet." Some respondents also linked ethical fashion with the notion of sustainability: "a garment that lasts," and local production: "a garment made in France," "local trade, promoting local culture and know-how."

In addition, several consumers appeared relatively skeptical about ethical fashion and were suspicious of the real motives of firms engaged in this area: "a marketing gimmick," "more manipulation," "a sales strategy," "a new way to make money," "above all, it's very vague," "it's often just greenwashing."

Table 9.2 Main barriers to ethical fashion consumption

Source	Type III sum of squares	Degree of freedom d.f	Mean square	F	Sig
Corrected model	8.301[a]	5	1.660	16.105	0.000
Y-intercept	332.380	1	332.380	3224.319	0.000
Price	0.020	1	0.020	0.190	0.663
Disponibility	0.021	1	0.021	0.200	0.655
Desinterest	1.132	1	1.132	10.984	*0.001*
Style	0.289	1	0.289	2.803	*0.095*
Lack of knowledge	2.782	1	2.782	26.988	*0.000*
Error	68.964	669	1.103		
Total	2433.000	675			
Corrected total	77.265	674			

[a]R-square = 0.107 (adjusted R-square = 0.101)

9.4.1 Main Barriers to Ethical Fashion Consumption

In order to identify the main reasons why people do not purchase ethical fashion products,[5] we performed a regression analysis in SPSS. The results obtained are set out in Table 9.2.

The primary barriers to the purchase of ethical fashion items appear to be, respectively, lack of knowledge, disinterest, and style. Many consumers said they knew little or nothing about this type of fashion: "I've never seen it," "I don't know what it is," "I've only known about ethical fashion for 2 months," "I don't really know what you mean by that, I don't know enough about the subject," "I didn't know until about a year ago, these products have little visibility," or else showed no interest in such products: "I've never really thought about it," "I haven't looked into it," "I have to admit it's the last of my worries," " I think about it, but that's all."

Few respondents (19.3 %) said they knew even one ethical brand name. The most frequently cited brands were Veja (35 times), Ekyog (31 times), Misericordia (14 times), El Naturalista (13 times), Patagonia (7 times), and Ethic et Chic (7 times). Some retail names, such as Monoprix, were also mentioned. Their limited knowledge of ethical fashion brands may be explained by a lack of communication. Indeed, most respondents (95.9 %) consider that ethical fashion brands do not communicate enough about their responsible practices.

Finally, many respondents stated that ethical fashion products were not trendy enough or did not correspond to their dress style: "no ethical look in my dress style," "it doesn't always match my dress style," "it's not a brilliant look," "not to my taste,"

[5] Clothes, shoes, and accessories.

Table 9.3 The effects of sociodemographic variables

Source	Type III sum of squares	Degree of freedom d.f	Mean square	F	Sig
Corrected model	17.254[a]	16	1.078	4.577	0.000
Y-intercept	289.677	1	289.677	1229.544	0.000
Gender	5.074	1	5.074	21.538	*0.000*
Age	2.963	4	0.741	3.144	*0.014*
Occupation	1.866	6	0.311	1.320	0.245
Monthly income	2.367	3	0.789	3.350	*0.019*
Education	0.097	2	0.048	0.206	0.814
Error	252.561	1072	0.236		
Total	2877.000	1089			
Corrected total	269.815	1088			

[a]R-square = 0.164 (adjusted R-square = 0.150)

"I haven't seen any ethical clothes of the type I need for my work," "ethical fashion often means original and second hand, and I can't wear that in my job."

9.4.2 Impact of Sociodemographic Variables on Ethical Fashion Consumption

In recent years, the literature on sustainable consumption has highlighted the impact of sociodemographic variables on responsible consumer behavior. To test the influence of these variables with respect to our study, we ran a regression analysis. The findings are set out in Table 9.3.

The findings indicate that gender, age, and income are the most influential variables in terms of consumer purchasing behavior in the case of ethical fashion products. We, thus, performed an analysis based on these variables. The main results are presented in Table 9.4.

Women appear to consume more ethical fashion products than men. Consumption also varies according to the age of the respondents: the 36 to 50 age group is the foremost consumer. With regard to the income variable, we noted that respondents with a medium income (between 1000 and 3000 €) consume the largest number of ethical fashion products. The socioprofessional categories with the highest income are those that consume the least.

Table 9.4 Consumers' purchase behavior of ethical fashion products regarding their gender, age, and income

Variables		Individuals who consume ethical fashion products		Individuals who do not consume ethical fashion products	
		Number of respondents	Percentage (%)	Number of respondents	Percentage (%)
Gender	Female	370	51.8	344	48.2
	Male	123	32.8	252	67.2
Age	Less than 20-years	8	22.2	28	77.8
	20–35-years	288	47.3	321	52.7
	36–50-years	133	51.6	125	48.4
	51–65-years	65	36.7	112	63.3
	65 or more years	6	37.5	10	62.5
Monthly income	<1000 €	141	46.7	161	53.3
	1000–3000 €	290	49.1	301	50.9
	3000–6000 €	51	35.7	92	64.3
	6000 € and more	11	21.2	41	78.8

9.5 Discussion

The aim of this chapter is to understand why French consumers appear to be less drawn to ethical fashion products, and to identify measures that could promote the development of this sector.

Our findings indicate that French consumers have relatively little interest in ethical fashion. This is consistent with the conclusions of prior research (Shen et al. 2012; Kim and Damhorst 1998; Butler and Francis 1997) which suggests that consumer knowledge and environmental awareness has little impact on decision-making when buying clothes. Chan and Wong (2012) consider that although fashion consumers have a positive attitude toward the protection of the planet, they rarely transform such attitude into ecofashion consumption. Also, Pookulangara and Shephard (2013) argue that even when individuals say they are aware of the ethics issue in the fashion industry, they continue to look for cheap and fast fashion. These results highlight an attitude–behavior gap between fashion consumers' environmental protection interest and ethical consumption. Consumers of fashion products seem to have a specific behavior when making consumption decision in comparison with consumers of other category of items (Niinimaki 2010).

In France, Cotelle et al. (2011) suggest that French consumers are now aware of the ethical issues in the world of fashion, but they have less impact compared to other sectors like food or cars. We believe that this is due to the cultural barrier mentioned in the literature (Doran 2009). France is renowned as the country of fashion and elegance, so consumers have very refined tastes and are extremely mindful of style. As Czarnowski (2009) pointed out, different countries may display a preference

for certain environmental products. Japanese consumers, for instance, demonstrate their environmental awareness through the purchase of cars, while Italians are more sensitive to green issues related to health and beauty products.

The keen awareness of French consumers with respect to the style attribute results in a rejection of ethical fashion items, considered as old fashioned. In effect, the respondents viewed ethical fashion products as frumpy or not in keeping with their style of dress. The context of contemporary society has led to a perpetual preoccupation with image (Pitombo Cidreira 2009). Fashion provides a means to satisfy the desire for difference and originality in terms of appearance (Örmen 2008; Pitombo Cidreira 2009). In the fashion industry, consumers endorse very short fashion cycles and focus on self-expression, aesthetic gratification, and group conformity (Kim and Damhorst 1998). Our findings are consistent with the conclusions of Chan and Wong (2012) who found that fashion consumers in Hong Kong do not compromise their needs of fashion clothing to be environmentally friendly. They have a preference for fashion clothing that appears esthetically attractive.

Furthermore, ethical fashion items are at times associated with lower quality. This finding raises the broader issue of perceived value, which appears to be another major barrier to the appreciation of ethical fashion items. For Ottman (2006), poor understanding of the conventional attributes of products pushes consumers to reject green products as they are considered to be of lower quality. In the Indian context, Gupta and Hodges (2012) showed that price and quality are the most important criteria that influence the consumer decision when choosing ethical fashion products.

Meyer (2001) argues that responsible products can only be successful if consumers perceive their attributes as better than those of conventional products. Environmental differentiation that does not take the multidimensional character of perceived quality into account has little chance of success (Caswell and Grolleau 2007) as consumers are unwilling to sacrifice a product's functionality for ethics (Devinney et al. 2011).

Our study indicates that three sociodemographic variables—gender, age, and income—have the biggest impact on consumers' purchasing behavior in the case of ethical fashion products. The analysis based on these three variables showed that women are the main consumers of these products. This finding is consistent with those of previous studies on responsible product consumption (Achabou and Dekhili 2013; Snelgar 2006). Snelgar (2006) suggested that women are generally more active in environmental matters, and that they are more open to social issues and to other people. In the specific case of the clothing industry, Niinimäki and Hassi (2011) also observed that women are more sensitive to environmental and ethical issues.

With regard to the age variable, our findings show that individuals aged between 36 and 50-years-old are the biggest consumers of ethical fashion products. The literature offers mixed findings with regard to the impact of the age variable on responsible

consumer behavior. The age variable has been extensively explored in studies on generativity in particular.[6] While Ryff and Heincke (1983) found that younger consumers show greater generativity than others, the findings by McAdams et al. (1993) suggest that middle-aged consumers have the highest level of generativity, while older consumers have the lowest. For McAdams and Logan (2004), the relationship between generativity and age is not very robust, and while generativity may be present at each stage of the lifecycle, it can vary in intensity. Finally, segmentation made on the basis of the income variable shows that the consumption of ethical fashion items decreases in line with higher levels of income. This is consistent with the conclusions by Achabou and Dekhili (2013) specific to the luxury clothing industry, and can be explained by the greater importance wealthier consumers give to the intrinsic quality of products, to the detriment of environmental and/or social quality.

9.6 Conclusion

The main finding drawn from this study is that the ethical attribute is not an important differentiation factor in the fashion market. When choosing products, consumers give priority to other criteria, notably the product's style and its intrinsic quality. Ethical Fashion in France currently finds it hard to develop because it does not fit in with the aforementioned expectations. It is viewed as unfashionable, or even frumpy, and therefore suffers from an acute image problem. Our results highlight the tendency of consumers to perceive ethical fashion as production that respects humans and animals (social dimension), and the environment to a lesser degree. This can be explained by the fact that social scandals in the textile industry are more likely to make the headlines (e.g., the collapse of Rana Plaza in Bangladesh) than environmental issues. On the other hand, ethical fashion is not associated with hand-crafted or cottage-industry production.

In view of these results, we believe that ethical fashion firms should focus their communication strategies on the design aspect of their creations (style), the quality of the products and raw materials used, and the cottage-industry aspect of production. Ethics should no longer be used as a sales argument, but rather as added value. Furthermore, the "made in France" label should also be used more widely. It not only indicates the origin of the product, but is also a helpful tool for consumers to make a judgment about a firm's ethical position and social responsibility (Koromyslov 2011).

The effort made by ethical fashion brands in terms of style and product quality should be emphasized in advertising campaigns. Given the small size of the firms, Internet appears to offer the least expensive means of communicating. As suggested

[6] The concern of adults with respect to the wellbeing of future generations is positively linked to more responsible consumer behavior (purchase of organic products, reduction of waste, purchase of "green" products, etc.) (Urien and Kilbourne 2011).

by Chan and Wong (2012), it is in the best interests of fashion brands to develop e-tailing in addition to their physical stores in order to improve the accessing ecofashion and the information about ecofashion, such as the price and the style. Today, many consumers use the Internet to share knowledge and increase their understanding of the world (Cervellon and Wernerfelt 2012).

To facilitate the access to ecofashion items, enterprises should develop the use of signage; the idea is to indicate where the ecofashion is placed in the store (Chan and Wong 2012).

Cobranding may also be envisaged as a solution to update the image of ethical fashion brands. This would involve working with leading brand names, many of which are currently trying to project a more responsible image. Such collaboration would be beneficial for both the ethical fashion firms and the leading brand names. It could also influence consumer behavior since, as Teulon (2006) argued, the impact of actions undertaken by leading brands is considerable given the extent of their global output.

The government should also play a role in promoting ethical fashion by raising French consumers' awareness of fashion-related environmental and social issues. Our study shows that even though some respondents say they are aware of ethical issues, the latter appear to have little impact on their purchasing decisions. Educating consumers is, thus, essential for increasing the awareness level about ethical fashion (Shen et al. 2012; Gupta and Hodges 2012). As discussed by Eckhardt et al. (2010), we believe that public awareness should be raised through the emotions rather than through rational and moral arguments (consumer lassitude with environment-related discourse). Thus, TV documentaries on child exploitation in carpet sweatshops in developing countries appear to have increased the ethical awareness of Swiss and German consumers (Eckhardt et al. 2010).

It is also important to improve consumer confidence in the information displayed on ethical fashion products, and we believe that the best way is through labeling. We should note that several labels have now been developed for the textile industry. In addition to official certifications, such as the European ecolabel, claims have also been produced by certification organizations, associations, and by companies themselves. Thus, consumers are confronted with information overload (Harbaugh et al. 2011) and are frequently suspicious of the opportunistic behavior of some firms (Dekhili and Achabou 2011). We believe that in the current context, greater harmonization of the information available is needed. Other avenues to be explored include ranking labels according to the extent of their demands (Van Amstel et al. 2008), and focusing on promoting a single label for consumers and companies (Harbaugh et al. 2011).

Although this research makes an important contribution, further studies should provide a better understanding of the ethical issue in the case of fashion goods. A future study needs to be conducted to examine the relationship between consumers' preference for ethical fashion products and the nature of the ethical practice mentioned (social, environmental).

Furthermore, an examination of the barriers to the purchase of ethical fashion items shows that consumers associate ethical fashion products to lower quality. In

order to gain a better understanding of the effect of ethical attribute on the perceived quality, we believe it would be fruitful for future research to perform a study to determine how the ethical attribute could decrease the perceived quality of an ethical fashion item.

Finally, our research reveals that gender, age, and income have a significant effect on the preference for ethical fashion products. This result is interesting but should be considered with caution because of the sample mobilized (convenience sample). Replicating this study with additional consumer samples in different countries or regions of France is necessary to test the effect of these variables.

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Chapter 10
Effects of Used Garment Collection Programs in Fast-Fashion Brands

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Abstract This research aims to investigate the fast-fashion brands' recently implemented used garment collection (UGC) scheme. It examines the effects brought by the UGC programs on brand awareness and image building of fast-fashion companies. A convenience sampling based consumer survey is conducted for this study. The statistical results reveal that the UGC scheme offered by fast-fashion companies is correlated to brand awareness and brand image. The findings imply that fast-fashion retailers can employ the used apparel collection program as a marketing scheme to help establish their own green brand image. This measure also enhances the fast-fashion retailers' brand positioning and their competitiveness in the market.

10.1 Introduction

In recent years, there is a growing concern on sustainability and corporate social responsibility (CSR) in the fashion industry. In fact, the fashion apparel-related industries are often being accused of bringing negative environmental impacts to the society. As we all know, the fashion apparel industry has brought some negative impacts to the environment. Concerns on the environmental impacts brought by apparel production and distribution are important, because our planet cannot support

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the current level of production and disposal of apparel that drives the depletion of natural resources and landfill places (Claudio 2007; Walker 2008; Winge 2008).

The fast-fashion retailers, in particular, are commonly viewed as the advocators of disposable fashion. This view, though can be controversial, may negatively affect the brand image and business performance of the fast-fashion retailers. As such, environmental sustainability is a critical issue to them, and fast-fashion retail leaders like H&M, and UNIQLO have stated in their CSR reports that they are doing more on environmental sustainability and even launching the campaign of recycling used garment in recent years (H&M website; Uniqlo website). Under such kind of CSR programs, the donors may receive a cash coupon and the collected garments are donated to the people in need such as refugees, homeless shelters, and poverty-stricken globally (Uniqlo website). In this chapter, we call this kind of programs the used garment collection (UGC) programs.

Undoubtedly, the UGC program can be regarded as a part of the fast-fashion companies' corporate socially responsible practices which would improve their corporate image. At present, the existing literature mainly focuses on linking the "green" branding measures and the associated impacts on consumer behaviors such as paying a premium or green purchase which focuses at the product level. However, very few studies consider the linkage between brand image and the sustainability programs such as UGC. In addition, to our best knowledge, there is no systematic quantitative study which explicitly studies how UGC implementation in fast-fashion companies affects their corporate branding. Therefore, there is a research gap on investigating the linking between UGC and fast-fashion retailers' corporate brand image, which deserves further investigation.

To be specific, this chapter aims to investigate the effects on the young consumers' brand awareness and brand image brought by the fast-fashion retailers' UGC program. Owing to resource limitations, this study was conducted in Hong Kong with the target respondents being the generation Y young consumers who were also college students[1]. Through this research, we aim to explore how consumers' response on fast-fashion companies' UGC program may create the desired brand awareness and brand image. We also discuss the research implications and generate managerial insights.

The organization of the rest of this chapter is listed below. First, we conduct a literature review in Sect. 10.2. Second, we develop the hypotheses in Sect. 10.3. Third, we discuss the research methodology in Sect. 10.4. Fourth, we present the data analysis and findings in Sect. 10.5. Finally, we conclude with a discussion on insights in Sect. 10.6.

[1] We explain later on why this consumer group is appropriate for this study.

10.2 Literature Review

10.2.1 Fast Fashion and Environmental Sustainability

Fast fashion can be described as an industrial practice in fashion, which offers relatively low-cost clothing collections based on the trendiest fashion that is usually driven by the luxury fashion brands (Joy et al. 2014). According to Childs (2014), and Choi (2014), the exceptional growth of fast-fashion retailers can be attributed to factors such as high-impulse buying, an increase in sourcing from low-cost developing countries, and a change in consumer attitudes. In fact, fast fashion greatly satisfies desires among young consumers for luxury and trendy fashion, even if it may embody "unsustainability" because of the "disposable fashion" nature. It is well-argued that fast-fashion companies do not offer the most durable products in terms of the selection of materials because of the costing issue and also the product nature. As a matter of fact, consumers are not assumed to use the fast-fashion products for a long time. If the above argument is sound, then more and more disposal of apparel and textile will be the result. There is no doubt that fast-fashion retailers, such as H&M, Zara, Uniqlo, and TopShop, sell garments at a very competitive price. Furthermore, their designs are usually made to be worn no more than, e.g., ten times and hence they are "disposable fashion". Note that disposability is an important issue with clothing products. For each disposed item, all the energy and chemicals that went into them during production and the carbon emissions from shipping them along the supply chain would be wasted. For the more complicated fashion items, such as jackets, many of them are not biodegradable; so, once they are thrown away in the landfill, they would stay there for centuries. In fact, as stated in H&M Conscious Actions Sustainability Report 2012, 5 % of wastes in the USA landfill are textile and 95 % of them are actually recyclable. Thus, the issue of collecting used garments for recycling and other processing is critical and important.

10.2.2 Brand Awareness and Brand Image

In fashion branding, customer-based brand equity is an influential framework (Aaker 1991). In a general sense, brand equity is defined in terms of the marketing effects uniquely attributable to the brand (Keller 1993). Customer-based brand equity of a fashion brand can be defined as the differential effect of brand knowledge on consumer response to the marketing schemes adopted by the fashion brand. We say that customer-based brand equity is present in a fashion brand when the consumers are familiar with the brand, and they hold some significant, positive, and unique brand associations in their memory (Keller 1993). To develop customer-based brand equity, Keller (1993) suggests that brands should take a broad view of marketing activity and recognize the various associated effects on brand knowledge. Note that

the long-term success of future marketing programs for a fashion brand is greatly affected by the knowledge about the brand in memory (Keller 1993). Therefore, brand knowledge is very important (Ailawadi and Keller 2004).

Brand knowledge is usually defined in terms of two critical components, namely the brand awareness and the brand image (Faircloth et al. 2001). To be specific, brand awareness toward a fashion retail brand is related to the strength of the brand node or trace in the consumers' memory, as reflected by consumers' ability to identify the brand under different conditions (Rossiter and Percy 1987). Note that brand awareness consists of brand recognition and brand recall performance (Chattopadhyay and Alba 1988). Raising brand awareness increases the likelihood that the brand will be a member of the consideration set. Undoubtedly, brand awareness affects consumer decision-making. Brand image is defined as the "perception about a brand as reflected by the brand associations held in consumer memory" (Keller 1993). Here, the brand associations can be classified into three major categories which include (i) attributes, (ii) benefits, and (iii) attitudes (Chattopadhyay and Alba 1988). It is well-known that a marketing program which can create a unique, strong, and positive brand association will help to create a positive brand image in the customers' memory (Keller 1993). Esch et al. (2006) empirically show that brand awareness and brand image will affect the consumers' consumption indirectly and directly, respectively.

Note that brand attitudes are defined as the consumers' overall evaluations of a brand. Brand attitudes are very important because they often form the basis for consumer behavior (e.g., brand choice). Fishbein and Ajzen (1975) develop a model that views attitudes as a multiplicative function of the salient beliefs a consumer has about the product or service (i.e., the extent to which consumers think the brand has certain attributes or benefits) and the evaluative judgment of those beliefs. Brand attitudes can be related to consumer beliefs about nonproduct-related attributes and symbolic benefits (Rossiter and Percy 1987). Brand attitudes can serve as a "value-expressive" function by allowing individuals to express their self-concepts.

In this study, we argue that the UGC program launched by fast-fashion companies is not only a response to the rising awareness of sustainability but also a branding strategy to enhance brand awareness and brand image (Chen 2008). Therefore, we explore the effectiveness of the UGC campaign with respect to various branding elements from the consumers' perspective.

10.2.3 Generation Y Consumers

Generation Y consumers, aged 18–35, in 2012, are the target group of consumers for this study. In fact, many generation Y consumers have been brought up in households where both parents work and have learnt to shop and make brand selection decisions earlier compared to the previous generations (Bakewell and Mitchell 2003). Therefore, "being born to shop" and "having the high need for material goods" are

characteristics of generation Y consumers. Generation Y consumers are also more concerned about fashion trends than probably any other age group (Martin and Bush 2000). As such, they are also the most crucial customers of fast fashion and heavily influenced by the fashion press and media (Birtwistle and Moore 2006). A study of young males and females between the ages of 15 and 24 reports that 38, 35, 33, and 24 % of them shop at fast-fashion brands such as Primark, Topshop, New Look, H&M, respectively. Forecasts of demographical trends reveal that, while some age groups are in decline, there will be an expansion in the 15 to 29-year-old group over the next 5 years. These all suggest that fast fashion will remain popular for the foreseeable future, and continue to be appealing to the young and fashion-hungry consumers, such as the generation Y. Note that the generation Y consumers are also especially socially concerned and aware of many global issues (Nayyar 2001; Morgan and Birtwistle 2009). These consumers form a powerful market segment with disposable income and are characterized by information empowerment. Thus, they cause increased awareness of environmental, social, and economic issues.

To sum up, the above discussions reveal that generation Y is an essential group of consumers for fast fashion and they are also sustainability conscious. As a result, they are the group of consumers selected for survey in this study.

10.2.4 Branding and Sustainability

There are several prior studies which link CSR (Luo and Bhattacharya 2006) or sustainability up with the corporate branding. We review them as follows. First, Brady (2003) explores how CSR can yield sustainable brand value. Fombrun and Shanley (1990) offer an early empirical link between charitable giving and reputation. Later on, Brown and Dacin (1997), though focusing on other relationships, identify an important link between CSR and corporate image. In addition, they include a control variable called corporate ability in their analysis. Brengman and Willems (2009) investigate the broad range of influences on dimensions of store personality in the context of Belgian fashion stores. They reveal an interesting connection between CSR and the fashion-store personality. One core finding from their study is that the fashion retail stores, which have a strong CSR program, are perceived to be more honest and trustworthy. Lai et al. (2010) propose and verify a link between CSR and corporate reputation in the B2B sector in Taiwan. Recently, using secondary cross-sectional data, Wang (2010) demonstrates that a relationship exists between lagged corporate social performance and brand equity. Similar finding is also observed from the studies of Torres et al. (2012) and Hur et al. (2013). To be specific, Torres et al. (2012) illustrate that the CSR program positively influences the global brand equity. Hur et al. (2013) empirically prove that brand credibility and corporate reputation are the important mediators that connect CSR and corporate brand equity. Note that some other studies have explored the linkage between CSR and brand satisfaction (Poolthong and Mandhachitara 2009), but do not proceed to investigate the influence of CSR on brand attitudes or brand reputation.

10.3 Development of Hypotheses

In the literature review, we know that the customer-based brand equity is defined as the differential effect brought by brand knowledge of consumers (Keller 1993) and the dimensions of brand knowledge include (i) brand awareness and (ii) brand image. Under brand awareness, there are brand recall and brand recognition; under brand image, the brand association includes brand attitude, benefit, and attribute (Keller 1993). In this study, owing to the research objectives and problem nature, not all elements are included and some modification is needed. Therefore, only brand recall and brand recognition (P.S.: brand awareness), and "benefit and attitude" (P.S.: brand image) are included in the investigation. In the following, we develop and propose the hypotheses.

Marketing programs are designed to enhance brand awareness and establish favorable, strong, and unique brand associations in memory (Keller 1993). Several marketing studies have found that CSR programs have a significant influence on several customer-related outcomes. More specifically, on the basis of lab experiments, CSR is reported to affect, either directly or indirectly, consumer product responses (Brown and Dacin 1997), customer–company identification (Sen and Bhattacharya 2001), customer donations to nonprofit organizations (Sen et al. 2006), and customers' attitudes toward quality of products (Berens et al. 2007). Obviously, the UGC program can be regarded as a part of *CSR scheme* which would share the same influence brought by the above marketing studies.

Furthermore, a strong record of CSR creates a favorable context that positively boosts consumers' evaluations of and attitude toward the firm (Brown and Dacin 1997; Sen and Bhattacharya 2001). To be specific, Bhattacharya and Sen (2003) suggest that CSR initiatives establish a key element of corporate identity that can induce customers to develop a sense of connection with the company. Not surprisingly, identified customers are more likely to be satisfied with a firm's offerings (e.g., Bhattacharya and Sen 2003). Therefore, it is believed that the UGC program launched by the fast-fashion retailers is not only a response to social responsibility but it would also create significant brand awareness, generate specific symbolic benefit and favorable brand attitude. All these would generate beneficial outcomes to the fast-fashion retailers in the long run.

Brand awareness is related to the strength of the brand node or trace in memory, as reflected by consumers' ability to identify the brand under different conditions (Rossiter and Percy 1987). We know that brand awareness affects consumer decision-making by influencing the formation and strength of brand associations in the brand image. A necessary condition for the creation of a brand image is that a brand node has been established in memory, and the nature of that brand node should affect how easily different kinds of information can become attached to the brand in memory (Keller 1993). Therefore, it is vital to increase brand awareness, and create brand node, in order to further build and enhance brand image. UGC programs could be viewed as a tool to generate brand awareness. Note that brand awareness includes both brand recognition and brand recall, where (i) brand recognition refers to the

consumers' ability to confirm whether they have seen or heard the brand before (Keller 1993), and (ii) brand recall refers to the consumers' ability to retrieve the brand from their mind when the product category is given to them (Keller 1993). With the above arguments, we have Hypothesis 1 and Hypothesis 2:

Hypothesis 1 UGC has a significant effect on brand awareness in terms of brand recognition.

Hypothesis 2 UGC has a significant effect on brand awareness in terms of brand recall.

Brand attitudes are defined as consumers' overall evaluations of a brand (Olsen et al. 2014). Brand attitudes are important because they often form the basis for consumer behavior toward the brand. According to Faircloth et al. (2001), brand attitude generally relates to the overall evaluation of objects. Observe that brand attitude can simply come from affect (feelings), cognition (beliefs), or previous experience. The UGC program is believed to generate a better consumer evaluation and attitude toward the fast-fashion retailers which have implemented it. Thus, we have Hypothesis 3.

Hypothesis 3 UGC has a significant effect on brand attitude.

Symbolic benefit corresponds to nonproduct-related attributes and relate to underlying needs for social approval or personal expression and outer directed self-esteem (Keller 1993). Note that the symbolic needs are defined as desires for products that fulfill internally generated needs for self-enhancement, role position, group membership, or ego-identification (Park et al. 1986). The symbolic meaning associated with the product is an important input to product image. When social groups attach symbolic meaning to a product, companies need to understand its nature so that they can reinforce or alter it to their advantage. Companies can take a more proactive stance by attempting to develop favorable symbolic images for their goods and services. The primary means by which a company can influence the symbolic image its product acquires is through a carefully planned and implemented marketing program (Leigh and Gabel 1992). Since the UGC program can be treated as a marketing program which may create the symbolic benefit and enhance the symbolic brand image to fulfill the needs for social approval, we develop Hypothesis 4.

Hypothesis 4 UGC has a significant effect on symbolic benefit.

10.4 Research Methodology

After forming the hypothesis, we move on to prepare the questionnaire and conduct the survey to collect data. For the questionnaire design, questions are developed based on the literature review and industrial observations. The 5-Point Likert Scale measure is adopted to get the consumers' inputs on their levels of agreement or disagreement which express the favorable and unfavorable attitudes toward an object; agree and disagree of the statement. Note that 5-Point Likert Scale has the advantage that it

Table 10.1 Summary of reliability test result

Elements of hypothesis	Cronbach's alpha (α)
Brand recognition	0.851
Brand recall	0.873
Brand attitude	0.815
Symbolic benefit	0.892

does not allow a simple yes or no answer from the respondent, but rather allows for degrees of opinion, and even neutral comment. Therefore, quantitative data is obtained and can be analyzed with meaningful interpretation. Before conducting the real survey, there was a pilot survey.

The purpose of pilot survey is to find out and correct the problems associated with the draft questions and avoid misunderstanding. In this study, as a pilot survey, 21 questionnaires were distributed to students who belonged to generation Y of The Hong Kong Polytechnic University. They were all aged between 17 and 27. After the pilot test, the polished and final questionnaire was formed which is divided into three sections. The first section includes the filtering questions to ensure the interviewee is aged between 17 and 27 which is the target group of the research, generation Y. The second section is the main body of the questionnaire and is divided into several smaller parts, which include "UGC," "brand awareness," "brand attitude," and "brand image." The final section devotes to collecting the respondents' general personal information.

The questionnaires were distributed through social media via the Internet. This method is fast, with high accessibility, environmentally friendly, and convenient to collect data from the generation Y respondents. Note that a nonprobabilistic convenience sampling was chosen for this study owing to resource constraint. The collected data sets were exported from the online questionnaire system and then analyzed by using SPSS version 19.0.

10.5 Data Analysis, Hypothesis Testing, and Discussions

10.5.1 Statistical Testing

Totally, 204 copies of valid questionnaires were collected. First of all, a reliability test was conducted. From Table 10.1, the Cronbach's Alpha values of all elements are over 0.7. We hence believe the factors employed in the survey study are reliable.

Next, we proceed to conduct the correlation analysis. From the statistical results (Table 10.2), we find that for Hypotheses 1–4, the Pearson correlation values are all positive and the correlation result is significant at the 0.01 confidence level. This result shows that all the elements under study are positively correlated with the UGC program.

Table 10.2 Results of correlation studies

	UGC	Brand recognition	Brand recall	Brand attitude benefit	Symbolic
UGC	Pearson correlation	0.247	0.317	0.439	0.377
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
	N	204	204	204	204

Table 10.3 Summary of correlation analysis

Hypotheses	*Pearson correlation (r)*
Hypothesis 1 (Brand recognition)	0.247[a]
Hypothesis 2 (Brand recall)	0.317[a]
Hypothesis 3 (Brand attitude)	0.439[a]
Hypothesis 4 (Symbolic benefit)	0.377[a]

[a]Correlation is significant at the 0.01 level (2-tailed)

Table 10.4 Mean score of the effects of UGC

	Dimension	Mean score
Brand awareness	Brand recognition	3.3
	Brand recall	3.5
Brand image	Brand attitude	4.0
	Symbolic benefit	4.2

From Tables 10.2 and 10.3, observe that the values of Pearson correlation helps reflect the degrees of correlation between UGC and (i) brand recognition, (ii) brand recall, (iii) brand attitude, and (iv) symbolic benefit, respectively. The larger the Pearson correlation value implies the higher level of correlation. From Table 10.2, the UGC program has the highest correlation with brand attitude (0.439[a]). The second-highest Pearson correlation value is Hypothesis 4 (0.377[a]), which implies that the UGC program has the second-highest correlation with symbolic benefit. The second-lowest and lowest correlations brought by the UGC program are brand recall and brand recognition, respectively.

10.5.2 Discussions

As shown above, in this study, correlation test is applied for testing the relationship between the UGC program and (i) brand recognition, (ii) brand recall, (iii) brand attitude, and (iv) symbolic benefit. From the correlation tests, we know that the four variables, "brand recognition," "brand recall," "brand attitude," and "symbolic benefit" are positively correlated to the UGC program.

Table 10.4 shows the mean scores of UGC toward the critical elements of brand awareness and brand image. Observe that they are all of above 3 in the 5-Point Likert

Table 10.5 Mean score of the effect of used garment collection to symbolic benefit

Symbolic benefit	Mean score
Refined	3.14
Attractive	3.67
Thoughtful	4.02
Approachable	3.93
Self-assured	3.63
Trustworthy	3.73
Confident	3.67
Prestige	3.16
Sporty	3.20
Modern	3.48
Proud	3.44
Optimistic	3.62
Elegant	3.13
Human-oriented	4.10

Scale, which means that the respondents agree that UGC affects the brand awareness and brand image of fast-fashion retailer. According to the statistical testing results, Hypotheses 1 and 2 are supported. This gives evidence that UGC has a significant effect on brand awareness in terms of brand recognition and brand recall. The result reveals that the UGC program can be utilized to enhance the brand awareness of the fast-fashion retailers (e.g., H&M and UNIQLO); in other words, this finding also shows that consumers have "ability to identify the brand" with UGC (Rossiter and Percy 1987). Given that more and more fast-fashion brands emerge in the market, it is expected that the fast-fashion retailers will continue sell garments at a very competitive price and hence there is keen competition among brands. The UGC can be a way to help the fast-fashion retailers to differentiate from others and earn a competitive edge.

From the significant statistical testing results on Hypotheses 3 and 4, we know that there is scientific evidence to show that the UGC program has a significant effect on brand attitude and symbolic benefit. Given the fact that "disposable fashion" is usually associated with fast-fashion brands, in order to change this brand image, and stand out from the "unsustainability cloud," fast-fashion marketers can wisely employ the UGC program. This act also fits the needs of the society. As a remark, establishing a positive brand image has long been recognized as an important element in building a strong brand (Keller 1993). It is a critical issue.

For symbolic benefit, note that it is usually related to the needs for social approval or personal expression and consumer may value the prestige and exclusivity of a brand (Solomon 1983). From Table 10.5, we can see that human-oriented (mean score 4.10), thoughtful (mean score 4.02), and approachable (mean score 3.93) are ranked

Table 10.6 Summary of hypothesis testing results

Hypotheses	Supported/not supported?
1. Used garment collection has a significant effect on brand recognition	Supported
2. Used garment collection has a significant effect on brand recall	Supported
3. Used garment collection has a significant effect on brand attitude	Supported
4. Used garment collection has a significant effect on symbolic benefit	Supported

top three in terms of mean scores among all dimensions. This implies that consumers value fast-fashion retailers as human-oriented, thoughtful, and approachable after noticing their implementation of the UGC program. Compared with the findings reported by Brengman and Willems (2009) in which the fashion store offering CSR program is perceived to be honest and trustworthy, this study shows a slightly different result from theirs. Even though both studies indicate positive symbolic benefit to the brands when there are ethical actions, this study shows that consumers especially value fast-fashion retailer as human-oriented, thoughtful, and approachable. We argue that the nature of fashion retailers may influence the results, because we are focusing solely on fast-fashion retailers whereas Brengman and Willems (2009) examine the more traditional fashion stores in Belgium. Moreover, owing to cultural differences, the perception of Hong Kong consumers and Belgian consumers may be different. Therefore, different symbolic benefits may be generated. Nevertheless, we believe that the UGC program is associated with the symbolic benefit and this emerging activity can be used as a promotional tool for fast-fashion retailers.

10.6 Conclusion, Implications, and Research Limitations

In this study, we have explored the effects brought by the UGC program to fast-fashion retailers. We have reviewed the related literature and formed the hypotheses. Through a consumer survey conducted in Hong Kong, we have collected data for statistical analysis. The statistical results demonstrate that there is a positive relationship between the fast-fashion retailer's implementation of UGC and the customers' brand awareness, and brand image toward the fast-fashion brand. As a summary, Table 10.6 shows the hypothesis testing results. In the following, we further discuss some implications from the research findings.

First, from the results of Hypothesis 1 and Hypothesis 2, we know that the UGC program is associated with the brand awareness of the fast-fashion brands. This relates to the consumers' ability to confirm and retrieve information of the respective fast-fashion brands. With this result, the fast-fashion retailers can put more effort and resources on promoting their UGC programs, e.g., via TV or Internet commercials, company's website or social media pages. More could also be done in the retail store in which banners can be posted and leaflets could be distributed to catch more

attention toward their UGC programs. Currently, in places like Hong Kong, the UGC programs of fast-fashion retailers are relatively "low profile" and we believe that the fast-fashion companies should take a more proactive approach in promoting them.

Second, from the results of Hypotheses 3 and 4 which relate to brand image, the consumers have positive brand attitude toward fast-fashion brands and there is an important symbolic benefit (in particular, in the dimensions of human-oriented, thoughtful, and approachable) associated with the fast-fashion brands when they have implemented the UGC program. Undoubtedly, in the fast-fashion industry, a positive brand image can provide a competitive advantage because it gives the brand the power to capture a larger market share with higher profit margins. Fast-fashion retailers can make good use of "environmental protection" via their UGC programs to differentiate themselves from others. As a remark, the current findings are associated specifically with the UGC programs. However, it is intuitive that other environmental sustainability measures may also have similar effects. In fact, the UGC program is just a small part of the formal sustainability programs of many fashion companies, more campaigns could hence be done to enhance the impact and trigger a bigger effect on brand image. We thus propose that fast-fashion retailer may exploit other popular and socially aware concerns on environmental issues and implement them together with UGC. From the fast-fashion retailer's perspective, our findings demonstrate that it is possible for them to improve their brand image through UGC, which is a part of better environmental management and CSR practices. We argue that the movement to sustainability is largely driven by the social expectations of consumers. Thus, it deserves a long-term investment and should be supported by a consistent and long-term strategy of the fast-fashion company.

According to Miller and Dale (2013), it is possible for retailers to enhance their brand reputation through better environmental management practices. Their results also show that sustainability practices can provide commercial benefits to the retailers as a strong business motivation. Furthermore, their study extends the benefits of CSR practices in the area of corporate branding. Our study also indicates similar findings in the scope of fast fashion, and shows the positive relationship between the UGC program and cooperate branding (e.g., brand awareness and brand image). In corporate level, to support the movement of "sustainability," a higher level of internal and external organization integration is necessary. From this perspective, we believe that a multidisciplinary team should first be set up in the fast-fashion retailers to manage, in an integrated way, "sustainability" related measures associated with the UGC. It makes sense to bring people with different areas of expertise together, too. Second, a cross-functional team is required for effective planning and implementing the UGC programs. Throughout the whole fashion supply chain, teams on research and development, production, sales and marketing, etc. should coordinate together and take part in the UGC programs. It is important for each functional department to send at least one representative to join this cross-functional team. Closer cooperation is generally believed to help increase communication and enhance the effectiveness of the program. Also, this cross-functional team should continuously seek feedback of the UGC campaign from consumers and propose ways to further polish and improve the program to better satisfy the needs of consumers and society. Integration with external organization, such as developing partnership with professional recyclers and

collectors, is crucial and helps ensure the UGC program associated reverse supply chain system is effective. In short, we propose that deep integrations internally and externally are important to support the implementation of UGC program in fast-fashion companies.

There are some limitations in this research. As time and resources are limited, only a relatively small sample size is used in the research. Thus, the statistical results may not totally reflect the real situation in the market. Besides, this research only targets at the generation Y consumers in Hong Kong and hence the results may not be generalizable and we need to interpret the results carefully. For future research, it would be good to examine how cultural differences may affect the research findings by conducting similar studies with consumers in other countries with different cultural backgrounds. In addition, it will be interesting to see if different or similar findings will be obtained when we study other fashion retailing business models (e.g., in luxury fashion).

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Index

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