



BSc in Business Administration

Sustainability is the new black

The global fashion industry and its impact on the environment

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Student name: Karen Sang Thi Nguyen

Social Security: 030292 – 3329

Instructor: Þorgeir Pálsson

Declaration of Research Work Integrity

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature of any degree. This thesis is the result of my own investigations, except where otherwise stated. Other sources are acknowledged by giving explicit references. A bibliography is appended.

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Abstract

Environmental pollution is one of the main concerns in the modern world. Almost all production of goods lead to the creation of environmental pollutants. The fashion and clothing industry is one of the largest contributors to the problem. The fashion and clothing industry is now consuming around twice as many fibers than it did 25 years ago (Source Founding Partners, Fairtrade & Global Organic Textile Standards [GOTS], 2017). Current practice of the industry is creating pressure on natural resources that cannot be recovered, and will threaten the growth of the industry in the near future (The Business of Fashion and Mckinsey & Company, 2016; Global Fashion Agenda & The Boston Consulting Group, 2017). This thesis is going to address the impact that the fashion and clothing industry has on the environment and society. The purpose is to look for realistic solutions to the problems. The focus will be on raw materials and textiles options. Although transportation and energy usage within the industry are major contributors to the environmental impacts, the discussion will be limited since it can be discussed as 3 separate industries.

Polyester, cotton and viscose rayon are the most popular fabrics used in the fashion and clothing industry, but the process of creating the fabrics leaves polluted footprints on the environment, effecting eco-system and violate human rights. In addition, the concept of sustainability within the industry is very weak. Nonetheless the need for more sustainable production methods, which make the best use of natural resources and minimize pollution and chemical discharge is critical. More sustainable options such as Fairtrade cotton, organic cotton, Better cotton, lyocell, bamboo and other innovative fibers will make a difference. In addition, establishing closed-loop production system and waterless dyeing technique will result in significant reduction of waste, less energy usage and reduction of chemical wastewater.

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1 Introduction

According to the industry report, *The State of Fashion 2017* by McKinsey & Company and *The Business of Fashion (BoF)* (2016) “Fashion is one of the world’s most important industries, driving a significant part of the global economy” (p.6). The year 2016 has been one of the hardest years for the fashion industry and can be summarized in three words: changing, challenging and uncertain. The global economy was highly disturbed because of incidences such as the terrorist attacks, Brexit vote, and volatility in the Chinese stock market. In addition, consumers have become more demanding and less predictable. The fashion industry is one of the most value-creating industries for the world’s economy as it provides numerous job opportunities across occupations (*The Business of Fashion and McKinsey & Company*, 2016). Economic growth depends on the continual marketing of new products, encouraging the disposal of old garments simply because the new products had made it fall out of style. When it comes to clothing, the cycle of each garment has become dramatically shorter (Claudio, 2007). Marketing campaigns encourage the consumers to associate the consumption of fashion with power, pleasure, fulfillment and personal creativity. Meanwhile business economists and corporate finance officers view the consumption of fashion in a different way. They view it as neither personal nor individual, but it is necessary to maintain the global capitalist economy (Rabine, n.d.). The earth’s natural resources are under pressure. With the current consumption and production, the pressure on natural resources will only intensify to the point where the growth of the industry will be threatened (*The Business of Fashion and McKinsey & Company*, 2016; *Global Fashion Agenda & The Boston Consulting Group*, 2017).

It is well known that the fashion and clothing industry has enormous impact on the global environment, and is said to be one of the most polluting industries in the world (Sweeny, 2015). As of today, the concept of sustainability in the industry is very weak. Consumerism has enhanced the potential negative impact on human health, and is a contributor to further reduction of natural resources. Today, it is easier and more cost effective for business to source for both low-cost materials and labor in the developing countries. Even so, consumers have been increasingly more aware of the negative impacts that these business actions have on the environment and communities. Today, internet and social media are building global communities and it has increase the awareness around sustainability impacts. Purchasing decisions can therefore be influenced by brand reputation (NICE Fashion, 2009).

This thesis is going to address the impact that the fashion and clothing industry has on the environment and society. The purpose is to look for realistic solutions to the problems that are created by businesses within the industry. The goal is to find a sustainable solution for the fashion and clothing industry to continue creating new value for society, and at the same time generate profits from its operations for the owners and shareholders. To find the solution to the question, various ways such as fabric choices, production processes, as well as standards will be examined. The main research question of the thesis is:

“Is there a way for fashion industry to minimize the negative impacts that it has on the environment and the society?”

To find the answer to the main research question and to get more insight into the industry, interviews were taken with 4 individuals, all with extensive experience and knowledge of the fashion industry. Interviews were conducted both through personal conversation and emails. The questions were mainly focused on their knowledge of the industry, concerns regarding the subject as well as ideas on what the industry could do to improve its current practices to prevent and minimize the problems.

The first part of the thesis will start off by defining the concept of fashion. Fashion is an important concept as it is often the reason why people buy more clothes and renew their wardrobe. The meaning of the word fashion has evolved throughout history. Another concept will also be introduced in this part of the thesis, that is fast fashion. Fast fashion has been dominating the clothing market since the 1980s. Fast fashion is all about the constant refreshment of product range at an affordable price for consumers of all ages. It was designed with the idea of “here today, gone tomorrow”. The purpose is to encourage consumers to visit stores more often (Bhardwaj & Fairhurst, 2010). Even though fast fashion offers retailers the opportunity to increase their profits, fast fashion has raised questions about ethical practices and sustainability within the industry as it promotes the “buy more new products and excessive throw away” behavior (Joy, Sherry Jr, Venkatesh, Wang, & Chan, 2012). The second part of the thesis will be focusing on the structure of the fashion and clothing industry. This part will also be covering the discussion on the supply chain and the importance of managing it. Challenges that the fashion and clothing industry is and have been facing throughout the years will be discussed in the third part. Lastly, more sustainable options will be presented, as well as various standards and certificates that already exist, aiming to improve sustainability as well as wellbeing of workers.

2 What is fashion

The definition of fashion varies from one person to another. It changes each time to fit the social tradition and clothing habits of people in different social classes (Kawamura, 2004). The term “fashion” and “clothing” tend to be used to express the same idea. Yet, fashion describes the current trends in the society and can be used to express various social meanings, whilst clothing is simply the materials that a person wears (Eberle et al., 2008; Kawamura, 2004). The concept of fashion also separates itself from other words such as “garments” and “apparel” as those words refer to tangible objects, something that can be touched or felt, whereas fashion is an intangible object that cannot be touched nor felt. Even though the concepts don’t refer to the same thing, they are still being used as synonyms of fashion (Kawamura, 2004).

Every individual has their actual self and an ideal self, but there will always be a gap between the two. Fashion offers the opportunity to fill that gap, it helps create the ideal identity that the individual desires (Das, Sharma & Gupta, 2014). Fashion helps people communicate their beliefs, values, attitude and lifestyle through their possessions such as clothes and accessories (Saravanan & Nithyaprakash, 2015). For that reason, fashion adds more value to clothing, but the additional value only exists in people’s beliefs and imaginations. Like fashion itself, this value varies from a person to person. Fashion is collective action and a collective taste as it is not created by a single person, but by everyone that is involved in the production of fashion (Kawamura, 2004, 2011). Just like how values vary from a person to person, collective action and taste in fashion also vary between different groups of people, depending on their culture, beliefs, attitudes and lifestyles.

Fashion can be distinguished into luxury fashion (*haute couture*) and everyday fashion (Saravanan & Nithyaprakash, 2015). In the past, fashion was meant to convey one’s social status, such as wealth and authority as well as the social expectations around these statuses. Clothes intended for mass production were not considered fashion as it lacked the creativity that fashion requires (Southerton, 2011). Today, fashion is enjoyed by almost everyone at every social level regardless of their status. Unlike the traditional fashion system where the “rich decide the course of fashion and this disseminated from the top to the bottom sections of the society” (Saravanan & Nithyaprakash, 2015, p. 3). The gap between high class and low class has become more unclear with the beginning of postmodernism, and the definition of what is fashionable had slowly begun to fade. Fashion is now not about clothing and it doesn’t require any visual materials to explain fashion but rather, clothes are simply being used to express

fashion (Kawamura, 2004, 2011). Consumer tastes and preferences have become increasingly diverse. More and more people are confidently expressing their unique selves through styling. Within the new structure of society and advanced technology of today, fashion information and trends are now spreading at an extremely rapid pace through multiple channels. For consumers in the postmodern and modern societies, anything and everything can be used to express fashion.

2.1 Fast fashion

Fast fashion is a term that refers to a phenomenon in the fashion industry where collections of low cost clothing based on the current market trend are produced as cheaply and as quickly as possible (Fletcher, 2013). Fast fashion provides the market with affordable apparels that fulfill the desire of consumers to acquire the look that appears in fashion shows and fashion magazines (Claudio, 2007). The life cycle of fast fashion clothing is very short and demand for such fashion items are extremely unpredictable. Hence, it is a must for companies in the fast fashion business to design a flexible and quick response system to be able to survive in the fast fashion environment. Fast fashion companies therefore rely on rapid prototyping, production made in smaller batches “with large variety, more efficient transportation and delivery, and merchandise that is presented “floor ready” on hangers” (Joy, Sherry Jr, Venkatesh, Wang, & Chan, 2012, p. 275), pre-tagged with all the necessary details and information such as size, style, color, etc.

Fast fashion is advantageous from the perspective of retailers (Joy, Sherry Jr, Venkatesh, Wang, & Chan, 2012). Fast fashion has been considered as a business model that is tailor made for the today’s internet-driven buyers. It offers significant business value to retailers whose product cycle has been shortened and are influenced by luxury brands, celebrities and media hype (Denning, 2015). Unlike retailers of ready-to-wear and haute couture, fast fashion retailers are only motivated by trends that are the most promising, spotted at fashion shows and from mainstream consumers instead of investing directly into designs. The trends are then transformed into products that can be placed into the market almost immediately (Tokatli, 2008).

Fast fashion retailers can be divided into retailers with their own factories and retailers with no manufacturing capabilities. Retailers without factories do not manufacture their own clothes but rather outsource them to other firms, most often to firms in developing countries where labor is significantly cheaper (Tokatli, 2008). The standard turnaround time from fashion

shows to consumers once allowed six months for manufacture, but today it has been compressed to a matter of a few weeks (Allwood, Laursen, Rodríguez & Bocken, 2016). The typical lifecycle of fashion clothing had 4 stages. “introduction and adoption by fashion leaders; growth and increase in public acceptance; mass conformity; and finally, the decline and obsolescence of fashion” (Turker & Altuntas, 2014, p. 167). Autumn/Winter. But toward the beginning of 1990s, 3 to 5 mid-seasons were added to the existing fashion calendar. The additional seasons have shortened the lead time and created great pressure on the supplier to deliver fashion products in smaller batches. There are two purposes to the changes, to satisfy consumers demand for clothes for specific events, and for retailers to attract customers to visit stores more frequently through low cost and low priced clothing that are available today but might be gone tomorrow (Turker & Altuntas, 2014; Bhardwaj & Fairhurst, 2010). The rapid turnover of such continuation has a side effect, that is excessive production and over consumption (Joy, Sherry Jr, Venkatesh, Wang, & Chan, 2012). Fast fashion is unsustainable and has been criticized because it encourages the consumers to throw away their “old” clothes and buy new ones. Consequently, fast fashion leaves behind a pollution footprint. With every step of the clothing life cycle it generates potential environmental problems, including discharge of hazardous chemicals, high water consumption, waste production, greenhouse gas emissions and violation of human rights and labor standards (The Business of Fashion and Mckinsey & Company, 2016; Claudio, 2007).

3 Fast fashion and clothing industry

The fast fashion industry is characterized by short product life cycles, large variety of products, unpredictable and volatile demand, inflexible and a long and complex supply chain (Şen, 2008). Fast fashion products are designed to capture the feel of the moment. Sale periods are short and seasonal, often measured in months or even weeks. Buying decisions by consumers of fashion products are very often made at the moment of purchase, availability is therefore very critical (Christopher, Lawson & Peck, 2004).

The fashion industry came to existence out of necessity (Southerton, 2011). Fashion clothing was used to emphasize power, wealth and social distinction and a belonging to a certain class (Eberle et al., 2008). Prior to the mid-19th century, clothes were all handmade, either produced at home or on order from tailors or dressmakers (Major & Steele, n.d). Luxury fashion, took the leading role in the fashion industry, producing only luxury fashion items (Eberle et al., 2008; Major & Steele, n.d). As the industry developed, new technologies such as sewing machines were introduced, as well as the development of factory system of production allowing clothing to be manufactured in large batches at a lower price. This development enables the industry to provide clothing for a wider range of audience (Southerton, 2011). The market for luxury fashion slowly started to change when it was challenged by changes in the business environment, globalization, customer base, and entrance of new competitors (Djelic & Ainamo, 1999). The fashion culture changed from luxury fashion and mass production ready-to-wear clothes to today's modern fashion, widely known as fast fashion (Major & Steele, n.d).

Today the industry is highly globalized, where fashion designers, manufacturers, merchandisers and retailers from all around the world collaborate to deliver end products to satisfy consumers. Clothes are no longer manufactured by the label itself, but it is manufactured through a network of contractors all around the world (Major & Steele, n.d). Over the past decades, the fashion industry had grown at 5.5 percent annually. According to the McKinsey Global Fashion Index, the industry is now worth an estimated \$2.4 trillion and is the seventh-largest economy in the world if ranked alongside individual countries GDP (The Business of Fashion and Mckinsey & Company, 2016). It accounts for a significant share of the world's economic output. The industry employs people across occupations. The clothing and textile sector alone accounts for 7 percent of the world's total exports and developing countries account for half of it (Allwood, Laursen, Rodríguez & Bocken, 2016). In 2015, around 60 million to 75 million people work in the clothing, textile and footwear sector alone. This is a massive increase

comparing to 2000, when only 20 million people were employed in the industry (Stotz & Kane, 2015).

3.1 Supply chain

The success of any business depends on an effective supply chain (Christopher, Lowson & Peck, 2004). Supply chain is a network of multiple business relationships. It represents the steps it takes to manufacture and deliver the product or service to the customer (“Supply Chain”, n.d.; Lambert & Cooper, 2000). Supply chain can be defined as “a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances and/or information from a source to a customer” (Mentzer et al., 2001, p. 4). Supply chain has three degrees of complexity: a direct-, an extended-, and an ultimate supply chain. Figure 1a illustrate a direct supply chain. “A direct supply chain consists of a company, a supplier, and a customer involved in the upstream and/or downstream flows of products, services, finances, and/or information” (Mentzer et al., 2001, p. 4). An extended supply chain is illustrated in Figure 1b, it “includes suppliers of the immediate supplier and customers of the immediate customer, all involved in the upstream and/or downstream flows of products, services, finances, and/or information” (Mentzer et al., 2001, p. 4). Figure 1c illustrates the ultimate supply chain. The ultimate supply chain can get very complex, as it “includes all the organizations involved in all the upstream and downstream flows of products, services, finances, and information from the ultimate supplier to the ultimate customer” (Mentzer et al., 2001, p. 4). For instance, the role of a third party financial provider provides financing and offers financial advice. A third party logistic supplier performs the logistics activities between the two companies and a market research firm provides “information about the ultimate customer to a company well back up the supply chain” (Mentzer et al., 2001, p. 4).

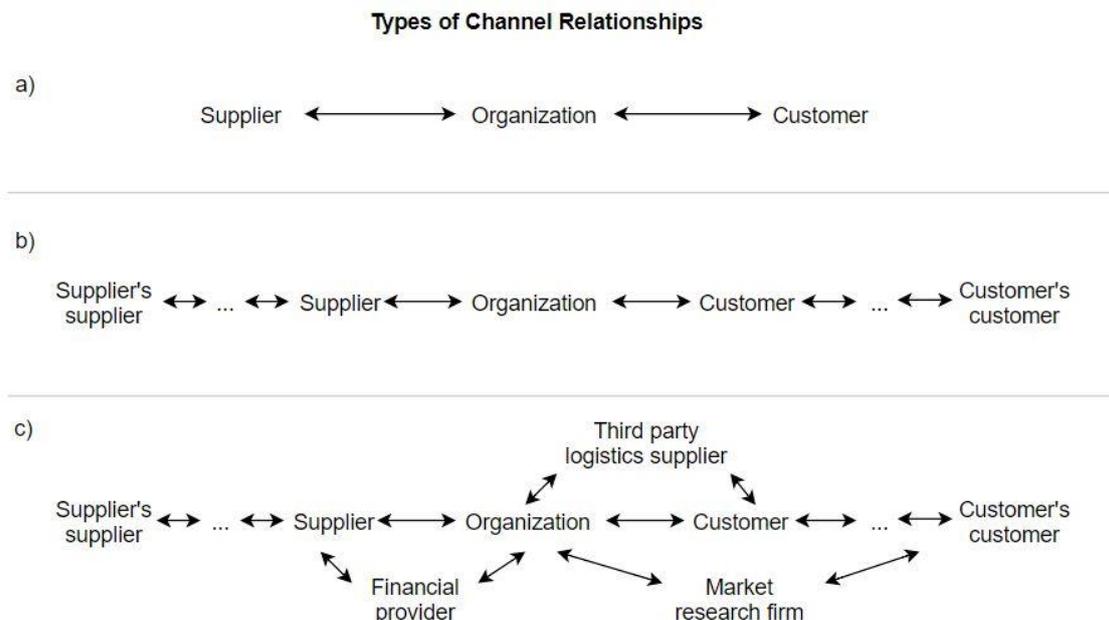


Figure 1: Types of Channel Relationship

a) Direct supply chain, b) Extended supply chain, c) Ultimate supply chain (Mentzer et al., 2001, p. 5).

Corporations have increasingly turned to the global market for their supplies, which require companies to look for more effective ways in order to coordinate the in and out flow of materials. The key to such coordination is to establish a closer relationship with suppliers. Today, the competition in the market is based on time and quality. Customers are constantly demanding faster and on time delivery, with no damage. Therefore, it is no longer seen as a competitive advantage to get a product to customers faster and more reliably than other competitors, but in fact a requirement to be in the market. The increased performance-based competition and global orientation, combined with rapidly changing economic conditions and technology have all contributed to the uncertainty of the marketplace. This uncertainty requires for more flexibility of individual businesses and supply chains, which demands for more flexibility in supply chain relationship (Mentzer et al., 2001).

As mentioned earlier, fashion and clothing supply chains are usually very long and complex and often involve many different entities (Christopher, Lawson & Peck, 2004). The supply chain of the clothing and textile sector, according to Hildegunn Kyvik Nordås in her paper, *The Global Textile and Clothing Industry post the Agreement on Textile and Clothing*, published in 2004, consists of 6 segments: raw materials, textile plants, apparel plants, distribution centers, retail stores and customers, as shown in Figure 2. The direction of the arrows suggest that it is a demand-pull-driven system. The black lines represent the flow of

goods, while the gray lines represent the flow of information. The flow of information starts with customers, which creates a starting point of what is being produced and when. In some cases, information flows directly from retailers to textile plants. For instance, direct information flow between retailers and textile mills happens when making decisions on patterns, materials and colors (Nordås, 2004).

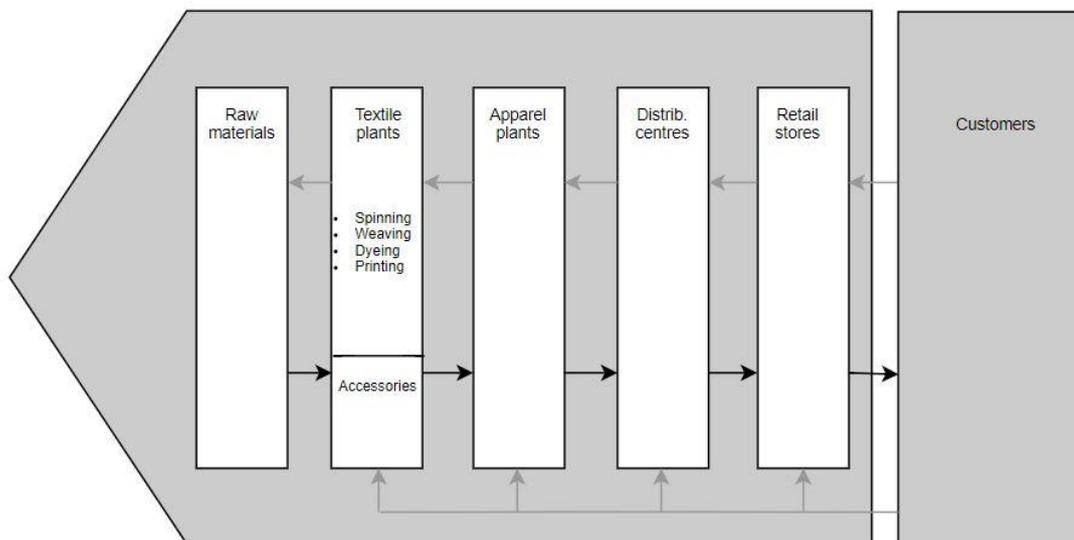


Figure 2: The Supply Chain in the Textile and Clothing Sector (Nordås, 2004, p.4).

Raw materials are categorized into two groups: natural fiber and synthetic fiber. Natural fibers consist of plant fibers such as cotton and linen, and animal fibers such as wool and silk. Synthetic fibers are also known as man-made fibers and include polyester, nylon and acrylic. Both synthetic fibers and natural fibers are converted into yarn (Şen, 2008; Eberle et al., 2008). Various methods are used to transform yarn into fabrics depending on yarn type and what purpose it is going to serve. Apparel plants are where fabrics turn into clothes, this is the most fragmented and labor-intensive segment of the supply chain, and is often outsourced to emerging countries due to a readily available labor source (Şen, 2008; Perry, Fernie & Wood, 2014).

The industry has changed a lot since 2004. Figure 3 presents another supply chain of fashion and clothing industry as suggested by the author. Here, the flow of information starts with influences, which creates consumer demands for a product. Following are decisions of what is being produced and when depending on what consumers desires. Consumer's purchasing behavior is being strongly influenced by various factors such as cultural factors, social factors, personal preference, lifestyle, the product itself, as well as external factors such as marketing campaigns, economic conditions and the consumer's purchasing power. Today,

technology development, particularly in the mass media sector has made it easier for consumers all around the world to keep track of the newest trend. This development has also made it easier for companies to influence their consumers. Consumers purchasing behavior of fashion goods is often influenced by various platforms such as social media which people have been prone to use for showcasing their lifestyle, fashion blogs, celebrities, news sites, online shopping, etc.

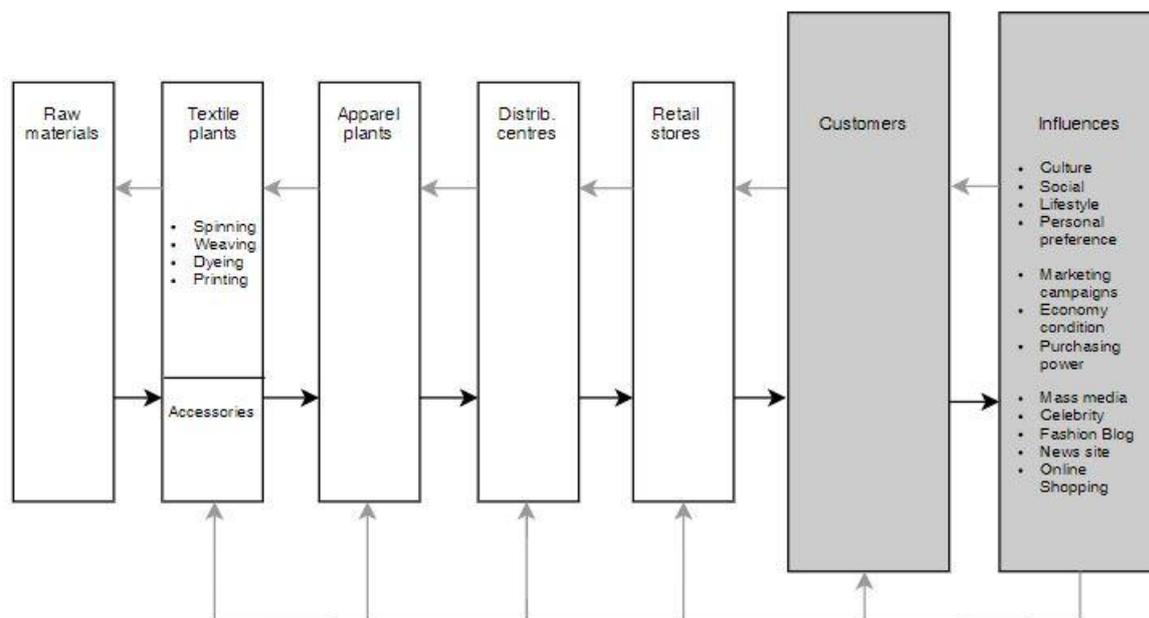


Figure 3: The Supply Chain in the Textile and Clothing Sector Presented by the Author

The fashion supply chain was protected by larger retailers against competition from out of the markets until the 1980s. The increasing fashion consciousness of consumers has led to the elimination of mass production of simple standardized designs and changed the structure of the supply chain. Instead it was “replaced by buyer oriented, strategically linked, highly responsive, low cost supply chains with shorter lead times” (Turker & Altuntas, 2014, p. 838). The traditional structure of the supply chain gives luxurious brands more control over merchandise quality and exclusivity which allows them to demand premium prices for their products. For other fashion and clothing companies, this traditional structure of the supply chain was rare. The shift in production toward developing countries had created a downward price pressure. To lower the price of goods, retailers and brands began to move toward a design/source/distribution model, with the focus on their core competencies of design, branding and retailing, outsourcing the production to independent suppliers around the globe (Perry, Fernie & Wood, 2014). This is illustrated in Figure 4.

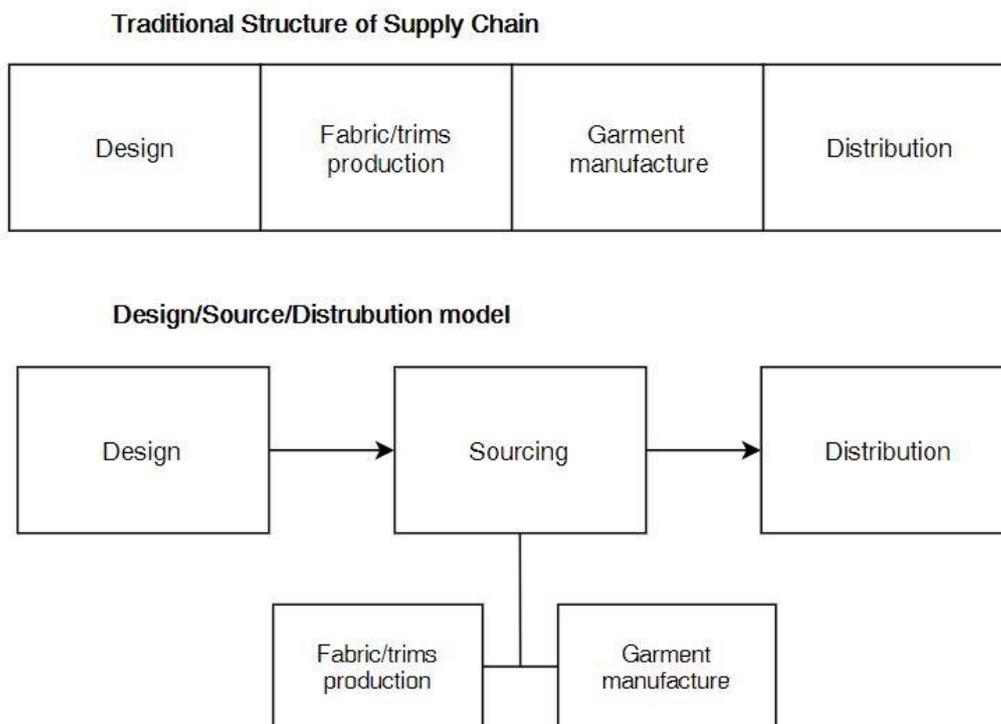


Figure 4: Supply Chain Model in the Fashion Industry (Perry, Fernie & Wood, 2014, p.4).

3.1.1 Supply chain management

Supply chain management is a crucial process in the competitive environment, the success of any businesses depends on the ability to manage and to integrate the company's complex network of business relationships. An optimized supply chain will result in lower costs and faster production cycle. The management of multiple relationships throughout the supply chain is referred to as supply chain management (SCM) (Lambert & Cooper, 2000; "Supply Chain", n.d.).

Supply chain management is defined as the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole. (Mentzer et al., 2001, p. 18).

SCM is used to describe managerial responsibilities in corporations, it "involves multiple firms, multiple business activities, and the coordination of those activities across functions and across firms in the supply chain" (Mentzer et al., 2001, p. 17). As mentioned before, the fashion and clothing industry is highly competitive and therefore requires a high level of responsiveness and high level of efficiency (Turker & Altuntas, 2014). Coordinating

and integrating the flow of information and materials is therefore very critical to response to changes in the fashion industry (Christopher, Lowson & Peck, 2004). However, to become and stay responsive various environmental, ethical and employment issues are being ignored, which creates an unsustainable sectoral structure (Turker & Altuntas, 2014). In the recent years, the production has been relocated to the developing countries to minimize the production costs. Such relocation has led to an inverted economic growth of the clothing industry in the America and Europe. The environment is being scarred by intensive use of chemicals in the fashion and clothing industries. Moreover, a number of big brands names were hit by sweatshop scandals (De Brito, Carbone & Blanquart, 2008). Due to the increasing awareness, companies have begun to implement new strategies and practices to respond to the increasing social and environmental problems (Turker & Altuntas, 2014).

It has been widely recognized that the performance of supply chain cannot be measured only by financial ratios or by cash-to-cash cycle time, lead time or any other logistics indicators. It is affected by much wider issues originating from both the internal organization of each entity of the supply chain and from the relationship quality between entities of the supply chain. In addition, new demand from customers and other stakeholders can have an affect the performance (De Brito, Carbone & Blanquart, 2008). To be a more ethical brand, transparency is the key. Companies must find the balance between finance and the need to maintain decent labor conditions and fair wages across the supply chain as well as address the environmental impacts of the production process.

Sustainable supply chain management (SSCM) has started to catch the attention from both practitioners and scholars in recent years. As the name indicates, sustainable supply chain management consists of both supply management and sustainability (Seuring & Müller, 2008). SSCM can be defined:

The management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social, into account which are derived from customer and stakeholder requirements. (Seuring & Müller, 2008, p. 1700).

In the last century, private consumption has grown enormously. International trade has intensified, and foreign direct investment has increased. The globalization trend has made the supply chain broader and more international. Sustainable development has been translated into principal and guidelines for companies by the United Nations in the Agenda 21. From the

perspective of the UN's Agenda 21, all companies can make a positive contribution toward sustainable development and it can be done through sustainability oriented initiatives. In addition to that, the NGO's stated that not only can corporations make a difference, but it should be part of their responsibility. In Europe, regulation in the direction of extending the responsibility of the producer has been increasing. The involvement of corporations with sustainability programs are forced by legislations, especially in Europe, even though their attitudes toward it varies a great deal. Some firms choose to fulfill only the requirements, other choose to be constantly updated about new rules in order to be ready for changes, and some go the extra mile in order to gain competitive advantage from acting as first movers (De Brito, Carbone & Blanquart, 2008).

4 Challenges

The fashion industry has grown remarkably in recent years. But with this growth, various concerns have been raised relating to the environment, social welfare and economy. The purpose of this section is to address the negative impacts of the industry. Topics surrounding labor standards, human rights and ethical behavior in the fashion and clothing industry have been a public concern for decades. Although many companies have been working aggressively to promote ethics and labor rights in their supply chain, the problems continue to remain (NICE Fashion, 2009; Pesticide Action Network UK, Solidaridad & WWF, 2017).

The fashion supply chain is especially sensitive to sustainability due to its characteristics. Environmental pollution is one of the major concerns of the modern world. Almost all production of goods will result in the creation of environmental pollutants. Large amounts of energy, water, various types of chemicals are used for the cultivation of raw materials, production process of yarn, fabric and garments. Following the treatment, additional amounts of polluted waste such as untreated dyes are discharged from the process. These pollutants are released into water, soil and air, which creates health issues and damages the ecosystem (Kumar & Gunasundari, 2018).

4.1 Ethical issues

Fair wage payment, age of workers, lack of gender equality, work hours, occupational health and safety, poor worker-management communication, worker harassment and discrimination have been very common issues in the industry (NICE Fashion, 2009; Pesticide Action Network UK, Solidaridad & WWF, 2017).

The continuous search for low production costs has led to a significant relocation of production sites toward less developed countries has led to loss of employment in the U.S. and European textile and clothing industry (Taplin, 2006). Workers that continued to be employed in the industry had to face wage reductions and sweatshop conditions while supporting higher level of growth and profitability of the largest corporations that increasingly dominate the industry. On the other hand, workers in the developing countries gained immediate employment in the sector, but in poor conditions (Rosen, 2002). Given the intensive labor requirement of the textile and clothing industries, some economists have argued that relocating production sites to low-wage developing countries is more efficient as they have a comparative advantage in their natural abundance of low wage labor. Moreover, the developed countries have advanced

technology, and can produce capital intensive manufactured goods and services more efficiently. Which makes it a win-win situation for both countries (Rosen, 2002).

The textile and manufacturing sector offer opportunities for development by creating many relatively low skilled jobs, however some workers are unable to escape from a cycle of poverty. Although most countries have a legal minimum wage, in some cases the legal minimum wage is far lower than a realistic minimum living wage. Employment in the textile and manufacturing sector has been increasingly concentrated in developing countries such as China, Pakistan, Bangladesh, India, Cambodia, Vietnam, etc. The employment opportunities have mostly been at the bottom of the supply chain, in the lower range of qualifications and very often in countries that provide limited job opportunities. The workforce in the textile and manufacturing sector have been mostly made up of women, that are low skilled and may be immigrant. In extreme cases, children are removed from school and used for cheap labor. Women account for around 75 percent of garment workers worldwide (Stotz & Kane, 2015; (Allwood, Laursen, Rodríguez & Bocken, 2016). The typical work for women in the garment sector are sewing, finishing and packing clothes. Whereas jobs that provide higher wages such as supervisors, technicians and machine operators are often done by men. These factors have contributed to maintain wages at a relatively low rate. Workers such as low skilled women, immigrants and children are most vulnerable to various forms of abuse. In addition, they may not know or be able to claim their rights as employees (Allwood, Laursen, Rodríguez & Bocken, 2016).

Women's participation in the minimum standards of industrial production is justified by defining the work of women that stem from their "nature", such as their small hands and their lesser intelligence which supposedly makes them unable to learn more complex skills (Rosen, 2002). For these reasons women were excluded from skills training and better paying industrial jobs. Many low wage industrial jobs, particularly sewing, required fine and detailed skills but were underestimated and poorly paid because they were done by women.

Many garment workers in developing countries, particularly women and migrant workers work in conditions known as the informal economy (Stotz & Kane, 2015). The International Labour Organization (ILO) has identified informal workers as “not recognized or protected under the legal and regulatory frameworks” (International Labour Conference, 2002, p. 3) and “are characterized by a high degree of vulnerability” (International Labour Conference, 2002, p. 3). The conditions that are supposed to be present in industrial working environments in some areas resemble more of a slave camp and at their extremes, worker abuse

and wages results in further poverty and may threaten the health and longevity of workers (Rosen, 2002).

4.2 Environmental issues

Environmental issues are the major problem that the world is facing today. Fashion and clothing industries are one of the largest contributors to the problem. The fashion and clothing industry are now consuming around twice as many fibers than it did 25 years ago (Source Founding Partners, Fairtrade & GOTS, 2017). Unfortunately, not only does this have a major impact on the environment but it also affects the society and the ecosystem. The production process makes intense use of chemical pesticides during the growing stage of raw materials, hazardous dyes and mechanical finishing processes in the creation of garments creates serious health risks, as well as significant negative impacts on the ecosystem (NICE Fashion, 2009).

Air quality has been a big problem all around the world, especially in the developing areas. Although the fashion and clothing industry is not the only cause of this problem, it has been shown to contribute a high percentage of the damage in certain areas. Air quality has been linked to illness and disease, long term exposure to breathing bad quality of air can cause variety of health problems (Young & Dhanda, 2012). Carbon dioxide (CO₂) emissions in life cycle of a garment are driven by material choice. The extraction of fossil fuel for synthetic fibers contributes significantly to the overall carbon footprint as well as processing, production, transportation and retails (NICE Fashion, 2009).

Water is the lifeblood of all species on earth as it provides drinking water and stimulates the growth of the plants, trees, fruits and flower. Water is a significant concern at the growing phase, during the processing phase of raw materials and the “in use” phase of a garment. Scarcity and purity of water sources are an immediate concern in many areas of the world (Young & Dhanda, 2012). The intense volume of water consumed at the growing stage of some crop-based materials such as cotton has reduced the amount of water available. Meanwhile, due to the increase in population, the demand for water has been increasing in some regions around the world. In addition, intense usage of pesticide during the growing stage of crop-based materials and poor water quality management during the processing stages has left societies vulnerable to serious health problems. The highest water and energy consumption is during the stages of consumer usage due to washing and garment care. Even so, the majority of consumers are unaware of the impact that washing cause (NICE Fashion, 2009).

The production in the fashion and clothing industry has risen. Polyester, cotton, cellulosic are the most popular fabrics used in the fashion industry. Polyester, also known as synthetic fiber are entirely man-made produced from petroleum, which is limited as it is a nonrenewable resource and can't be replaced naturally at the rate we consume it (Claudio, 2007). Synthetic fibers consist of several materials, each with different monomer structure and characteristics, polyester and nylon being the most popular of all. Each year, over 70 billion barrels of oil are used to make polyester. In addition, both polyester and nylon are nonbiodegradable and will remain in the nature indefinitely. The production process of synthetic fabrics is an energy intensive process, it uses harmful chemicals, and generates a significant amount of greenhouse gas, which contributes to air pollution. Although the production of polyester is less energy intensive than production of nylon, it still requires more than double the energy required to produce cotton (Karthik & Rathinamoorthy, 2017). The process releases 14kg of CO₂ per kilogram, which can worsen or cause respiratory diseases. In addition, dyeing of polyester and nylon is not environmental friendly as it is not suitable for natural and low impact chemical dyes. Since 2000, fast fashion has been a beneficial to retailers as well as sellers of fabrics made from polyester or other synthetic fabric. The preference of using polyester over natural fiber keeps the prices low, but instead, the cost that the environment and the society must pay is very high. In 2002, polyester overtook cotton in term of clothing consumption for the first time and has continued to grow strongly and steadily ever since. Around 5 million tons of polyester were produced globally in 1980. By 2014, the production of polyester has reached approximately 46 million tons (Claudio, 2007; Source Founding Partners, Fairtrade & GOTS, 2017).

Cotton is one of the most important natural fibers in the textile industries worldwide, and is the second most used fiber in the fashion and clothing industry. Cotton has been widely traded product all around the world, and is a key source of revenue for the developing countries. Cotton is a \$51.4 billion business in 2013-2014 and is grown in around 35 million hectares worldwide. Around 100 million rural households are involved in the production of cotton in more than 75 countries all around the world. Australia, Brazil, China, India, Pakistan and the USA are the major production countries. Together, these countries account for approximately 80% of all cotton production globally (Fairtrade n.d.-b; Source Founding Partners, Fairtrade & GOTS, 2017; Pesticide Action Network UK, 2017). Although cotton is a natural fiber, it is not without its problem. The production and processing of cotton has visible impacts on the environment and has raised questions regarding ethical issues. The pricing structure for cotton

has been unfair and threatens workers livelihoods (Chapagain, Hoekstra, Savenije & Gautam, 2006; Source Founding Partners, Fairtrade & GOTS, 2017). From field to end product, cotton has to pass through numerous production stages, each stage has its own impacts (Chapagain, Hoekstra, Savenije & Gautam, 2006). The production of cotton involves the use of a large amount of pesticides, fertilizers and toxic chemicals that can have a dramatic effect on the health of the farmers, workers and their communities, as well as polluting the local ecosystem (Das, Sharma & Gupta, 2014; Source Founding Partners, Fairtrade & GOTS, 2017). Overuse of synthetic fertilizers can also cause damage to the fertility and increase acidification of the soil (Pesticide Action Network UK, Solidaridad & WWF, 2017). Between 2007-2012, the market for all pesticides grew by 9.8 percent per annum. According to the International Cotton Advisory Committee (ICAC) published 2012, the latest figure shows that around 5 percent of pesticides sold are intended for use on cotton (Pesticide Action Network UK, 2017). Cotton is grown in less than 3 percent of the world's arable farmland, yet the growing stage of cotton uses approximately 11 percent of the world's pesticides (NICE Fashion, 2009).

Another fiber that is also used widely is cellulosic. This material is a combination of natural and man-made processes as the source material is a mix between natural and man-made. The source material is obtained from wood and then undergoes a man-made process (Source Founding Partners, Fairtrade & GOTS, 2017; Eberle et al., 2008). One popular type of cellulosic is viscose, also known as rayon. Viscose rayon was first produced and sold as artificial silk until 1924 when the name rayon was adopted. The process that the woods must go through uses heavy chemicals that contributes to both water and air pollution (Chen & Burns, 2006). The toxic chemical can harm those working with them if it is not handled correctly. If the disposal of toxic chemicals is not carried out safely or recycled correctly, for example dumped into rivers, then it can have a serious impact in the environment. Another problem is the lack of transparency in most viscose production. The origin of the raw material is often unknown, this makes it impossible to know where the material comes from and the impact of harvesting it (Source Founding Partners, Fairtrade & GOTS, 2017).

In addition, the dyeing process makes intensive use of water and chemicals. Synthetic dyes are widely used in textile dyeing. Printing is another form of dyeing. In dyeing, color is applied in the form of solution, while printing, color is applied in the form of thick paste of the dye (Babu, Parande, Raghu & Kumar, 1995). The color fastness varies, meaning that all dyes do not attach to the fabric. The loss of dyes that end up in wastewaters could vary from 2 to 50 percent, depending on the type of the dye, leading to severe pollution of surface and ground

waters in the area where dye factories are located. Every year, an estimated 208,000 tons of dyes are discharged in the textile production, worldwide (Ali, 2010). In general, about 50 percent of water pollution is generated from dyeing, printing and finishing (Babu, Parande, Raghu & Kumar, 1995). Sewages containing dyes are highly pigmented and are clearly visible. Colors are therefore the first pollutant to be recognized in wastewater and gives a straight forward warning of water being polluted (Ali, 2010). In major textile processing areas where fabric dye factories are located, locals are able to tell which was the latest color was used in the textile industry (Chapagain, Hoekstra, Savenije & Gautam, 2006). Due to the commercial scale of textile production and extensive application, synthetic dyes can result in considerable environmental pollution and are a serious health issues. Disposal of the untreated toxic chemicals from dyes, without any treatment, directly into rivers or ocean can cause serious environmental hazards and human health issues, as it could end up in the human food chain as well as endangering water based life and other animals. (Ali, 2010; Claudio, 2007; De Brito, Carbone & Blanquart, 2008; Saicheua, Knox & Cooper, 2012).

Apart from the impacts from textile production processes, transportation of goods and usage of a tremendous amount of energy also has major impacts on the environment. The impacts from transportation includes greenhouse gas emissions that contribute to climate change and pollutant emissions which affect air quality. In addition, noise pollution causes annoyance and health risk and the infrastructure has serious impacts on both landscape and the ecosystem. The greenhouse gas emissions of the transport sector are strongly related to the energy use of the sector and is dominated by the CO₂ emission from burning fossil fuels. The emission of pollutants that affects the air quality give rise to health care costs, material damages, crop losses and contribute to damage of the ecosystem. Due to globalization, the use of energy from transport had tripled over the last few centuries and is steadily increasing. The growth in the non-OECD countries have been higher than in the OECD countries (Huib van Essen, CE Delft, Delft, the Netherlands, 2017).

4.3 Transparency issues

Transparency issue are the challenge that the industry has been facing, due to the fact that the supply chain of fashion and clothing industry is both long and complex. The majority of fashion companies don't own factories, which makes it difficult to monitor and control the conditions throughout the supply chain. Fashion companies may work with hundreds of suppliers, manufacturers and subcontractors at any given time. Due to a countless number of manufacturers and subcontractors, as the supply chain lengthen, issues such as employee abuse,

and bad working conditions slowly becomes invisible. In addition, many brands don't deal with their suppliers or manufacturer directly, and only a number of bigger brands would send an auditor to double check their suppliers and manufacturers to ensure that they fulfill all the requirements that the brand requires. Nevertheless, another issue arises, bribery, which is very common in some areas. The awareness of transparency issues has been increasing in the recent years for both fashion companies and consumers. However, the main problem is the majority of smaller fashion companies may not take any action to be fully transparent. The cost that follows this strategy is usually very high and for small companies, it can exceed the cost of simply staying in the business. (B. Guðfinnsson, director of LEXUS Enterprises Limited, personal communication, October 25, 2017).

4.4 Waste

The sales of clothing items have risen dramatically in the recent years. Sales of clothing has been seen to rise especially in the emerging economies, as more people have joined the middle class. In addition to that, the price of clothing have been falling relatively, and the number of garments purchased by the typical consumer have been increasing dramatically. Inexpensive clothes are more likely to be discarded rather than be mended, reused or recycled.

Fast fashion has been particularly attractive segment of the industry and a source of significant growth for some clothing companies. Shorter lead time of production allows fast fashion businesses to introduce new products more frequently. This enables shoppers to expand and refresh their wardrobes more frequently. Consumers now keep fashion clothing items for much shorter period of time than they did 15 years ago, discarding the lowest-priced garments after wearing it for just a few times and treating such garments as practically disposable. Since 2000, the number of garments produced each year has doubled, and exceeded 100 billion units for the first time in 2014 (Remy, Speelman & Swartz, 2016). Today, about 150 million tonnes of clothing and footwear are sold in the world every year (I:Collect [I:CO], 2017). The rate of purchase and disposal has dramatically increased. When it comes to disposing of clothing, fast fashion and trends toward shorter life cycles of garments has contributed to overall waste impacts and led to a general neglect of the importance of reclaiming and recycling used materials. The impacts are not solely created by fashion obsolescence and rapid changing trends. In the cost competitive markets, to lower the price of goods, the cost of making the products must be lowered. To be able to lower the cost, poorer quality of materials will be chosen, the result is a lower quality garment that has less potential to be reused. Waste in garment production, retail and post-consumers are increasing by a significant amount each day

(NICE Fashion, 2009). Nevertheless, only a minority of fashion and clothing companies that are searching for ways to address the inefficient usage of raw materials

Textile waste is generated in both stages of business, pre-consumer and post-consumer. Textile waste generated from pre-consumer stages consist of by-product materials from the production of fiber, yarn or fabric. Meanwhile, post-consumer textile waste consists of any type of clothing discarded after being used. The industry has been making great progress in the recycling of pre-consumer waste, recycling the waste into new raw materials for furniture, mattresses, automobiles, paper and other industries. Meantime, post-consumer waste still poses as threat to the environment (Chen & Burns, 2006).

5 Sustainable fashion

The new approach of fashion with conscience is ethical fashion. The principal of this approach is to source garments sustainably, in order to minimize the impacts on the environment, as well as ethically, providing workers with good working conditions and standards, fair payment that supports their livelihood and wellbeing. The existence of ethical fashion is highly influenced by the combination of fashion and sustainability (Das, Sharma & Gupta, 2014). Materials play an important role in the current understanding of the ways in which fashion and textile industries can contribute toward sustainability, as they are the starting point for every product (Fletcher, 2013). One such approach is to use sustainably grown fibers that require less pesticides, irrigation and other input. Sustainability is a concept that is often paired with corporate social responsibility and is a primary issue of the twenty-first century. The principal of sustainability is to meet the human needs without shattering the nature or society. The most frequently used definition of the concept is taken from the Brundtland report, “sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (1987, p. 41). Its purpose is to encourage businesses to take part in business ethics and to take long term damage into consideration when making decisions rather than focusing only on the short-term profit (“Sustainability”, n.d.).

“Eco-efficiency strategies focus on maintaining or increasing the value of economic output while simultaneously decreasing the impact of economic activity upon ecological systems” (Braungart, McDonough & Bollinger, 2017, p. 1337). Eco-efficiency is a one-way, linear flow of materials through the industrial systems. That is, raw materials are obtained from the environment, made into products and disposed at the end. In the system, eco-efficient methods aimed to minimize the volume, speed and toxicity of the material flow system, but are unable to adjust its linear progression. While some materials are recycled, it is very often recycled as an end-of-pipe solution. Due to the fact that these materials were not designed to be recycled at the beginning. Hence, the result of this type of recycling process downgrades material quality instead of actually recycling the materials. Which limits the usability and therefore continues the linear, cradle-to-grave dynamic of the material flow system, is illustrated in figure 5 (Braungart, McDonough & Bollinger, 2017).

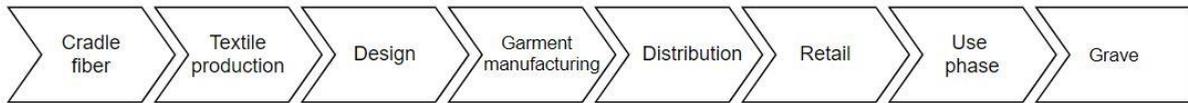


Figure 5: Cradle-to-Grave, Linear Flow of Material.

Eco-effectiveness is a concept that offers a positive alternative to the traditional eco-efficiency approach. Eco-effectiveness is an extension of eco-efficiency, aiming to provide maximum economical value with no negative impact on the economy. The concept proposes the transformation of products and the flow of materials, forming supportive relationship with ecological systems and future economic growth. “The goal is not to minimize the cradle-to-grave flow of materials, but to generate cyclical, cradle-to-cradle “metabolisms” that enable materials to maintain their status as resources and accumulate intelligence over time” (Braungart, McDonough & Bollinger, 2017, p. 1338). Cradle-to-cradle, circular flow of material is illustrated in figure 6.

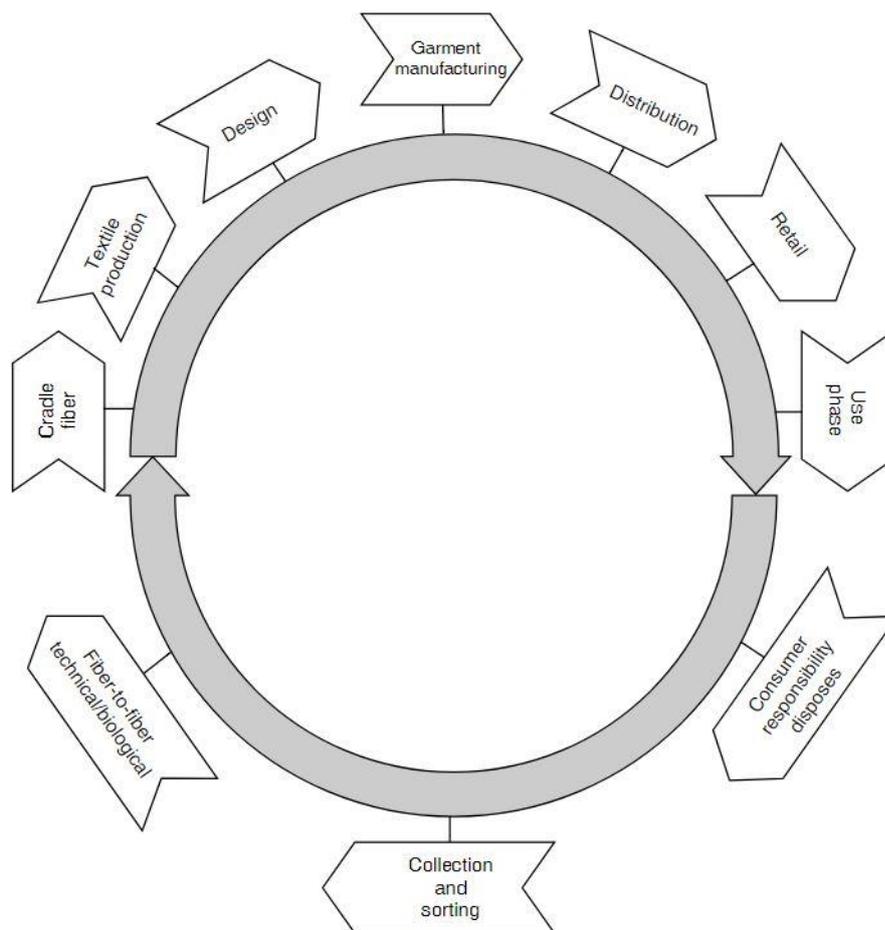


Figure 6: Cradle-to-Cradle, Circular Flow of Material
(Payne, 2015, p. 113)

5.1 Cotton standards and certificates

Cotton is the most common raw material of the fashion and clothing industry. The cultivation of cotton has long been identified as unsustainable, but there has been changes toward more sustainable cotton. “Sustainable agriculture envisages three goals: environmental health, economic profitability and social and economic equality” (Radhakrishnan, 2017, p. 36). Many development programs which promote sustainable cotton cultivation have been recognized to protect the livelihood of farmers and their communities.

5.1.1 Fairtrade

Fairtrade is a global movement which supports farmers, including cotton farmers. It is an alternative approach to trade, based on partnership. Fairtrade can be an effective way for companies who are looking to source their cotton sustainably to have a positive impact on people and the planet. When cotton and other products are marked with “FAIRTRADE”, it means that both producers and traders have met the Fairtrade Standards. The Fairtrade Standards were designed to address the imbalance of power, injustice in trading relationships and unstable markets. It improves terms of trade for farmers and provides them with better deals and a fair price for their cotton. This allows them to earn a more stable income, improve their life and take more control of their lives and communities (Fairtrade International, n.d.-a.). 90 percent of the world’s cotton farmers are in the developing countries, which has where Fairtrade is mainly focused their operations (Fairtrade International, n.d.-b). In 2014, 22 producer organizations that were Fairtrade certified for seed cotton across 7 countries, represented 54,700 small farmers, which was an improvement compared with 2013, when there were 26 producer groups. 60 percent of the Fairtrade cotton farmers are in India, where 85 percent of all Fairtrade cotton is produced. In 2014, Fairtrade producers sold 21 percent more cotton compared to 2013. Even so, the total number of Fairtrade cotton farmers have been reduced by 8 percent in 2014 (Fairtrade International, 2015).

According to the 2015 Fairtrade Monitoring and Impact Report, prices for Fairtrade cotton were 8 to 18 percent above the price of regular cotton. Due to the structure of the cotton sector in West Africa, where cotton processing and marketing is generally controlled by parasitical cotton companies, farmers and their organizations have had limited influence on price negotiation. The majority of producers that produce only Fairtrade cottons have experienced problems selling their Fairtrade certified cotton. Although this kind of structure can be considered as a flaw of the system, the aim of it is to cover the cost of sustainable production and protect farmers against sudden drops on the market price. The premium, which

is paid on top of the regular selling price is to provide additional income to invest in their businesses, families and communities. Aside from the financial benefits, the Fairtrade Standards protects farmer's health and safety. Fairtrade works with farmers to ban and reduce dangerous chemicals and genetically modified cotton seeds as well as support them to adapt to climate change and promote efficient usage of water. Fairtrade cotton fields in India and Western Africa are rain-fed, by doing so the region's water footprint is reduced.

Beyond farmers protection, in 2016, Fairtrade introduced the new Fairtrade Textile Standard and Programme (Fairtrade International, n.d.-b). The goal here is to address the unsafe and unfair labor conditions in production factories. The purpose of the Fairtrade Textile Standard is to set requirements which reach to all workers across the entire textile supply chain, guaranteeing a decent living and strengthening workers position to fight against poverty. "The requirements ensure that employers pay living wages, guarantee the right to join trade unions, and make certain that health, safety and environmental principles are adhered to" (Fairtrade International, 2016, p. 3).

5.1.2 Organic cotton

Organic cotton is the oldest sustainable cotton. Currently, organic cotton is being considered as the highest level of sustainability in the fashion textile market (Radhakrishnan, 2017). It has very strict standards on the use of chemicals, banning the use of synthetic pesticides. Hence, "organic cotton is grown from non-genetically modified seeds without the use of any synthetic agri-chemicals. Beyond replacing synthetic fertilizers and pesticides by organic ones, organic cotton cultivation also takes into account broad agronomic processes" (Pesticide Action Network UK, Solidaridad & WWF, 2017, p. 4). Even though many plant-derived extracts or other chemical preparations are used in the process they have been considered as natural and non- or low-toxic (Pesticide Action Network UK, 2017).

In 2014, 65 percent of all Fairtrade cotton producers also held organic certification, and this continues to be a preferred option for Fairtrade cotton producers. In 2015, Fairtrade cotton producer that held organic certification had increased to 73 percent. The organic premium is 27 to 60 percent above the regular cotton price (Fairtrade International, 2015; Pesticide Action Network UK, 2017). Organic cotton is grown in 19 countries and represent 0.03 percent of the worldwide production. 97 percent of the global supply of organic cotton comes from 5 countries; India with 67 percent, followed by China, Turkey, Kyrgyzstan and the USA (Pesticide Action Network UK, 2017).

The two leading standards for organic cotton grown and other crops are the Global Organic Textile Standard (GOTS) and the Organic Content Standard (OCS) (Truscott, Tan & Emberson, 2016). “GOTS is the worldwide leading textile processing standard for organic fibers, including ecological and social criteria, backed up by independent certification of the entire textile supply chain” (GOTS, 2017). It covers the entire textile supply chain, from harvesting of the raw materials to processing, manufacturing, packaging, labeling, trading and lastly distribution of textiles (GOTS, 2017). With GOTS, companies can expect clear environmental and social benefits from the strict criteria in the standard as all stages can be traceable (Source Founding Partners, Fairtrade & GOTS, 2017). OCS is a standard for tracking and verifying the presence and amount of the organic grown material in a final product. It relies on third-party certification to track the „flow of a raw material from the source to the final product and this process is certified by an accredited third party. It allows for transparent, consistent and comprehensive independent evaluation and verification of organic material content claims on products“ (Textile Exchange, 2013, p. 5).

5.1.3 Better Cotton Initiative (BCI)

The Better Cotton Initiative is the largest cotton sustainability programme in the world. The BCI objectives is to “Make global cotton cultivation better for the people who produce it, better for the environment it grows in and better for the sector’s future” (Pesticide Action Network UK, Solidaridad & WWF, 2017, p. 4). BCI focused on providing farmers the opportunities to train and learn effective ways to adopt more socially, economically and environmentally sustainable practices of production. Farmers with BCI licenses produce cotton in a way that minimizes the effect of pesticides and fertilizers, while caring for soil and water as well as committing to decent work conditions that support workers safety and wellbeing.

Today, about 75 percent of the world’s cotton is grown with genetically modified cotton seeds. BCI allows the use of genetically modified as it will be difficult to achieve the objective of making Better Cotton a mainstream sustainable product if millions of farmers are excluded from their training and support (Better Cotton Initiative [BCI], 2017a). The production of Better Cotton has been increasing rapidly in the recent years. It is now grown in 23 countries, covering around 1.5 million farmers and accounts for 12 percent of worlds production or 2.5 million tons of lint each year (Pesticide Action Network UK, 2017). Many retailers and brands aiming to improve the environment and become more ethical as well as improving their brands images have been sourcing Better Cotton for their products. For instance, IKEA announced in September 2015 that 100 percent of cotton used in IKEA products comes from more sustainable

sources (BCI, 2015). The retail chain C&A has also recognized the environmental impacts of cotton farming, the company is one of the largest sustainable cotton purchasers. In 2016, 53 percent of the cotton sold by the company has met the standard of more sustainable cotton, 33 percent of cotton sold were organic cotton. Their goal is to close the gap by 2020 and use only more sustainable cotton in their products (Remy, Speelman & Swartz, 2016; C&A, 2017).

5.1.4 CottonConnect

CottonConnect is a social business. CottonConnect works on delivering business, environment as well as social benefits to brands, retailers, farmers, suppliers and partners. The main purpose is to create a transparent supply chain. CottonConnect also works on training farmers in the agricultural economy practices, and supporting the improvement of farmers livelihood (CottonConnect, n.d.-a). In 2010, CottonConnect launched a program called, The REEL Cotton Programme. The REEL Cotton Programme is “a three-year agricultural program providing farmers with training on sustainable cotton practices” (CottonConnect, n.d.-b, p. 1). The programme has since trained over 20,000 farmers and has proven to increase both yields and profits, while reducing environmental impacts. The programme “is independently verified by a code of conduct developed with FLOCERT, the organization that provides Fairtrade International certification” (CottonConnect, n.d.-c). The REEL Cotton code verifies that farmers are using sustainable practices and is fully transparent and can be traced from farmer to store (CottonConnect, n.d.-c).

5.1.5 Cotton Made in Africa (CmiA)

Sub-Saharan Africa is the 5th largest cotton exporter in the world and has a key role in fighting poverty. There are about 3.4 million smallholder cotton farmers in Sub-Saharan Africa. So far, African smallholder farmers have not been able improve their economic living conditions, as they are faced with many challenges such as low productivity, poor infrastructure and fluctuation in the world market prices (Cotton Made in Africa [CmiA], n.d.-a). The basis of CmiA standards are focused on the social, environmental and economic aspects of cotton production and processing. The objective of Cotton Made in Africa initiative (CmiA) is to “Improve the living conditions of African smallholders and promote environmentally friendly cotton cultivation” (Pesticide Action Network UK, Solidaridad & WWF, 2017, p. 4). In 2005, CmiA set its goal to improve living conditions sustainably for cotton farmers in Sub-Saharan Africa. This commitment was not based on donation but rather to help people to help themselves through trade (CmiA, n.d.-a). Hence, CmiA cotton is grown specifically by smallholders. CmiA have been making significant contributions to environmental protection through

environmentally friendly methods, borrowed from organic farming. Farmers who grow cotton according to the CmiA standards don't use any artificial irrigation. CmiA are exclusively rainfed and use mostly natural fertilizers and are harvested by hand (CmiA, n.d.-b). In 2016, CmiA is produced in 10 African countries by 780,000 farmers (BCI, 2017b; Pesticide Action Network UK, 2017).

5.2 Fibers

Apart from standards of more sustainable options of cotton. Mia Shu, the education manager at Redress suggests switching to new innovative fibers and recycling options which would minimize the impacts (Personal communication, November 9, 2017). Choosing more sustainable and environmentally friendly fabric that needs less pesticides, synthetic fertilizer and chemicals would indeed minimize the impacts. According to Edda Skúladóttir, a designer, tailor and owner of an Icelandic brand Fluga, who has many years of experience of the fashion industry in Los Angeles. The use of lyocell and bamboo fabrics has been increasing in recent years. She has begun to incorporate these fabrics into her collection and plans to continue to source for more in the future (Personal communication, November 15, 2017).

5.2.1 Cellulosic fibers

Lyocell, modal and rayon are cellulosic fibers being made of cellulose. Rayon is from the first generation of cellulose fibers, also known as artificial silk. Rayon is soft and has highly glossy finish. Rayon is versatile fiber, for example it is breathable, and does not insulate body heat, making it ideal for hot and humid weather. In addition, rayon absorbs more moisture than cotton and is easily dyed (Kumar & Suganya, 2017). The production process of rayon uses a significant amount of chemicals. Rayon is therefore not considered as sustainable choice of fabric.

Modal is from the second generation of cellulose fibers and is known for its softness. Modal fabrics are very soft, crinkle resistant, drapes well, air and moisture absorbent and cool to the touch. It is considered better than cotton fabric as it softer and has more strength than cotton. Due to its characteristics, modal fabrics are very suitable for health suits and activewear. Modal is produced by using only beech wood to make fiber. Rayon on the other hand are made of wood pulp from any tree, making it impossible to trace the content. The most sustainable type of modal is Lenzing Modal®, produced by an Austrian company Lenzing. It is produced using the symbiotic production process. This production method uses less energy as well as other resources. Up to 95 percent of materials are recovered as the result of the innovative processes. Moreover, the beech trees require no artificial irrigation nor planting. The

beechwood forest is therefore completely natural, making it a sustainable source of raw materials. Lenzing also claimed to source more than half of the woods locally, and the rest from its neighboring countries. This reduces the distance of transportation, which minimizes the environmental impacts from transportation. (Lenzing, n.d.-d; Leverette, 2017).

Lyocell is from the third generation of cellulose fibers (Kumar & Suganya, 2017). It is the most recognized regenerated fiber, and is the leader of man-made cellulose fibers. Lyocell is produced from wood pulp cellulose, but the production process has less hazardous impact on the environment (Cai et al., 2007). TENCEL® is a branded lyocell fiber, also produced by an Lenzing, via solvent spinning rather than the traditional viscose methods (Lenzing, n.d.-a; Common Objective [CO], 2017). TENCEL® has been certified by the international Forest Stewardship Council and is 100% biodegradable (The Eco Market, n.d.). Lyocell fiber is produced using the closed loop process, which makes it extremely eco-friendly. Over 99 percent of the solvent used in the production process of lyocell can be recovered and reused, creating significantly less toxic and waste compared to other cellulosic fibers (Erdumlu & Ozipek, 2008; Nayak & Mishra, 2016). Closed loop recycling (CLR) is a method referring to the materials being recycled is the same material being produced. The cradle-to-cradle practice is a related to the fundamental nature of closed loop recycling, “in which a CLR fibre will be recyclable as well as recycled into the same production chain” (Payne, 2015, p. 111). This special process has received the European Award for the Environment from the European Union (Lenzing, n.d.-b). Lyocell fabrics are softer than silk, cooler than linen and have the ability to absorb 50 percent more than cotton. It is anti-bacterial due to its moisture management. The feel of fabric is similar to rayon, smooth and drapes beautifully. TENCEL® lyocell also has qualities such as crinkle and wrinkle resistant, and breathable, making it suitable for sporting garments (Lenzing, n.d.-a; The Eco Market, n.d.). Unlike production of cotton, which uses farming land for its production, TENCEL® raw material is wood, which has its root in sustainable forest plantation practices that is not suitable for farming. This means that the production of TENCEL® fibers is not competing with food production. In addition, water consumption is 10 to 20 times less than water consumption of cotton production, and uses less energy and water compared to other man-made fibers (Lenzing, n.d.-b; “Lyocell”, n.d.).

5.2.2 QMILK

QMILK is natural fiber made from non-food milk, developed by a German-based company Qmilch IP GmbH. QMILK production uses 100 percent renewable raw materials. The process was developed to generate zero waste and no requirement for chemical additives. The fiber is

therefore entirely biodegradable and can be recycled as soil improver (Wrap, n.d.). In Germany alone, 2 million tons of milk are disposed every year, QMILK recycles waste products generated by the dairy industry that are not suitable for human consumption. The fiber has an incredibly soft feel and is ideal for sensitive skin. QMILK fiber is naturally antibacterial, high color brilliance, fire protection and moisture absorbance properties, making it particularly suitable for activewear and lingerie. The process is resource efficient as it requires low water and energy consumption. Only the maximum of 2 liters of water is needed to produce 1 kilogram of fiber and the process takes about 5 minutes. QMILK can be produced at temperature below 100°C, this indicates a more cost-efficient production process as well as guarantying a minimum of CO₂ emissions (QMILK, n.d.).

5.2.3 Bamboo

Bamboo fiber is obtained from the bamboo plant. The bamboo plants are cheap natural resources and are widespread throughout Asia. It can be harvested after 3 to 5 years. The advantage of using bamboo as raw material for textiles are many, including its biodegradability, renewability, organic status and efficient space consumption. The plant itself requires low water usage and its carbon sequestering abilities given a sustainability managed bamboo forest. Unlike cotton and other textile raw materials, the bamboo plants don't need replanting (Erdumlu & Ozipek, 2008; Waite, 2009). The plant also improves the soil quality as well as helps to rebuild eroded soil, because the root system of the plant stays intact after harvesting (Nayak & Mishra, 2016). Bamboo is the fastest growing plant in the world. In just one day, the plant can grow at minimum of 1 meter. This growth occurs naturally, requiring only rain water, eliminating the need for irrigation or fertilizers and chemical pesticides. Bamboo can produce 50 times more fiber per acre than cotton. The bamboo plants also have the ability to replace 30 percent of its biomass in a year, which is significant compared to 3 to 5 percent biomass replacement by forest trees (Waite, 2009). The advantages of bamboo fiber are its natural antibacterial characteristic, high capacity of air and moisture adsorption, quick dry capabilities, softness, ensuring breathability of fabric, brightness as well as UV protective characteristic. Bamboo is believed to not cause any skin allergies as the production process of bamboo doesn't require any chemical additives to obtain antibacterial characteristics (Erdumlu & Ozipek, 2008). Bamboo also has the ability to stay cool in warm weather and warm in cool weather. (Waite, 2009).

Despite the fact that the growing stage of bamboo plants is sustainable and eco-friendly, there are still some drawbacks with bamboo textiles. The processing stages of turning the plant

into fiber can be hazardous. This is where the debate of whether bamboo textiles are truly as green as they should be.

There are two main methods of processing bamboo namely, mechanical and chemical. Mechanical methods are the old ways of producing bamboo fiber, it results in natural, also known as original bamboo fibers with a texture that resembles linen. The Mechanical processing method is eco-friendly, this processing method is similar to flax and hemp production. However, due to its costly, time consuming and labor intensive production method, plus insufficient demand for the products, this method is less used (Nayak & Mishra, 2016). The chemical methods produce softer bamboo textiles. There are two chemical processing methods, bamboo viscose rayon method and bamboo lyocell method. Bamboo viscose rayon method, as the name indicates is a method that produces bamboo fibers the same way viscose rayon is produced. The bamboo viscose rayon method make use of hydrolysis alkalization with multiple stages of bleaching to break down the plant, making it the unsustainable way of producing bamboo fabric. Additionally, it is harmful to workers and local communities, if not disposed or recycled correctly. Meanwhile bamboo lyocell method produces bamboo fiber in the same way as lyocell are produced (Textile Learner, n.d.; Nayak & Mishra, 2016). Bamboo fibers produced using the lyocell method are more sustainable and environmentally friendly than viscose bamboo methods, but then again it gives a more expensive product (Nayak & Mishra, 2016).

The majority of bamboo fibers for textile are produced using the viscose rayon production method due to the price difference between the fabrics. Even so, garments made from bamboo are very often labeled as “green”, “biodegradable”, etc. regardless of its manufacturing methods (Nayak & Mishra, 2016). China is the biggest bamboo growing country. Farmers had begun to clear natural forestland to grow bamboo to answer to the increasing demand for bamboo fabrics of the industry. In addition, evidence has been found farmers using unnecessary chemical fertilizers to increase their profits. The intensive farming practice such as making use of chemical fertilizer and pesticides, intensive management of bamboo species and clearing other plants will have negative impacts on biodiversity of bamboo. This practice will eventually lead to reduction in resilience to external threats and reducing the capacity to erosion control and nutrient cycle. The results will lower the productivity of bamboo forests (Carter, 2008; Nayak & Mishra, 2016).

As of today, there are still no regulations, standards or certificate on how to produce sustainable and environmentally friendly bamboo textiles. However, the U.S Federal Trade

Commission (FTC) had expressed concerns regarding bamboo labelling, and formed regulations exclusively for consumer protection from unfair business practices in 2009, forcing companies to distinguish between rayon made from bamboo and natural bamboo (Nayak & Mishra, 2016).

5.2.4 Recycle and reuse

Sustainable and environmental friendly practices are not solely about choosing or developing sustainable methods to constantly obtain and make use of new resources. Some natural resources are limited and are not renewable. Renewability is an important aspect of sustainable development. Recycling or reuse of garments is therefore necessarily to ensure that the least amount of raw materials goes to waste and ends up in landfills. In recent years, many innovative companies have developed new kinds of fabric using recycled materials that can satisfy the requirement of consumers as well as protecting the environment from further impacts.

I:CO is an innovator for collection of post-consumers garments and provides collection bins, sorts the items, removes anything wearable that can be reused and sold, and recycles the rest. This process ensures the maximum reutilization of materials. Today, I:CO collects clothing and footwear in more than 60 countries all around the world. The I:CO take-back system contributes towards reducing textile waste by reuse and recycle clothing and footwear. Thus, creating opportunities for valuable raw materials to be reprocessed, help protect the environment and maintain natural resources, thus forming the basis for a circular economy in the clothing industry (I:CO, 2017). Garments that cannot be worn can be recycled. Lenzing company had developed new lyocell branded fiber Refibra™, also known as the new TENCEL™ fiber. Refibra™ is the first generation of cellulose fibers featuring recycled material on a commercial scale. It offers a solution for circular economy in the textile economy. Refibra™ fibers are made from wood and leftover cotton scraps that result from the cutting operations. This has reduced the need to obtain additional raw materials from nature and lowers the pressure on natural resources (Lenzing, n.d.-c).

Polyester has been the most widely used textile in the industry. It is a well known fact that synthetic material is not biodegraded. However, recycled polyester is being produced by recycling post-consumer waste product, soda bottles made of polyethylene terephthalate also known as PET. By recycling the plastic bottles, it creates a new purpose for the materials and prevents them from going to landfill, where due to their nature they would remain forever as they are not biodegradable. Hence, plastic bottles have become a potential source of raw materials with the ability to reduce environmental pollution. The most common textile produced

from recycled polyester is fleece and knitted pile fabric, which are often used for outdoor clothing. The production process of recycling polyester fiber uses 33 to 53 percent less energy compared to the production of conventional virgin polyester fibers. (Patnaik, Mvubu, Muniyasamy, Botha & Anandjiwala, 2015; Karthik & Rathinamoorthy, 2017). Additionally, production of recycled polyester reduced the significant amount of pollution or 54 percent less compared to pollution generated by the production of virgin polyester fiber made from new raw materials (Chen & Burns, 2006; Karthik & Rathinamoorthy, 2017). REPREVE is a brand of recycled fiber produced by Unifi, Inc. REPREVE is made from recycled materials, including used plastic bottles. To make a pair of Khaki pants, it will only take 7 bottles, 5 bottles to make a t-shirt, 50 bottles makes a fleece jacket, 42 bottles can make seats in a Ford Fusion. In addition, by using bottles, a total affect of 630 million bottles recycles is a saving of 3.8 million gallons of gasoline, 1 year worth of drinking water for a population of 52,313 people and the preservation of 2,934 acres of pine forest. Through REPREVE unique U Trust™ Verification system, REPREVE are able to ensure that recycled fibers are made with transparency, it is traceable and certifiably sustainable (Repreve, n.d.-a).

The major limiting factor of recycled polyester is the quality of recycled polyester may not be as good as polyester made from new raw materials, and once the fibers are woven into fabrics, most fabrics are considered non-recyclable. This is due to different types of chemicals and finishes such as dyes and bleaches, and the fabric may be blended with different synthetics (O Ecotextiles, 2009). The base color of recycled polyester ranges from white to creamy yellow, making it difficult to achieve consistency in shades, which can lead to multiple dyeing processes in some cases (Karthik & Rathinamoorthy, 2017).

Like polyester, nylon is made from non-sustainable resources and is not biodegradable. Nylon is also more difficult to recycle than polyester as it does not break down easily. In addition, recycling nylon is not cost-effective, compared to the price for new polymers which are often very cheap, making it an unattractive business choice for the industry (Karthik & Rathinamoorthy, 2017). According to The United Nations Environment Programme (UNEP) and The Food & Agriculture Organization (FAO) an estimate of more than 640,000 tons of fishing gear, including fishing nets are abandoned and dumped in the oceans every year (Aquafil Group, n.d.; Healthy Seas, n.d.; Karthik & Rathinamoorthy, 2017). A Korean based company, Hyosung has developed a method for recycling nylon into a textile fiber named Regen (Karthik & Rathinamoorthy, 2017). Another 100 percent regenerated nylon, ECONYL® was successfully produced in 2011. ECONYL® is made from recycled nylon waste such as

fishing net that would otherwise end up in landfills or polluting the oceans. The fishing nets are recovered, broken down and combined with other types of both pre- and post-consumer waste that later turned into ECONYL® regenerated nylon yarn. This process prevents further damage to the entire ecosystem, it cleans the seas as well as saving natural resources (Aquafil Group, n.d.). Today, ECONYL® is widely used in activewear. Although the method cannot be said to be completely environmentally sustainable, the quality of regenerated nylon is the same compared with virgin nylon. Unlike recycled polyester PET, recycled nylon can be broken down infinite number of times and reprocessed into new yarn without any loss of material quality (Healthy Seas, n.d.; Bush, 2015).

5.3 Textile dyeing

Color is one of the main attractions of any garment, if consumers do not consider the color is attracting enough, then it will become a failure as a saleable product. In the past, fabrics were dyed with natural dyes. Natural dyes are derived from natural materials such as plants, root, bark, invertebrates and minerals. Natural dyes are renewable and eco-friendly, if the resources are not being exposed to any kind of toxic. However, fabric dyes from natural resources give a dull and limited range of colors, as well as low color fastness when exposed to sunlight and washing (Kant, 2012). In addition, the production of natural resources requires farming land, which is primarily required for food production, hence using natural dyes in the mainstream textile processing industry is a big challenge. For these reason, synthetic dyes replaced natural dyes when the industrial production of textiles became preeminent. Synthetic dyes are easily available in ready-to-apply form, consistency of shades, better color fastness and a simpler application process (Saxena & Raja, 2014). However, synthetic dyes are widely known as unsustainable and bring harm to the ecosystem. Excessive use of synthetic dyes results in enormous amount of wastewater and the majority of synthetic dyes are toxic and hard to break down due to their complex chemical structures.

5.3.1 Waterless dyeing methods

Air dyeing technology is one way to add colors to textile without using any water. The dyeing process uses air instead of water to dye garments. This allows companies to create textiles with rich designs and colors, without any harm to the water and environment. Air dyeing technology uses 95 percent less water, emits 84 percent less greenhouse gases and require 87 percent less energy compared to synthetic dyeing (Kant, 2012). However, this technology works exclusively on synthetic materials. The process doesn't require boilers, screen printing machines, drying

ovens, or cleaning and sourcing chemicals, which eliminates major sources of pollution. Hence, air dyeing technology generates little to no wastewater (Kumar & Suganya, 2017).

The Hong Kong Research Institution of Textile and Apparel have developed another waterless dyeing technique. Solvent-assisted dyeing is colorfast, and uses 90 percent less water compared to the conventional methods, making it an environmental friendly choice. The solvent can be recycled and is reusable and is therefore very cost effective. It can be applied to cotton and most other natural fibers, in all stages (fiber, yarn, fabric or garment) (The Hong Kong Research Institute of Textile and Apparel [HKRITA], n.d.).

Screen-free printing such as digital textile printing is another option that can help reduce pollution. Digital textile printing is a highly creative form of textile printing. It provides greater design flexibility compared to the traditional screen printing. Today, designers prefer textile digital printing for small prints due to its environmental friendly features, cost effectiveness and other advantages such as faster turnaround time and very quick design change, just-in-time customization and the ability to print on demand, which reduces time to market. The digital textile printing process prints directly onto the fabric, and therefore requires less physical, direct involvement. The downsides of this method are that the fabric still needs to be washed to remove excess dye. In spite of this, it reduces energy use by 75 percent, can save up to 95 percent of water and eliminates by-production of waste dyes completely. Hence, it decreases industrial waste and print loss, leading to less impacts on the environment and minimizes textile waste (Kumar & Suganya, 2017; O Ecotextiles, 2012).

6 Results

The term “environmental friendly responsible” refers to all processes throughout the supply chain, including raw materials, fibers, fabrics, manufacturer, consumer usage and care, and lastly the ultimate disposal that have minimal negative impacts on the environment and society (Chen & Burns, 2006).

The fast fashion trend has changed the fashion and clothing industry dramatically in the past few decades. The lifecycle of each garment has shortened. More seasons have been added to satisfy the demand of consumers and at the same time companies are grabbing the opportunity to maximize their profits. The additional seasons has created tremendous pressure on suppliers to reduce lead time, which results in delivering smaller batches of garments. While everyone within the supply chain are trying to grab their shares of profits, the wellbeing of workers and the local communities in the manufacturing area have been ignored. This creates problems such as low wages payment, unacceptable working conditions, safety standards, and human rights violations etc. In addition, the over-production of clothing, excessive usage of toxic chemicals in the textile production processes and the culture that constantly encourages people to renew their wardrobe every few weeks has pushed the industry to become one of the largest contributors to the major environmental crisis in today’s world.

Recently, the rise of the middle class in China has moved production away from the country. Workers now demand for higher wage payments, and it has become harder for manufacturers in China to hire workers at such wages as were once considered normal. The bottom end of the supply chain requires the greatest workforce. Women account for 75 percent of the textile and manufacturing sector worldwide, particularly in sewing and finishing processes. In some extreme cases, children are being used for a cheap and easy to command workforce. Although working conditions vary from place to place, and the industry is slowly beginning to reduce the gender imbalance, it still poses as an issue within the supply chain. In addition, the demand for cleaner environmental surroundings in China have also been increasing. In recent years, Chinese tourists have been flowing into Europe, seeing the blue sky and breathe in the cleaner and fresher air than they are used to. This may be a contributing reason for the populations realization that the conditions that make people have come to realized that the conditions they’ve been living in are not considered normal nor is it healthy. (B. Guðfinnsson, director of LEXUS Enterprises Limited, personal communication, October 25,

2017). The attitudes of Chinese consumers have also been shifting toward clothes that do not taint their waters (China Water Risk, 2016).

6.1 Textiles

The fashion and clothing industry is consuming twice as much fiber as it did 25 years ago. Polyester is the most popular fabric in the market, followed by cotton and viscose rayon. Polyester is one type of man-made fabric (synthetic), made from petroleum. Cotton is a natural resource, made from cotton plant. Viscose rayon is the most popular type of cellulosic, which is made from wood but then undergoes a man-made process. Polyester, cotton and viscose rayon are not being considered as sustainable and eco-friendly fabrics. The environmental impacts of using such fabrics are enormous. Today, air quality, water quality and quantity, pollution, soil condition, and climate change are at an alarming level.

Awareness of the impacts caused by the industry has been increasing in the recent years as well as the danger it might bring in the very near future. Today, the majority of products are made following the Cradle-to-Grave system, or a linear model. This means that once a product has been used for the purpose it was designed for, in the end, the product will get disposed of and the resources are lost forever. The current practice of industry has created pressure on natural resources that cannot be recovered. Meanwhile mankind will continue to grow and demand for such resources will only increase. The cradle-to-Cradle system, or a circular model presents an alternative design and production concept. Within the Cradle-to-Cradle system, products are designed so that the resources can be captured and reused to create products again. Currently, this model is used in the minority of businesses. But as both the increase of environmental issues and resource scarcity increases, it is slowly being adopted by the more innovative companies around the world (Mia Shu, education manager at Redress, Personal communication, November 9, 2017).

6.1.1 Sustainable materials

According to the education manager at Redress, Mia Shu, the attention on sustainability standards such as the Fairtrade cotton, Organic cotton, Better Cotton Initiative and Cotton made in Africa and has dramatically increased (Personal communication, November 9, 2017). What these standards have in common are restrictions on using highly hazardous pesticides as well as supporting farmers and ensuring fair business relationships.

Today, sustainable cotton accounts for 12 to 15 percent of the total global production, but only a fifth (21 percent) of this is actively sourced by companies as sustainable, the

remaining 79 percent is traded as conventional cotton (Pesticide Action Network UK, Solidaridad & WWF, 2017; BCI, 2017b). Growing more sustainable cotton would bring many benefits for both farmers and the environment. Nevertheless, without demand from buyers, sustainable cotton will remain a minority product in the market and the social and environmental problems of the cotton sector will continue. Even though the demand for more sustainable cotton has been increasing throughout the years, the uptake is still lagging.

Soil management is important for maintaining and improving the fertility of the soil. According to Shanthi Radhakrishnan, plants that grow in a sustainable environment are usually rich in nutrients due to healthy soil, which is a result of organic growing methods and sustainable practices (2017). However, organic cotton is not necessarily the best alternative for conventional cotton as it will lead to another environmental problem instead. The production of cotton requires cultivated land, and cultivated lands are also required for food production. Organic cotton is grown in the most natural way as possible which takes much longer of time to grow compared to the conventional cotton, and the yield can be much lower. If it were to take over from conventional cotton in the market, it will require a much larger space for growing in order for organic cotton to be able to answer to the demand of the market. The environmental problem will decrease considerably, but the soil quality will be slowly sucked up as the cotton plant requires a lot of nutrients (B. Guðfinnsson, director of LEXUS Enterprises Limited, personal communication, October 25, 2017).

Over the past 20 years, the use of cellulosic fibers has been growing in the fashion and clothing industry, particularly viscose rayon. Due to its unsustainable production process, Mia Shu had suggested using Modal®, TENCEL® and QMILK as substitute, replacing the conventional viscose rayon (Personal communication, November 9, 2017).

The production of TENCEL®, Lenzing Modal® and QMILK fiber are very sustainable and eco-friendly. There are still a few drawbacks to these fibers, like most other textiles, the process of turning fiber into fabric, as well as dyeing and printing processes may not be as sustainable and environmental friendly. This is dependent upon the producers as some may use toxic chemicals in these additional processes (The Eco Market, n.d.). As mentioned earlier, modal is a type of rayon fabric. While Lenzing Modal® fiber is indeed the sustainable choice for the industry, the origin of other modal fibers on the market are very often less transparent. Another important factor is the price of these fabrics. The cost of switching out conventional viscose rayon for TENCEL®, Lenzing Modal® and QMILK are very high. TENCEL®,

Lenzing Modal® and QMILK are much more expensive fibers than the conventional viscose rayon. Today, they are considered as luxury products.

Through personal hands on experience with fabrics, the author suggests using bamboo lyocell as substitute for both viscose rayon and cotton. Bamboo lyocell is currently more expensive than conventional viscose rayon, bamboo rayon and cotton. Nonetheless, the fabric is more affordable than TENCEL®, Lenzing Modal® and QMILK. Currently most bamboo textiles are being produced using the viscose rayon production methods, which is not considered environmentally friendly. But, ecologically innovator textile companies such as Littrax and Lenzing have developed natural bamboo fibers, offering a greener alternative, which is also market certifiable for manufacturers who are looking to produce sustainable bamboo based apparel. This new development is designed to keep the cost of bamboo textile down and to improve the properties of the fibers (Nayak & Mishra, 2016). In addition, bamboo can provide a new source of income for millions of people worldwide.

6.1.2 Textile production

All countries have their own technique of producing fabrics, but the Chinese fabric production and dyeing methods are still more favored, as the technique offers more variety of texture and feel. Hence, many materials are still being processed in China (B. Guðfinnsson, director of LEXUS.Enterprises Limited, personal communication, October 25, 2017). Due to the intensive use of water, chemicals and energy in the production process of textiles and following increased awareness of the impact from textile production, the Chinese government has released various policies and regulations that significantly impact the textile sector (Mia Shu, education manager at Redress, Personal communication, November 9, 2017). With polluted and limited water resources, as well as other resources including land, China is aiming to become “economy & environment” instead of “economy over environment” like it used to be (China Water Risk, 2016).

The biggest blow to the textile industry is the Water Pollution Prevention and Control Action Plan, released in 2015. The plan acts as an umbrella plan that ties in other central policies. It includes new industrial standards that businesses and factories must follow, or be shut down within 3 years from the time of release (China Water Risk, 2016). Coal is the biggest source of energy in China, as such the coal industry has enormous impacts on the environment and is one of the largest contributor to global warming (B. Guðfinnsson, director of LEXUS.Enterprises Limited, personal communication, October 25, 2017). Yet, the textile industry of China discharge double the amount of wastewater compared to the coal industry. In

addition, a large amount and types of hazardous chemicals used for textile processes such as dyeing, and finishing are very often not treated and discharged directly into waterways. (China Water Risk, 2016). According to Bárður Guðfinnsson, regulations and standards aiming to increase responsibility from dyeing factories has already led to shut down of numerous dyeing factories China. In addition, The European Union has banned fabrics that contain dangerous toxins (Personal communication, October 25, 2017). Although the Chinese government has recognized the importance of cleaner environment and water resources, the rest of the developing countries are still focusing on improving their economies.

Closed-loop production systems seek sustainability. Many negative impacts such as pollution, waste and energy consumption can be avoided by establishing closed-loop production systems. For instance, lyocell and bamboo lyocell are made using this innovative production method. In addition, textile waste and fibers from both pre- and post-consumer can be recycled using the closed loop, cradle-to-cradle system and re-enter the garment production chain (Payne, 2015). Another solution is waterless dyeing such as air dyeing, solvent-assisted dyeing and digital textile printing technology. Waterless dyeing techniques reduces significant amount of water and energy required in the production process. In addition, solvent from solvent-assisted dyeing technique can be recycled and is reusable.

6.2 End of lifecycle

Consumption of clothes has been increasing steadily each year, consumers are keeping clothes about half as long as they did 15 years ago. It is estimated that 60 percent of all clothing ends up in landfills within a year of it being made. The need to stop clothing from going to landfill and wasting the limited resources has become a necessity. Opportunities for the industry to be more sustainable and environmentally friendly is to reuse older garments that are still in good condition, and those that cannot be reused can be recycled. I:CO provide collection bins and collects used clothes from all around the world. I:CO then sorts the items for reused or recycled. The benefit of reusing garments is that it can help those in need, either by reselling garments for affordable prices or by donation. Companies like Patagonia have developed standards and practices for choosing materials that can be easily reused or recycle. Aside from selling brand new clothes, the company collects used garments both instore and through the mail, Patagonia also offers repair services to customers who wish to extend the life of their garments (Remy, Speelman & Swartz, 2016). In addition, many online thrift stores have been popping up recently, selling second hand clothes that are still in good conditions and reusable.

Previously, recycling technologies have not been able to turn unwanted garments into fibers that could be reused to make new products. The reason for this is due to the presence of different components such as different fibers, dyes and accessories (Chen & Burns, 2006). As a result, approximately 60 percent of all clothing produced ends up in landfills within a year of being made or burned to produce energy (Remy, Speelman & Swartz, 2016). Recycled garments are usually downgraded in quality and cannot be recycled the second time. However, a new solution may have been founded. A Japanese technological innovation company, Teijin Group has developed a method of recycling polyester garments multiple times without loss of quality by taking old polyester garments and recycling them into new polyester raw materials. The company had successfully removed additives from polyester products through a process called chemical recycling. This process is carried out by Teijin's ECO CIRCLE™ closed-loop recycling system for polyester products. More than 160 companies worldwide are working together to collect used polyester clothing. Textiles are collected, broken down and processed to create new polyester fibers (Teijin Frontier CO., LTD., n.d.; Bettin, 2014). The technology obviously brings many benefits to the environment. Chemical recycling polyester reduces both CO₂ emissions and energy by approximately 80 percent. According to Ricky Miyatake, the general manager of environmental programs of Teijin Frontier, the disadvantage is the transportation. Polyester clothes are collected from all over the world, but the only manufacturing factories are in Asia. Garments must therefore be shipped back, and forth which generates enormous amount of CO₂ emissions (Bettin, 2014).

6.3 Transportation

The fashion and clothing industry is an international business. The production of a single garment often involves several countries. Transportation is therefore a big part of the whole production processes and retail. Raw materials and garments are constantly being shipped back and forth. For instance, raw materials must be transferred to textile plants to produce fabrics, from there fabrics are transported to factories in various locations all around the world for further processes. As for the fashion companies, fabric examples and prototypes are being shipped back and forth until they have been accepted and approved. Fabrics that have been chosen will be shipped from various locations to numerous manufacturing factories all around the world. Finished products are then distributed to numerous retailers all around the globe, where retailers then sell at their store or via online shopping etcetera. All of this requires transportation (B. Guðfinnsson, director of LEXUS Enterprises Limited, personal communication, October 25, 2017). In addition, fast fashion clothing is often shipped as retail-

ready, this means that the capacity of each container is less comparing to flat-packs that allows for full usage of containers. The packaging around clothes when shipped ready for retailer are often made from nonbiodegradable plastics, which eventually end up in landfills.

The fact that the fashion and clothing industry is an international industry, means that transportation of goods cannot be eliminated. Minimizing transportation is still possible. According to Edda Skúladóttir, although a knitting company does exist here in Iceland, some Icelandic fashion brands have been moving the production of knitted fabrics abroad (Personal communication, November 15, 2017). By sourcing locally, and flat packing to fully use the capacity of containers can reduce the need for long distance transportation and space.

6.4 Transparency

Lack of transparency has been an issue for decades. According to Thao Thi Nguyen, production manager of TNHH RICHWAY, through personal communication on the 27th of October 2017, the production company TNHH RICHWAY consist of over 400 staff members. On top of that, there are numerous of small subcontractors all over Vietnam. In recent years, there have been a rise of a few giant production companies in the Hai Duong province where Thao Thi Nguyen is located. In developing countries, transparency is not at the forefront of everyone's mind and the working and environmental conditions have become a norm. Even as a production manager, she does not have any access to information such as content of the fabric that is being used, neither does she have the correct name of the fabric being used. The information has been lost somewhere on its way through the supply chain.

When the global supply chain is not transparent, consumers and workers often lack important information about how and where the textiles and clothes are made. Leading to lack a of awareness about the effect it has on the environment and people. The author believes increasing transparency is the first step of transforming the industry. Increasing awareness among consumers and workers, in both developed and developing countries and across the supply chain is very important. It is impossible to make sure that human rights are being protected, and environmental practices are green without knowing who, where, how and under what condition the garments are being made.

7 Conclusion

Consumers, governments and companies involved with the fashion and clothing businesses are slowly realizing the irreversible effects of collective behavior on the environment and society. It is and has been easier and more cost effective for businesses to source low cost materials and labor in the emerging countries. Nonetheless, the textile sector is certainly speeding up its efforts to make the supply chain more sustainable. There has been a lot of development concerning sustainable practices. Innovative companies have increasingly been developing solutions that once were considered impossible. To minimize the negative impact that the fashion and clothing industry has in the environment and the society, it will require a higher investment today as more sustainable production and textiles are slightly more costly, as well as investment in equipment to improve the working conditions. But in the long run, switching to a more sustainable and environmentally friendly, as well as ethically produced clothing will result in a much better future for many more generations to come. Table 1, 2, and 3 summarizes the results of this research.

Standards and regulation can help to transform the industry to have greater accountability for their actions, but the key for increasing sustainability in the fashion and clothing industry depends on consumers. Consumer's awareness of the consequences of their current consumption behavior, and an increased demand for clothes produced in more sustainable, environmental friendly and ethically will create pressure on the industry to act differently. Although awareness has been increasing amongst the consumers, it has not reached sufficient levels to affect the producers. Transparency is a major issue, the lack of knowledge about where resources come from, how products are being made, who made it, under what conditions it was made and lastly, what happens to the product after being discarded is terrifying. An increase in transparency and collaboration across the supply chain is necessary in order to prevent important information from being lost. Thus, making sure that everyone involved are aware of dangers which will lurk in the near future if the current practice continues to be unabated.

Tafla 1: Environmental aspects

| Environmental issues | Uses | Impact | Solution |
|-----------------------------|---|--|---|
| Synthetic fabrics | Nonrenewable resources Significant amount of energy Significant amount of chemicals | Air pollution Water pollution Health risks Damage the eco-system Nonbiodegradable | Recycled polyester Regen ECONYL® |
| Cotton | Significant amount of pesticides Significant amount of fertilizers Significant amount of chemicals Significant amount of water | Water pollution Health risks Damage the eco-system | Bamboo lyocell Fairtrade cotton Organic cotton Better cotton REEL cotton Cotton made in Africa |
| Viscose rayon | Significant amount of chemicals Significant amount of water | Air pollution Water pollution Health risks Damage the eco-system | Bamboo lyocell Lenzing Modal® Lyocell Innovative fibers |
| Production processes | Significant amount of chemicals Significant amount of water Cradle-to-Grave | Water pollution Health risks Damage the eco-system | Closed-loop production system Waterless dyeing technologies Cradle-to-Cradle |
| Transportation and energy | Significant amount of fossil fuels Coal | Climate change Air pollution Noise pollution Damage the landscape Crop loss Health risks Damage the eco-system | Source locally Flat pack |

Tafla 2: Waste aspects

| Waste | Impact | Solution |
|-------------------|------------------------------|-------------------------------|
| Natural resources | Landfill | Reuse |
| Pre-consumer | Pollute the ocean and rivers | Recycle |
| Post-consumer | Climate change | Closed-loop production system |
| | Air pollution | Cradle-to-Cradle |
| | Impacts on landscape | Waterless dyeing technologies |
| | Damage the eco-system | Innovative recycling methods |

Tafla 3: Ethical aspects

| Ethical issues | Improve |
|---------------------------|---------------------------|
| Unfair wage structure | Union |
| Poor working conditions | Regulations and standards |
| Poor worker management | Increase gender equality |
| Lack of safety equipments | |
| Lack of gender equality | |
| Work hours | |
| Age of workers | |

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