

SUSTAINABLE FIBRE FOR SUSTAINABLE FASHION SUPPLY CHAINS: WHERE THE JOURNEY TO SUSTAINABILITY BEGINS

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Abstract:

Adopting a sustainable business model is an essential element of gaining competitive advantage. Specifically, the management of fashion and textile supply chains characterized by geographical extension requires paying particular attention to environmental and social sustainability. Following an analysis of the literature on sustainable supply chains in the fashion and textile industries, this qualitatively based research examines – from a supply chain perspective – the sustainability initiatives implemented by a yarn and garment producer through a single case study. Subsequently, the classification of potential sustainability initiatives is presented. From this investigation, several good practices for sustainable fashion supply chains can be identified, providing a reference point for similar companies.

Keywords:

sustainable fashion supply chain, sustainable textiles, closed loop supply chain

1. INTRODUCTION

In 2010, cKinetics's report entitled March to Sustainability [1] postulated that the coming years would be focused on sustainability and the optimal use of natural resources to generate value in the textile supply chain. It seems that we have now reached that point. The fashion and textile industry is particularly sensitive to this issue due to the multiplicity of stakeholders involved in product creation. Furthermore, the global expansion of these sectors, and the consequent offshoring of several brands (to cite a few: Zara, H&M, Benetton etc.), have exposed the management of supply chains to many risks. The disruption of global supply chains might depend on their lack of sustainability compliance. The textile industry, whose main production area is in Asia, is one of the largest global industries after the oil industry; it is also one of the most polluting [2]. According to the European Commission, the impacts of textiles depend on the fibre from which the apparel is made and can be classified into energy use; greenhouse gas (GHG) emissions; eco toxicity from washing (water heating and detergents) and dyeing of textiles; resource depletion and GHG emissions from processing fossil fuels into synthetic fibres, e.g., polyester or nylon; water use; toxicity from fertiliser, pesticide and herbicide use; energy use and GHG emissions associated with fertiliser generation and irrigation systems related to production of fibre crops, e.g., cotton; and water use, toxicity, hazardous waste and effluent associated with the production stage, including pre-treatment chemicals, dyes and finishes. Realization of sustainable supply chains requires consideration of the social and economic aspects of sustainability as well. From a social perspective, workers in this sector are unskilled and underpaid. On the other hand, 70% of export earnings in developing countries derive from this sector (Allwood [3]). For many, achieving sustainability in the textile and fashion industry is full

of contradictions. Particularly, the production of such a large amount of waste could constitute a significant impediment. However, as [4] mention, the market for sustainable fashion is growing ten times faster globally than the market for unsustainable fashion.

In addition, the survival of most existing supply chains will depend on the evolution of their current business models into new business models that carefully consider both environmental and social impacts. All actors contribute to shrinking the environmental footprint of textile products [5]. Because the textile and clothing supply chain is long and starts with fibre formation [6], the sustainability journey starts here as well, due to the considerable negative externalities that can be generated during this phase.

The pressing need to improve the way of doing business derives, to some extent, from legislative forces. [7] state that no industry improves sustainability in its supply chain without any external motivation. However, the voluntary actions undertaken by supply chain members can contribute to the achievement of a truly sustainable supply chain [8].

The research question is: how can textile industry members voluntarily contribute to the achievement of sustainable supply chains?

This paper is structured as follows: the next section presents the results of a literature review; next, the applied methodology is described; the fourth and fifth sections present findings and conclusive remarks, respectively.

2. SUSTAINABLE SUPPLY CHAIN MANAGEMENT IN THE TEXTILE INDUSTRY

In recent years, there has been growing attention to the sustainability of supply chains. Sustainability in fashion and textiles fosters ecological integrity, social equity and human flourishing through products, actions, relationships and practices [9].

This trend is the result of the dispersion of different phases of product creation around the globe. In this current economic scenario, the sustainability of a single business is not sufficient for the realization of the goals expressed in the Brundtland Report [10], as the economy is characterized by supply chain competition [11–18]. Table 1 presents some definitions of sustainable supply chain management applied to the fashion and textile industry.

Observing the current scenario, it seems that the fashion and textile industry is hardly achieving the goals of sustainable development. [28] propose a classification of practices for environmental sustainability in the textile industry, using six categories: product design, product materials, process, technology and processing materials, waste management, Strategic Environmental Assessment (SEA) and supply chain.

Sustainability in the fashion industry is relevant both to up-stream and down-stream supply chains. The first refers to practices of cleaner production, dye manufacturing and coloration processes [29–31]. The latter refers to use, reuse, recycling and disposal [32]. In particular, the sustainable fashion supply chain embraces the phases of eco-material preparation, sustainable manufacturing, green distribution, green retailing, and ethical consumption [33].

As a result of the abovementioned practices, a sustainable fashion product is made in an environmentally and socially friendly manner along the supply chain, which includes raw material production, manufacturing, distribution, and retailing. In this vision, focusing on supply chain management can assure the competitiveness of the company and allow the pursuit of environmental sustainability [34].

Table 1 – Sustainable fashion and textile supply chain definitions

SSCM – general overview	SSCM in textile and fashion supply chains
The sustainable management of a supply chain requires a broader vision and must highlight the economic, environmental and social aspects of business practice [19, p.264]	Management of sustainability along all fashion supply chains thus involves: resource production and extraction, fibre and yarn manufacturing, textile manufacturing, apparel assembly, packaging, transportation and distribution, consumer use, recycling and ultimate disposal [20].
The creation of coordinated supply chains through the voluntary integration of economic, environmental, and social considerations with key inter-organizational business systems designed to efficiently and effectively manage the material, information, and capital flows associated with the procurement, production, and distribution of products or services in order to meet stakeholder requirements and improve the profitability, competitiveness, and resilience of the organization over the short- and long-term. [21].	Social sustainability in the textile sector addresses: Work hours, fatigue [22] wages [23], skills development and training [24]; human rights [23], flexibility and security [23, 25], and health and working conditions [23, 26].
The management of supply chain operations, resources, information, and funds in order to maximize the supply chain profitability while at the same time minimizing the environmental impacts and maximizing the social well-being [27].	

One type of sustainable supply chain is the closed loop supply [35]. Undoubtedly, companies understand that striving for sustainability can enable the achievement of competitive advantage, but this requires them to rethink their business models, products, technologies, and processes [36, 37]. In particular, as [38] claim, the closed loop business model falls into the category of sustainable business models because closed loop management can ensure the sustainability of supply chains from the perspective of the triple bottom line (people, planet and profit[39]).

Following [28] frameworks, fibres regenerated from waste constitute the element on which environmental sustainability can be based [40, 41]. In particular, regenerating fibres from waste permits companies to close the loop and is an essential element of supply chain sustainability, as closing the loop for many supply chains is becoming mandatory [42, p. 86].

Moreover, in the context of the rising prices of raw materials, finding new procurement sources has already become a requirement for long-term business sustainability [42]

The structure of the textile and fashion supply chain presented in Figure 1 shows that the sustainability of this industry is based on the involvement and collaboration of different actors [34].

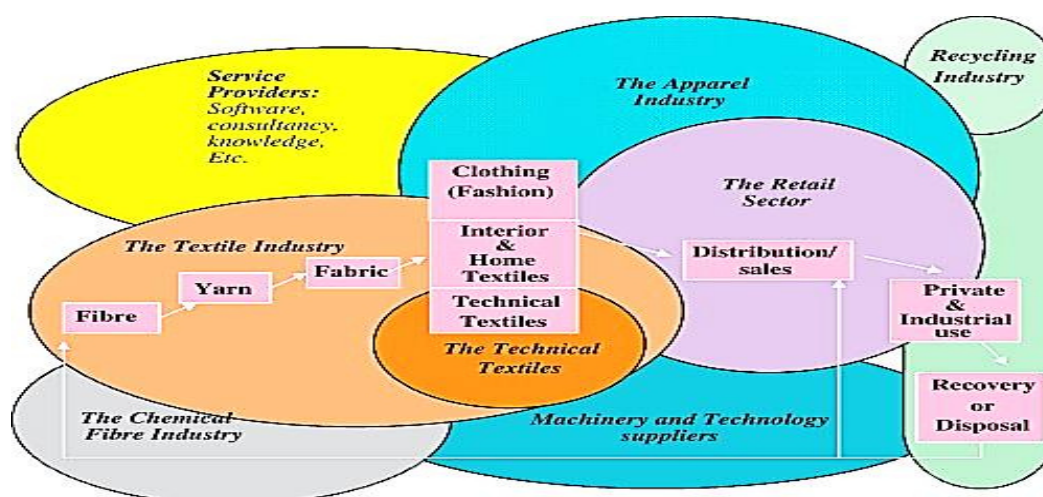


Figure 1 – The textile and fashion supply chain (adapted from EURATEX, 2004)

As global fibre production (mainly of cotton and polyester) has set a new global record of 86 million tons in 2013, reaching nearly 12 kg per capita [43] it is becoming essential to reuse and recycle.

3. METHODOLOGY

The main purpose of this paper is to understand the environmentally and socially responsible initiatives adopted by members of the textile industry. The research process was divided into two phases: a review of academic literature and reports published online and a case analysis. The case analysed here was selected from the Global Reporting Initiative database, which is considered by many researchers to be a valuable source of information as it is a global standard [44, 45, 46].

Selection was guided by the following criteria:

- The textile and apparel industry was selected as it was the object of the current study;
- Territory of Europe with a focus on Italy.

Because this study focuses on the sustainability of the supply chain, the abovementioned criteria were initially integrated with the selection of the latest report available on the GRI's website using the recently published GRI standard. After applying this criterion, only one company was identified.

Because of the voluntary nature of adherence to the GRI, the analysis of this company is of particular interest, as it may represent exceptional excellence within Italy.

However, analysing only one report seemed to the author to limit the scope of this paper. Therefore, this study presents the evolution of the environmentally and socially responsible initiatives conducted by the identified company, based on an analysis of all reports presented in the GRI database.

The company's website, and interviews obtained from internet sources, also constituted valid sources of data [The following interviews were analysed: <https://www.youtube.com/watch?v=fR57-CSRJfM>, CEO of Aquafil Giulio Bonazzi presentation at TED entitled "*The bright side of waste*"; <https://www.youtube.com/watch?v=ZtK4k3oy5tA> entitled "*Mezzo secolo di Aquafil*"]

https://www.youtube.com/watch?v=ZkqqkzRG_zo entitled “*Giulio Bonazzi parla della sostenibilità in Aquafil*”].

4. FINDINGS

4.1. Company profile

Aquafil Spa is privately owned; it was founded in 1969 and is headquartered in Italy (Arco, Trento). It is a leading global manufacturer of polyamide 6 fibre and polymer. It is present on three continents (Europe, Asia, America) and eight countries (Italy, Slovenia, Croatia, Germany, United Kingdom, USA (Georgia), Thailand and China). In 16 plants, the Group employs more than 2700 people. It produces two products that are used in two sectors' business units:

- Bulk continuous filament (BCF) yarn for carpets and textile flooring, and filaments used for textile flooring;
- Nylon textile filament (NTF) yarn for garments and clothing used in the apparel and sportswear industries;
- A third business unit dedicated to sustainability-related issues such as recycling, promoting the use of energy with a low environmental impact and/or from renewable sources, and the promulgation of sustainability and environmental culture [47].

All regenerated yarns by Aquafil are grouped under the ECONYL® brand. These yarns offer the same quality and performance as normal Nylon 6 but with incredible environmental benefits because they come from regenerated waste and are 100% endlessly regenerable.

Aquafil produces filaments (NTF) for clothing in the sectors of underwear, sportswear and beachwear, and polymers (EP) for sports equipment capable of ensuring the highest standard of care for the most extreme activities and climatic conditions [48].

There are six steps to closing the loop in Aquafil's production model: Recovery of waste, preparation of material, depolymerization, polymerization, transformation, and re-commercialization [49]. Due to space limitations the description of the phases of the production process realized at Aquafil is omitted. However, all detailed information about it can be found on the company's website and in its Sustainability Reports.

4.2. Sustainable initiatives undertaken by Aquafil

Table 2 represents the sustainability-oriented initiatives included in this report from 2007 to 2014 from a triple perspective, analysing both environmental and social efforts. The first set of efforts includes four elements: energy, emissions, wastes and water, whereas the second set addresses issues of corporate social responsibility. Environmental sustainability refers to *research into optimizing production processes while simultaneously meeting the commitments we have made to the customer and to protecting the environment* [50].

Table 2 – sustainability-oriented initiatives included in this report from 2007 to 2014

Year	2007	2008	2009	2010	2011	2012	2013	2014	
Report's name	Sustainable report								
Sustainability is/is not	Sustainability is the crux of the dialogue between the Group and its customers, suppliers, employees and the local communities	Sustainability is not a result to be achieved; rather it is a way of thinking, a way of being, and a principle that must constantly guide us.					To be sustainable means to create values for stakeholders by using resources efficiently and respecting people and the environment without endangering the needs of future generation.		
GRI	GRI 3.0	GRI 3.0	GRI 3.0	GRI-Referenced	GRI - G3.1	GRI - G3.1	GRI - G3.1	GRI – G4	
Environmental initiatives	<p>a) 3,104,133 euro invested in reducing environmental impact, 44% for increasing energy efficiency, 23% for safety, 18% controlling emissions, 10% for the treatment of dangerous substances, 5% for managing water resources, 0.4% for reducing noise.</p> <p>b) Closing the loop: our scrap is converted into top quality yarn: Econyl 70 is made of 70% postindustrial scrap (30% virgin polymer).</p>	<p>a) Reduced use of natural resources, areas and spaces dedicated to landfills, reduced CO2 emissions by product unit by 50%.</p> <p>b) Replacing neon with low consumption systems</p> <p>c) Installing on-off light switches</p> <p>d) Increasing the efficiency of the internal energy production system</p> <p>d) registered The Eco Pledge brand</p>	<p>a) ECONYL® has attracted attention from the clothing industry; it contains a high percentage of recycled material.</p> <p>b) consolidated environmental balanced sheet;</p> <p>c) Development of closed loop cycle products that save natural resources and contribute to the regeneration of the environment.</p> <p>d) Energy efficiency improvement plan,</p> <p>e) Substitution of textile yarn reprocessing machinery motors with low energy consumption equivalents.</p> <p>f) Substitution of existing refrigeration machines with new low-consumption types.</p> <p>f) Heating of offices, canteen and changing rooms at Arco(It) with heat recovered from hot water.</p> <p>g) Elimination of 50 t/year of separated wastes through</p>	<p>a) Econyl plant uses secondary raw materials from post-industrial waste and post-consumer waste.</p> <p>b) Consolidating employee awareness towards recycling and waste separation.</p>	<p>a) Implementation of the Econyl® Regeneration System that permits removing waste from the environment.</p>	<p>a) The Healthy Seas, a Journey from Waste to Wear'' project;</p> <p>b) EcoMeTex European Project (2012-2015)</p>	<p>a) Partnership with the Ellen MacArthur Foundation for Circular Economy 100,</p> <p>b) Adoption of Code of Conduct and an Organizational, Management and Control Model;</p>	<p>a) Renewal of the partnership with the Ellen MacArthur Foundation for circular Economy;</p> <p>b) Development of web tool for gathering information concerning the environment and for calculating performance indicators</p> <p>c) The purchase and installation of new equipment for pollution prevention;</p> <p>d) plan to extend ECONYL® with the aim of</p>	

			the use of aluminium tubes.					encouraging all the suppliers who are part of the ECONYL® supply chain to take steps toward improving their environmental indicators, thus helping to reduce the impact caused by the whole system.
Social initiatives	<ul style="list-style-type: none"> a) Multifaceted system of work shifts b) Professional development c) Safety and health in the workplace d) Promotion of recreational and sport activities e) Help with a smile project f) Scholarships for employees' distinguished children 	a) Promotes the integration of the physically and mentally disabled and the socially disadvantaged into the community	<ul style="list-style-type: none"> a) Increased number of employees (despite negative macroeconomic situation), b) Schools and the industry work together initiative c) Cooperates with the ENAIP (Ente Acli Istruzione Professionale) e) <i>We cook for you Event</i> 	<ul style="list-style-type: none"> a) Project at Jiaxing, China; b) Festival of Economics 2011, Trento (It), c) IFSC, Climbing World Championship 2011, Arco; d) Rollerski World Cup 2011, Oroszlavje 		a) Zero Infortuni initiative	<ul style="list-style-type: none"> a) The Nylla app was launched at the GreenTec Awards in May 2014 with the aim of raising children's awareness of the importance of recycling 	

4.3. Closing the loop

The company analysed here closes the loop through reintroduction of wastes (fishing networks, carpet fluff) into the cycle and production of new and infinitely reusable material to bring responsible products to life forever [49]. Sustainability issues in textiles require taking into account the influences emerging from outside the boundaries of the conventional textile industry, as well as going beyond companies and individual industries [51]. From this perspective, the organization's performance is [reported] in the wider context of sustainability [52]. Extracting raw materials from waste prevents the deposition of fishing nets into landfills, which could significantly damage the marine ecosystem [49]. Furthermore, the availability of recycled materials is an opportunity for clothing manufacturers to capitalize on the growing sensibility of consumers towards environmental issues [53] [Recently, Aquafil has collaborated with Levi Strauss & Co. for the creation of a denim collection that will be totally made from Econyl. As the

CEO of Aquafil stated “We envision a world where everyday items don’t have to come at the expense of the environment. This new partnership is further proof that sustainable materials can be used to reinvigorate products that have been traditionally made. Levi’s is redefining the denim industry.” <http://www.mycoolbin.com/2016/04/09/levis-teams-with-aquafil-for-sustainable-jeans-line/> Producing 10,000 tons of ECONYL® saves 162,000 GJ of energy, eliminates 11,000 tons of waste, and saves 70,000 barrels of oil [48]. Econyl® products are waste positive, meaning that *the amount of waste removed from the environment and used for the production of the same is greater than the amount of waste resulting from the production process* [48].

5. CONCLUDING REMARKS

Sustainability, seen as *the new challenge of the future, [which] will enable every company to grow and develop* [50] also plays an important role in managing the fashion and textile supply chain both upstream and downstream. For this reason, every negative and positive action affecting both environmental and human health should be evaluated from a supply chain perspective because *The sustainability of an individual organization may, or may not, be compatible with the sustainability of society as a whole, which is attained by addressing social, economic and environmental aspects in an integrated manner* [54]. However, assuring environmental protection within supply chains requires collaboration between suppliers and customers and also creates an opportunity to develop new commercial and business relationships. Furthermore, these relationships are essential for the journey towards sustainability, the creation of a circular economy, and the success of sustainable supply chains [53].

This study aimed to provide a preliminary analysis of one company’s interpretation of sustainability in the textile and clothing industry. Numerous opportunities for future research arise from this study. We need a deeper understanding of the motivations that guide companies operating in this sector to manage their supply chains sustainably; an analysis of an entire company’s supply chain to know how (and if) its members are currently adapting to the postulates of sustainable development; and a better understanding of how cross-sector collaboration can foster the creation of sustainable textile and clothing supply chains.

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