Textile Science and Clothing Technology

Subramanian Senthilkannan Muthu
Editor

Roadmap to Sustainable Textiles and Clothing

Regulatory Aspects and Sustainability Standards of Textiles and the Clothing Supply Chain

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Preface

Sustainability is no longer a new concept in any industrial sector, including the clothing industry. Each face and facet of sustainability—namely the economic, environmental, and social aspects—are becoming familiar to and widely practiced by different industrial sectors. Every industry has its own agenda in addressing the different segments of sustainability. Products from various industrial sectors are unique in terms of their life cycle impacts at the raw material, manufacturing, and distribution phases, and very importantly at the use and disposal phases. Hence, every industry should have its metrics to measure and address sustainability. This is true for the textiles industry as well, which is why this roadmap series details the important aspects of sustainability as it relates to the textiles and clothing sector.

This is the third volume of roadmap series on sustainable textiles and clothing. As emphasized in Volumes 1 and 2, the environmental impacts created by the lengthy textile and clothing supply chain are huge. Every industrial sector has its own regulatory and compliance aspects, along with its specific sustainability measurement methods and standards. Similarly, there are well-defined regulatory aspects, sustainability measurements and standards, environmental labels, and laws earmarked for the textiles and clothing sectors. This volume covers the aspects pertaining to the textiles and clothing sector.

Corporate social responsibility (CSR) is one of the important aspects of today's industry, and every factory/industry should be implementing this measure. CSR has become a part of doing business, and it is needed by everyone involved, including stakeholders, customers, and buyers. However, CSR practices align with different industrial sectors along the practices specific to each industry. In light of this discussion, "Perspectives, Drivers and a Roadmap for Corporate Social Responsibility in the Textile and Clothing Industry" is devoted to discussions on the drivers that shape CSR, approaches of CSR in the global context, and a roadmap to implement CSR practices.

One of the important developments in the field of sustainability in the textiles and apparel sector is the formation of a sustainable apparel coalition, where all the brands and major players in the market join hands together to achieve sustainability in this sector. One of the important indices being used by apparel industry is the

Higg Index, which was developed by the Sustainable Apparel Coalition (SAC). This volume has two dedicated chapters to discuss this topic. "Sustainable Apparel Coalition and Higg Index" outlines the detailed developments and the history of the SAC, the development of Higg Index, and other details pertaining to environmental impact and assessment tools for products.

"Making the Connection Between UNGC Code of Conduct for the Textile and Fashion Sector and the Sustainable Apparel Coalition Higg Index (2.0)" discusses in-depth aspects of the Higg Index of the SAC by establishing the connection between the United Nations Global Compact (UNGC) Code of Conduct for the Textile and Fashion Sector and the SAC Higg Index (2.0 version). In addition, it presents very important details of analyses pertaining to the differences between both initiatives. Because there is a dearth of detailed information on the SAC Higg index, this volume has two chapters to disseminate the information pertaining to one of the important sustainability initiatives of apparel sector.

"Environmental Adaptation by Small and Medium Sized Textile and Garment Companies in Vietnam—Is Governance an Issue?" deals with another important issue—environmental adaptation. Having considered Institutional theory as a crux and tool, this chapter highlights the influence of current institutional mechanisms on the adaptive capacity of textiles and garment small- and medium-sized enterprises in Vietnam in response to national and international environmental requirements.

"Sustainable Measures Taken by Brands, Retailers and Manufacturers" highlights the measures and attempts taken by various apparel brands, retailers, and manufacturers involved in the clothing supply chain as an appreciation of the measures taken to achieve sustainability in the clothing sector. This chapter presents detailed discussions related to sustainability measures considered by various brands, such as Adidas, Burberry, Patagonia, Levi's, and Nike; retailers, such as Walmart and Target; and manufacturers, such as Novozymes. This chapter deals with sustainability aspects such as measuring and mitigating the various environmental impacts, development of tools and standards, and the practice of energy-efficient measures.

The frequently used term of "eco-labels" plays a major role in sustainability efforts. There are various eco-labels produced and used every day for textiles and clothing products. Two chapters are earmarked for this important topic. "Development of Eco-labels for Sustainable Textiles" introduces the reader to the basics of textiles and ecology, the use of restricted substances and the importance of measuring them, the availability of different organic products and their significance for the clothing sector, and the basics of eco-labeling, including characteristics and benefits. "Ecolabels and Organic Certification for Textile Products" follows with a discussion of the important eco-labels and organic certifications being used in the apparel industry. This chapter presents detailed information pertaining to various sustainability standards and certification schemes applicable to the textiles and clothing sector.

I wish to take this opportunity to thank all the contributors to this third volume of the *Roadmap to Sustainable Textiles and Clothing* for their timely efforts to bring forth this book, which is enriched by the technical content in their chapters. I have

no doubt that the readers will benefit from their contributions, which highlight the important details associated with the regulatory aspects and sustainability standards of the textiles and clothing sectors. Along with the previous two volumes in the roadmap series, this book will certainly become as an important reference for the researchers, students, industrialists, and sustainability professionals working in this field.

Contents

Perspectives, Drivers, and a Roadmap for Corporate Social Responsibility in the Textile and Clothing Industry

Mônica Cavalcanti Sá de Abreu

Abstract This chapter presents an overview of concepts, drivers, outcomes, and practices related to corporate social responsibility (CSR). It provides a roadmap that can guide managers in introducing CSR to their companies. In recent years, the textile and clothing industry has become more globally competitive, yet enormous gaps remain in the quest to promote and attain economic and social development that is more equitable and more environmentally grounded. Social, economic, political, and legal factors affect countries differently and result in different institutional dynamics and organizational behaviors. This has led to different CSR approaches among countries. Getting textile and clothing firms even better engaged in CSR requires ongoing efforts in conjunction with governments and society. CSR progress will be limited until the overall regulatory system is updated to provide stronger institutions and improved governance mechanisms. However, CSR establishes a new way of doing business that combines success and the creation of value through a respectful and proactive attitude towards stakeholders.

Keywords Corporate social responsibility · Corporate governance · Environmental management · Stakeholders

1 Introduction

The key question that must guide corporate social responsibility (CSR) is the contribution that a business should make to society. Steiner and Steiner (2009) answered this question by defining CSR as the duty of a firm to create wealth in ways that avoid harm to or enhance societal assets and the environment. The fundamental idea

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is that firms have responsibilities that go beyond lawful execution of their economic functions. The overall performance of a firm must benefit society.

According to Carroll (1979), CSR encompasses economic, legal, ethical, and discretionary expectations that society has about the organizations. The economic responsibility of a company is based on the production of goods or services and profit-making. Without this, a firm cannot exist. Legal responsibility recognizes that a company is part of a broader society that has established laws governing its operations. Ethical responsibility reflects cultural norms and expectations about what is the "right thing to do." Finally, discretionary responsibility relates to voluntary actions benefiting the public without expectations of returns to the firms. Lee (2008) pointed out that society expects organizations not only to earn profits but also to invest and benefit the environment, employees, consumers, and the community in general.

Husted and Salazar (2006) proposed three different CSR approaches practiced by companies. One of these is altruistic CSR, which is characterized by philanthropic actions. Companies take actions without expectations of competitive advantages. However, companies may benefit indirectly through enhancing employee commitment and overall image. In a coercive CSR approach, companies fulfill the minimum legal requirements, which benefits the company by eliminating risks of financial penalties, prosecution, or consumer boycotts. The strategic CSR approach involves social investment, which enhances competitive advantages to the firm and may be expected by shareholders. This approach is aimed at targeting returns to the company based on product differentiation and improved performance.

Minimizing environmental and social impacts cannot be achieved through political means alone but requires learning processes in companies and other organizations (Schaltegger et al. 2013). Textile and clothing industries cause several environmental and social impacts that can be addressed by CSR policies. Pedersen and Andersen (2013) explained that the desire for fast fashion has created demand for 80 billion new garments per year, which represent a consumption hysteria that far exceeds human needs and planetary boundaries. Downward price pressure means that consumers are getting increasingly accustomed to cheap fashion and, by the same process, pressure companies to reduce cost. Another barrier is the need for constant change in the fashion industry—a tendency that promotes overproduction, overconsumption, and waste. Colors, shapes, and materials keep changing at a fast rate, which goes against the idea of longevity of clothes.

On the other hand, Karaalp and Yilmaz (2012) reinforced that textile and clothing industries play an important role in the economic progress of developing countries, which have a lack of capital but have an abundance of cheap labour. Lack of knowledge makes it difficult for companies to break with the status quo and develop new business models that have sustainability as a core value. It is argued that the textile industry is especially short on technical knowledge. An increasing number of companies are experimenting with new products and processes to cope with the social and environmental challenges. For instance, companies are increasingly exploring alternatives to conventional cotton as well as new technology to lower the environmental impact of textile manufacturing.

The purpose of this chapter is to provide a general view of the key aspects of the research on CSR in the textile and clothing industry. It is organized as follows: First, I will explain some important drivers that shape CSR. Then, I will present CSR approaches in textile and clothing firms, taking China and Brazil as examples. Finally, I will propose a roadmap to increase CSR practices and present conclusions to this chapter.

2 Drivers that Shape Corporate Social Responsibility

As already described, CSR can manifest through different strategies and respond to different objectives. There are drivers that play important roles in shaping the way in which companies address CSR. Drivers are characteristics and issues related to the company and its stakeholders, which shape the organizational strategy and the CSR responses. CSR is likely to be more important for some companies than for others, depending on the nature of these drivers.

Stakeholder pressures, regulatory demands, cost factors, and competitive requirements drive corporations to adopt CSR strategies. Gonzalez-Benito and Gonzalez-Benito (2006) stated that drivers also include company features (e.g. size, position on the value chain, internationalization), external factors related to the industrial sector (e.g. position on the value chain, environmental risk, concentration, cohesion), and managerial perceptions and motivations. In addition, the country in which companies operate determine the particular institutional dynamics influencing the CSR response (Delmas and Toffel 2004).

In the case of the textile industry, there are particular drivers that exert significant influence on CSR. They include stakeholder pressure, size of the company, position in the value chain, and institution dynamics. These issues are discussed in more detail in the following sections.

2.1 The Role of Stakeholder Pressure on Corporate Social Responsibility

CSR is characterized by identifying, anticipating, and managing stakeholder expectations (Clarkson 1995). Stakeholders can be defined as groups or individuals that can affect or is affected by the accomplishment of the organizational purpose (Freeman 1984; Fassin 2009). Defining stakeholders is complex because of the broad range of individuals and organizations that are actively or passively involved in the company and its business. Clarkson (1995) defined stakeholders as people or groups that hold or require participation, rights, or interests in the corporation and in its activities. Such claims for rights or interest derive from transactions or actions taken by the organizations and can be legal or moral, individual or collective.

Carroll and Näsi (1997) suggested that a stakeholder can be defined by their position relative to a boundary between the company and its external environment. Internal stakeholders are part of the organizational structure and include owners, managers, and employees. External stakeholders are all actors who are not part of the organization but interact with it, including competitors, government, consumers, community, media, and the natural environment.

Buysse and Verbeke (2003) presented four categories of stakeholders: internal primary (employees, shareholders, and financial institutions), external primary (domestic and international consumers and suppliers), secondary (national and foreign competitors, international institutions, nongovernmental organizations [NGOs], and the media), and regulatory (governments and regulatory agencies). Stakeholders provide resources, generate demands, and assess their actions, creating a context of crucial interrelationships.

CSR actions depend on the type and degree of stakeholder salience, which means the degree to which managers give priority to requests from stakeholders, based on the attributes of power, legitimacy, and urgency (Mitchell et al. 1997). Coercive power is exercised by regulatory agencies using fines and license suspension to force businesses to conform to their standards. The exercise of utilitarian power is exemplified by the banks, which may make funding decisions based on risk criteria. Finally, normative power is exercised by the media and NGOs, which play a critical role in informing society and influencing government policies and company strategies.

According to Mitchell et al. (1997), legitimacy figures heavily in helping companies to identify stakeholders that merit managerial attention. However, emphasizing legitimacy and ignoring power leave major gaps in a stakeholder identification scheme because some legitimate stakeholder have no influence. A final attribute that profoundly influences managerial perception and attention is urgency. Urgency means the degree of attention paid to the stakeholder claims by managers. Stakeholder—manager relationships need to be evaluated in terms of the absence or presence of all or some of these attributes.

Husted and Allen (2011) differentiated stakeholders as market or nonmarket stakeholders. Based on this clear division, market stakeholders provide the company with resources and can threaten to remove these resources or impose conditions on the continued supply of resources. On the other hand, non-market stakeholders, who do not participate directly in the companies' supply chain, can only indirectly influence the flow of resources and supply chain management by the firm. As nonmarket stakeholders gain familiarity with company environmental impacts, they manage to achieve a level of awareness and effective action (Abreu et al. 2013).

Ferraz and Mota (2002) tested a model in which the stakeholder pressures are divided along two lines: formal and informal. Formal pressures flow from regulation and surveillance entities through warnings, fines, and loss of environmental licensing. Informal pressure is exerted by others stakeholders (in particular community-based groups), through market actions or complaints, which may lead to reduced consumption of a company's product or services.

The theory of resource dependence can explain stakeholders' influence on organizational strategies (Frooman 1999). It describes how firms deal with the external resource environment. In fact, there are two components of this environment. One is the social dimension of corporate activity, which has been described as nonmarket activities. The other is the economic dimension, which has been termed market activities (Baron 1995).

Besides their interest related to the flow of resources, firms also need to considered stakeholders in terms of their social identities, and their different interests, ideologies, values, and expectations (Crane and Ruebottom 2011). In this way, companies address stakeholder's demands through their CSR strategies (Maignan and Ferrel 2003). CSR covers all aspects of a firm's activities, including those related to ethics and/or societal benefit (Husted and Allen 2011).

CSR activities undertaken by a firm vis-a-vis stakeholders can be motivated by profits and/or ethics orientation. It is essential to define actions to create both social and economic value. Carroll (1999) argued that CSR should be seen as a process, not as a set of results. Jamali and Mirshak (2007) pointed out that the concept of CSR has been progressively rationalized, becoming associated with the broader goals of the organization related to its reputation and attainment of stakeholder demands.

2.2 *Influence of Position in the Value Chain and Firm Size on CSR Practices*

González-Benito and González-Benito (2006) defined *position in the value chain* as the proximity to the final consumer within the supply chain. They also pointed out that extractors of raw materials and manufacturers of intermediate products can often camouflage their environmental and social impacts behind the final producers' trademarks. Distributors, consumers, and other external stakeholders identify more readily with the final product (González-Benito and González-Benito 2010).

According to Crandall (2006), consumers are increasingly aware of the need for environmental and ethical business practices. Demands of consumers have now become the most important external pressure affecting the environmental and social performance of companies (Daub and Ergenzinger 2005). Castelo Branco and Rodrigues (2008) pointed out that, the nearer a company is to the final consumer, the more probable that it will be known by the general public.

Arora and Cason (1996) found that customer contact, measured by the level of advertising expenditures, is a significant predictor of participation in pollution preventions programs. In a sense, clothing firms seem to have adopted more comprehensive CSR practices than textile manufactures. However, Abreu et al. (2012) found that textile manufacturing firms in Brazil and China tend to have more complete CSR practices in place than clothing firms. This seems to be because in these countries, manufacturers face greater pressure from regulatory agencies while consumers are not active stakeholders. In the same study, firms of larger size (as

measured by the number of employees) were found to have more complete CSR practices than smaller ones.

Henriques and Sardoky (1996) confirmed that size can influence a firm's visibility and hence general expectations of corporate social performance. Aragón-Correa et al. (2008) also concluded that environmental risks and stakeholder pressures increase in relation to size. The larger the firm, the more susceptible it may be to public scrutiny. Castelo Branco and Rodrigues (2008) argued that larger companies disclose more information related to CSR than smaller ones. Large companies need to consider social responsibility activities and disclosure as a way of enhancing corporate reputation.

González-Benito and González-Benito (2010) added that large firms are more inclined to adopt CSR practices, mainly related to environmental issues. Engaging in voluntary environmental programs and social behavior has a positive relationship with size. Firm size is an indicator of the resources available to the firm (Arora and Cason 1995; Christmann and Taylor 2001). From a CSR perspective, firm size can be viewed as a double-edged sword: It increases social and environmental demands from stakeholders, but it is also indicative of the availability of resources to respond to those demands.

2.3 *Country Influence and Institutional Dynamics on CSR Practices*

Abreu et al. (2012) found that firms having the same size and position in the value chain can have different approaches in terms of CSR, depending on the country in which they operate. A variety of institutional conditions of the country influence corporate decisions to act in socially responsible ways. Such behavior is more likely to occur to the extent that firms are monitored by strong regulatory agencies, the existence of collective industrial self-regulation, and the institutional capacity of NGOs, media, and the general public. These actors can be engaged in dialogue and create pressure on firms (Campbell 2007).

Institutional dynamics and organizations are interrelated. Organizations neither react directly to all pressures dictated by the organizational field, nor do they act completely autonomously without the influence of external pressure (Hoffman 2001). Baughn et al. (2007) pointed out that economic, political and social factors influence the regulatory context, normative expectations, attitudes, and shared know-how underpinning CSR. These factors have an important impact on the diffusion of organizational practices. At the same time, they can limit the available set of alternative CSR approaches (Delmas 2002).

Matten and Moon (2008) indicated that regulative, normative, and cognitive forces lead to increasingly standardized and rationalized practices in organizations, running across industries and national boundaries. In this way, the institutional framework provides a theoretical perspective that is helpful in understanding

organizational strategy and what types of pressure mechanisms are employed to deal with sustainability concerns.

Regulative forces tend to feature the roles of government agencies, as well as formal laws and policies and their enforcement, emphasizing how rule-based systems aim to coerce actors into certain behavior. Normative forces introduce prescriptive, evaluative, and obligatory dimensions into business-society relationship. They define goals and objectives but also designate ways (rules) to pursue them. The third category of forces, cultural-cognitive, emphasizes the role of cultural beliefs in enabling actions that tend to remain unquestioned by society (Scott 2008).

Delmas (2002) demonstrated how coercive, normative, and cognitive forces of the institutional environment within a specific country affect the cost and potential benefits of ISO 14001 adoption, and how this would lead to different adoption rates in Europe and in the United States. In her framework, the lack of specific legal mechanisms in the United States and cooperation between industry and regulatory agencies most likely account for the slow pace of adoption of ISO 14001. Multinationals may also initiate the diffusion of ISO 14001 through mimetic mechanisms.

CSR reflects how the firm is influenced by the institutional environment and government policies that build on the business–society relationship (Siltaoja and Onkila 2013). Matten and Moon (2008) have argued that CSR practices are influenced by the historical evolution of the institutional framework in which business, government, legal, and social actors operate. National differences in CSR can be explained by political, financial, educational, labor, and cultural systems. These are the key components that have shaped the historical development of the national business system. In this way, strong institutions are necessary to encourage corporations to be responsive to the social concerns beyond their own economic interests (Campbell 2007).

3 Approaches to Corporate Social Responsibility in a Global Context

The globalization of the business environment in recent years has made it imperative for firms to look for foreign market opportunities in order to gain and sustain competitive advantages. Globalization can be defined as the process of intensification of cross-area and cross-border social relations. Companies from different locations increase transnational interdependence of economic and social activities. The increase of globalization gave rise to what has been called the "Washington Consensus": a set of policies that countries around the world had to adopt if they were to receive assistance from the major international financial institutions (Blowfield and Murray 2008).

The impact of the Washington Consensus on the course of globalization has been enormous, creating an environment for foreign investment, global trade, and removal of tariff barriers. Companies operating in this environment need to have more sophisticated strategies than domestically oriented firms. As a consequence of

globalization, market characteristics and industry structure have changed substantially in recent decades. Stakeholder pressure varies by country depending on the strategy chosen and the institutional context faced by the firm.

Globalization has also heightened concerns about the ability of national governments to protect the natural environmental and provide social welfare. New actors have emerged in the international arena, voicing concerns about the impact of unfettered globalization on the natural environment. They have influenced firms to introduce environmental and social issues as key considerations in the core business (Christmann and Taylor 2001, 2002). Scherer and Palazzo (2008) pointed out that, in a globalized world, the traditional set of government and business responsibilities may not be appropriate to guarantee the efficient and peaceful integration of society. Firms become political actors that need to take on social responsibilities beyond their economic role, and mere compliance with the law and the rules of common decency are not enough.

Emerging countries have opened their markets to international trade and investment. They have also taken steps to stabilize their economies by curbing inflation substantially, controlling budget deficits, privatising many state enterprises, and revaluing their currencies (Dominguez and Brenes 1997). Based on the common thesis of globalization, the Western-style form of CSR is being introduced in emerging countries. In this way, a cosmetic level of convergence in explicit CSR may be materialized in light of isomorphic pressures (Jamali and Neville 2011).

Peinado-Vara (2006) argued that there is a need to improve the institutional capacity of governments and civil society together with the investment climate. There is a need to go beyond 'one size fits all' approaches and instead develop an understanding of what CSR can and does mean in specific countries and societies. The institutional framework of each country reflects its distinct history and the peculiarities of its sociopolitical configuration (Jamali and Mirshak 2007).

3.1 Removal of Tariff Protection to Textile and Clothing Companies and the Impacts on CSR in China and Brazil

Globalization in the textile and clothing industry occurred under the special arrangement resulting from the Uruguay Round of the General Agreement on Tariffs and Trade, which established an agreement on special transitional measures. Towards the end of the Multi-Fibre Arrangement (MFA) and the demise of apparel quotas, Frost and Ho (2006) argued that one of the favorite games played in the media was guessing industry winners and losers. The consensus was that the ramifications would be catastrophic for most countries but a big advantage to China, which gained access to US and European markets.

China and Brazil are emerging markets that were differently effected by the MFA process. In fact, Chinese exports rose a whopping 44.95 %, but it was hard to conclude that China was going to gobble up the entire textile and clothing market (Miller 2004). On the other hand, textile companies in Brazil were severely affected

by increased competition as a result of the entrance of low-cost products into the Brazilian market. A substantial percentage of textile companies could not withstand these external competitive pressures and failed. It is interesting to review how textile firms in these two countries dealt with CSR in this context.

3.1.1 The Case of China

China is still listed as a developing country but is rapidly changing. Beginning in 1979, the GDP grew by nearly 10 % per year on average (Braendle et al. 2005), until very recently. It is now the second largest economy and the largest trading nation in the world. China highlights the transition from a state planned to a market-oriented economy (Bo et al. 2009). The country is fully integrated with the world economy through global supply chains and exports of finish products. The Chinese Government has a strategy to attract foreign investments, keeping its exchange rate artificially low and taking advantage of multilateralism to encourage rapid market penetration (Athukorala 2009).

Impressive legal reforms have been as part of China's obligations as a member of the World Trade Organization (Buhmann 2005). China´s relationships with other countries has become more intense due to both trade policy and security issues. Social welfare still remains a distinguishing element of Chinese political ideology (Moon and Shen 2010). However, structural reforms and accelerated development have not resulted in increased funding to promote social welfare (Fang et al. 2007). Privatization did not significantly change the role of industry related to social and environmental responsibilities.

Ip (2009) pointed out that the CSR activity in China started in the mid-1990s. At that time, a few large multinationals and some major Chinese companies were interested in implementing codes of conduct. By the late 1990s, a greater number of multinational companies began to apply such codes. However, this activity was limited to monitoring audits of the factories themselves. Consumers, government, and the media were not aware of the concept of corporate social responsibility. Even workers, who took part in audit processes had limited knowledge of CSR.

Utting (2003) pointed out that the 2002 Conference on Labor Relations and CSR under Globalization in Beijing provided a useful agenda for China to introduce socially responsible production and marketing practices. CSR was seen as a way to raise awareness of the need for national ratification and compliance with international conventions and agreements related to labor, environmental issues, and human rights.

According to Moon and Shen (2010), China has adopted aspects of Anglo-American corporate governance style, but there have been few government or nongovernment institutions to constrain antisocial behavior by the companies. However, national and provincial governments and, in some cases, businesses themselves have started to look to CSR as a way to rebuild their social legitimacy. Chapple and Moon (2007) noted that the traditional form of company involvement in CSR in Asia was based on community involvement. However, new relationships are being introduced, including socially responsible employee relations.

Kolk et al. (2010) conducted a survey of retailers in China, involving both Chinese and non-Chinese international companies. Communications about CSR/sustainability by these large Chinese retailers were found to be substantial different from those by international companies. Chinese company communications focused on economic issues and philanthropic actions, whereas international companies' reports dealt mainly with product reliability. Contentious labor and environment issues received limited attention in communications from both groups.

Using data on 68 of the largest multinational companies in China and India, Lattemann et al. (2009) suggested that the pattern of CSR development may be different among the emerging countries due to differences in governance systems. Even though India has a lower level of economic development than China, Indian firms reported more frequently on CSR due to a more rule-based, as opposed to relation-based, governance environment. The authors suggest that CSR improvement will not be immediate in China because the governance environment changes relatively slowly.

Nevertheless, global concerns about pollution are creating pressures for change in China. Baughn et al. (2007) stated that CSR policies and practices in Asia often compare unfavorably with those in the United States, Europe, and Australia. The rapid development of industrial parks has caused land degradation, water resource depletion, greenhouse gas emissions, and loss of biodiversity (Geng and Hengxin 2009). Companies favor opportunities involving large industrial parks, where timely and less bureaucratic approval processes are appreciated by investors.

Christmann and Taylor (2001) stated that the Chinese government has failed to protect the environment and social rights, but this can be ameliorated through self-regulated performance of multinational companies. Similarly, Tsoi (2010) observed that CSR is fairly significant to large export-oriented businesses. However, most local/regional companies only become involved in CSR when it is a customer requirement. These companies normally meet local legislative requirements but see going beyond these requirements as unnecessary.

Liu et al. (2010) pointed out that pressure from investors, business partners, and creditors to improve environment performance is only superficial, and the influence of communities, neighboring industries, and NGOs is weak. In the People's Republic of China, the parastatal character of many firms will probably increase their adherence to state-fostered norms, but it will restrict their autonomy to independently affect norm-building on sustainability.

3.1.2 The Case of Brazil

In the same year that the MFA came into effect, the Brazilian textile and clothing industry was seriously influenced by structural reform to the Brazilian economy (*Plano Real*). Under this plan, Brazil accelerated the privatization of state-owned industries and intensified its inclusion in the world economy through neoliberal policies (Green 2003). *Plano Real* was based on an economic strategy that linked the local currency (*Real*) to the dollar at a relatively fixed rate. The Brazilian textile

and clothing industry was faced with the need for restructuring within the Brazilian economy as result of the *Plano Real* and at the same time responding to global restructuring under the General Agreement on Tariffs and Trade.

Plano Real provided a basis for stopping the inflationary spiral. Trade liberalisation followed, contributing to an increase in the internal supply of goods by reducing the demand pressure on prices (Tigre and Botellho 2001). Furthermore, the privatisation process seemed to be the solution to both the fiscal crisis and the lack of resources to finance investments (Baer and Bang 2002). Brazil has changed fundamentally and, in the recent period, it has experienced a more stable process of democratisation in its social and political institutions.

The impact of the commercial opening was more intense on the textile industry than in other sectors, leading to an intense concentration of movement, and consequent implications on labour productivity. Textile companies demanded financial support from the Brazilian governments, mainly through reduced taxes or subsidies, and most of them cut their costs stringently. Many companies moved to north-eastern Brazil, an economically depressed area, encouraged by state-level fiscal incentives and cheap labor costs. Only a few companies invested in improved product quality or implemented a differentiation strategy to increase their domestic and international market share.

Economic pressures continue to be the dominant factor influencing the behavior of textile firms. The Brazilian economic environment is jeopardized by high taxes and interest rates, which reduce investment possibilities. Textile companies demanded financial support from governments and received assistance through subsidies and support from the Brazilian Development Bank. The main purpose of the investments was to increase the production capacity, build new plants, acquire new equipment, and protect the environment (Kon and Coan 2005).

These firms cannot afford to invest a large amount of money over a number of years in order to improve environmental performance of their products and process. However, textile firms attempt to meet the legal requirements of enforcement agencies within a limited range of organizational capabilities. Brazilian textile companies merely fulfill the minimum legal requirements of enforcement agencies (Abreu 2009). These companies are predominantly small and medium sized, and they operate mainly domestically.

Company customers are mainly concerned with price, delivery time, and quality. Many retailers are sending conflicting signals back up the textile supply chain as they try to manage and balance “green” and business interests. Nonetheless, international customers exert a higher pressure on large textile companies to improve their environmental performance.

Most textile companies have not implemented environmental policies. In general, they have not appointed an environmental manager. The percentage of investments related to the environment is not significant in textile companies. However, some textile companies are in the process of implementing environmental training programs, ISO 14001 certified environmental management systems, and purchasing and contract requirements.

The reasons for implementing an environmental management system (EMS) were discussed by Abreu (2009). Brazilian textile companies tend to base their EMS on meeting legal requirements. Operational controls involve wastewater and electric energy, which represent the most significant production costs. Few textile companies use communication practices to cultivate links with stakeholders or report environmental performance. Brazilian textile companies are affected by weak stakeholder pressure because their environmental impact is low and enforcement is not a high priority. They represent an important source of employment for people in areas where they have their production facilities. Social pressures are low and there are fewer motives to develop environmental strategies.

Abreu (2009) also pointed out that textile companies have predominantly "sleeper" approaches. Environmental issues do not influence the firm's strategy. This situation typically occurs when environmental issues mean cost without any competitive advantages. Few Brazilian textile companies are innovators. They are more concerned about Asia's influence on the market, and they are establishing strategies involving differentiation and increased participation in international and domestic markets. These firms are market leaders and enjoy first-mover advantages. In short, good environmental practices are viewed as an important way to capture premium profits and increase sales.

Large textile companies, having international markets, appear to have more sophisticated environmental strategies than domestically oriented firms. These innovator companies develop green-label products to supply markets that are more sensitive to environmental issues, such as Europe, and have reviewed their processes to reduce costs, improve their images, and become more competitive. They invest in environmental technologies and efforts at production reformulation, reduction of waste, recycling, and energy and water conservation.

Brazilian textile companies invest minimal resources on social issues, both internal (e.g. improved working conditions) and external (e.g. investments in education, health, or sports within local communities) (Abreu et al. 2008). The lack of investment on social issues reflects the fact that textile industry is based on tax incentives and low labor costs (Kon and Coan 2005). Extra benefits, such as salary bonus or profit incentives, when they exist are limited to large- and medium-sized enterprises. Many of the textile companies have not developed codes of ethics.

Compared to China, the Brazilian textile and clothing industries are more supportive of the comprehensive adoption of CSR practices (Abreu et al. 2012). Alon et al. (2010) also found that Brazil scored higher than China in an investigation of CSR motives, processes, and stakeholder pressures. Stakeholders were more frequently mentioned by Brazilian firms. CSR activities in China emphasized both company performance and stakeholder demands. In terms of processes, in Brazil, volunteerism, health, and the environment were emphasized in corporate communications. In contrast, Chinese firms emphasized sponsorships of arts and culture.

The democratic political system in Brazil, which has been in place for almost 30 years, allows for a more transparent and rule-based governance environment. It also supports a more vocal society demanding responsible actions on environmental, social, and labor issues by government and business. The regulatory side of

the institutional environment is the main influence on the CSR practices of textile firms. Coercive pressures also occur through industrial metastandards, such as ISO 14001, which are imposed as supply chain requirements of international markets (Christmann and Taylor 2001; Zeng et al. 2005; Abreu et al. 2008). In this sense, coercive isomorphism is the dominant process in textile firms.

Mimetic processes and normative pressure play a limited role in relation to textile firms. These firms operate in a business climate of uncertainty and extreme competition with low margins. Managers tend not to consider environmental and social issues as a priority, even in the long term. The potential benefits of adopting CSR practices are not clear to textile firms in Brazil or China. Thus, CSR is not embedded as a voluntary and legitimate organizational practice.

4 Roadmap to Implement Corporate Social Responsibility Practices

A CSR roadmap is presented in Fig. 1. It identifies drivers, mechanisms to implement CSR practices, and outcomes. A company initiating a CSR should identify the various driving forces directing sustainable behavior and the desired outcomes. This provides the basis for identifying the most appropriate practices that should be adopted by the company. The types of practices that may be required are divided into the following four categories: internal, natural environment, relational, and discretionary.

Internal practices focus on providing a healthy and safe environment and appropriate career plans for employees, and they guarantee the production of a quality product. Natural environment practices encompass an EMS, which can be considered a moral and legal necessity to reduce and control environmental impacts. Discretionary practices include the development of social programs focused on local communities. Finally, relational practices involve the development and maintenance of relationship with stakeholders.

Welford (2004, 2005) defined a similar set of four categories of CSR practices based on stakeholder relationship and orientation. These practices are classified as internal and accountability (which are more focused on market stakeholder satisfaction), and relational and citizenship (which are more related to building a good image in the eyes of nonmarket stakeholders). Kim and Choi (2013) suggested another breakdown of four CSR practices: internal environment, moral, discretionary, and relational. Although these studies contribute to developing and expanding CSR practices, it is important to address the underlying rationale for stakeholder demands.

Figure 1 includes a broad range of drivers, desired outcomes, and various practices that could be encompassed in a company's CSR. However, in proceeding with CSR, a company has to address priorities among the various possibilities and develop an implementation plan with the most appropriate allocation of resources over time.

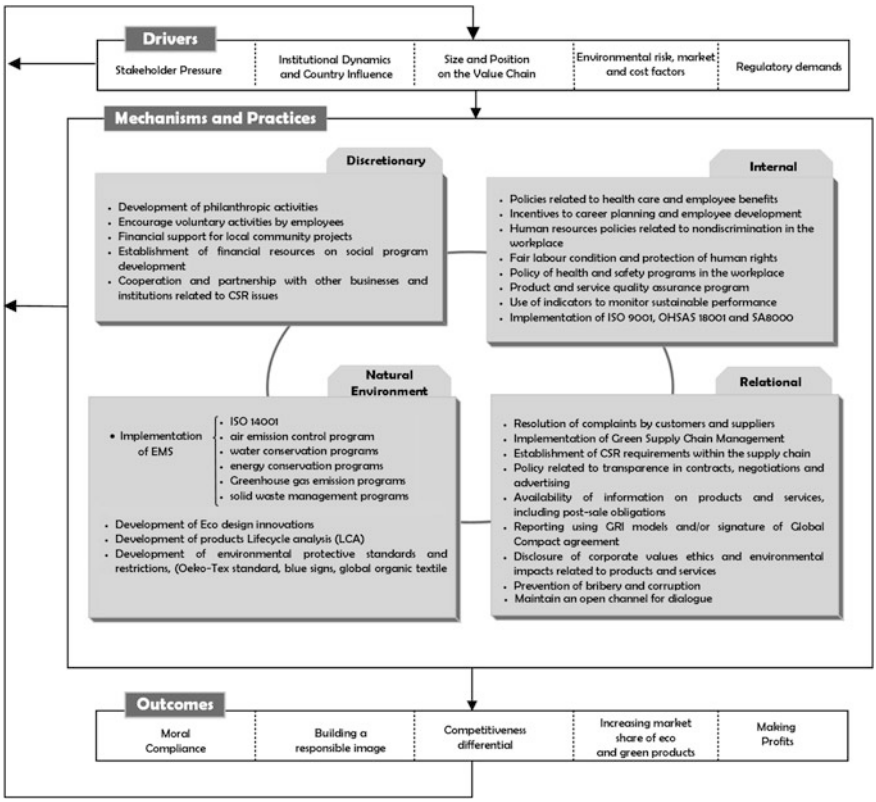

Fig. 1 Corporate social responsibility roadmap in the textile and clothing sector

The highly competitive nature of the textile and clothing industry will make decisions by a company to implement CSR problematic. Many companies will find it difficult to use scarce resources on what will be perceived as esoteric investments. However, the opportunities presented by 'ethical,' 'green,' or 'eco' marketing provide an argument against such a view. The opportunity may exist to offer competitive products in a marketplace where others are having difficulty or are being threatening by moral or social concerns.

Companies can achieve success in capturing market share through CSR-based promotions. Such promotion may be through ethics-based campaigns directed by non-governmental organizations showing that the company is free of practices against human rights, labor, and environmental standards that are considered endemic to the textile industry (Lobel 2006). A sense of moral obligation and the potential to realize cost reductions—particularly related to production materials, waste handling, and/or liability—can be considered another argument for the introduction of CSR in the textile industry.

It is increasingly acknowledged that CSR works best in concert with stable and well-functioning regulatory systems. Therefore, initiatives to promote sustainability need to be coordinated with policy making at all levels to speed up the transformation of the textile and clothing industry. In general, policymakers can use a variety of tools to influence corporate sustainability policies and practices, such as awareness raising, tax incentives, or public procurement.

Pedersen and Andersen (2013) suggested that policy makers should set minimum requirements for fashion products. Regulatory standards would ensure that fashion companies include more sustainable products in their offerings to consumers. The minimum standards could include, for instance, durability, washability, and the ability of garments to maintain their shape after washing. Moreover, mixed materials could be abandoned for certain types of environmentally friendly products. These minimum requirements would increase the quality of the products, protect the environment, and ensure the health of workers as well as consumers.

Jamali and Mirshak (2007) suggested that, in developing countries seen to have a weak regulatory capacity, managers can take direct responsibility as moral actors by guiding the principles of CSR in their respective organizations. In general, companies should aim to be as transparent as legally possible without creating situations that will result in unforeseen consequences. Having their management systems certified by international standards, such as ISO 9001, ISO 14001, OHSAS 18001, or SA8000, are almost mandatory to operate in international markets. The CSR approach could evolve to include reporting using Global Reporting Initiative (GRI) models, signature of Global Compact agreement, and use of indicators to monitor sustainable performance.

Klassen and McLaughlin (1996) suggested that improved environmental performance could enhance profitability by improving cost efficiency and sales. Lo et al. (2012) pointed out that an EMS can optimize production procedures and reduce packaging, raw materials, energy and water consumption, and toxins released to the environment. Pollution levels should be monitored and corrective actions should be taken when needed.

When applied to the textile and clothing industry, the effective implementation of an EMS should enhance the utilization of fabrics, materials, water, and energy. In some cases, textile firms could acquire new environmental technologies, such as flocculation technology for the treatment of dyeing mill effluent (Vandevivere et al. 1998). In addition, an EMS is particularly important for firms that export to markets with tight environmental regulatory requirements (Delmas 2002).

The mainstream textile and clothing sector depends on a change in dominant consumer values, attitudes, and behavior. While consumers often have a positive view of socially and environmental friendly products, these attitudes are rarely transformed into concrete buying and consumption behavior. Moreover, due to nontransparent supply chains, consumers often are unaware of the consequences of their buying behavior and, thus, are unwilling to pay a premium for sustainable product. Communication to consumers has to take into consideration national and cultural differences because knowledge about sustainability varies significantly (Pedersen and Andersen 2013).

According to Delmas (2001), improved environmental performance can enable a firm to improve its corporate image and expand its markets, because consumers are increasingly willing to pay higher prices for green products and services. Meyer (2001), however, stated that the majority of fashion customers are in favor of environmentally friendly clothes when they are sold at the same prices as the conventional ones. It is crucial for consumers to be introduced to a pricing scheme in line with the actual costs of production.

Pedersen and Andersen (2013) pointed out that a large number of brands have recently introduced various take-back systems, repair services, and recycling schemes. Moreover, several companies have built a business on transforming used materials into new products. One example, the Finnish fashion brand Globe Hope has developed competence in turning existing materials (military laundry bags and seat belts) into new fashion products. These innovations are not only good for society but can also be a source of profit, growth, and competitive advantages for companies. Therefore, policymakers play an important role by providing tax breaks for sustainable manufacturing, subsidies for recycling, and lower value-added taxes on sustainable products.

There is also a need to increase the transparency of the textile and clothing supply chain. Therefore, it is suggested that companies should be required to have bar codes on labels that enable consumers to see where and how products are made. Mandatory trustworthy labels (e.g. about the product's carbon footprint) are a potential solution to increase the transparency of the industry and make it easier for consumers to make sustainable buying decisions (Pedersen and Andersen 2013).

Life-cycle assessment (LCA) is an evaluative tool that considers the environmental impacts of a product or process from cradle to grave. It takes into account the production and acquisition of raw materials, fabrication and assembly, transportation, use, and disposal. Through LCA, it is possible to assess the absolute and relative performance of production processes, to support decision-making, and provide the basis for the 'greening' of business practice. Piekarski et al. (2013) pointed out that when LCA is involved and engaged with business management, green innovation and internal entrepreneurship are made easier.

Kozlowski et al. (2012) pointed out that design standards present a key opportunity to integrate sustainability objectives—and do so at a lower cost. It is at this phase that the bulk of environmental and social impacts are fixed (locked in) through decisions such as the choice of raw materials, textiles, dye colours, finishes, and processing. It is also through design that there is the greatest opportunity to effect change.

For example, once jeans are designed, decisions regarding raw materials can be addressed. The choice of raw material can have a major influence in reducing environmental and social impacts. The designer has many organic options for natural fibers, recycled options for synthetics, and many new eco-textiles such as lyocell, which has a closed-loop production system. Choosing alternative fibers other than cotton and polyester promotes biodiversity and reduces the impacts on the ecological systems tied to their production (Kozlowski et al. 2012).

For instance, new tools for transparency and traceability are proposed for the textile and clothing supply chain, including live cams, metric tools, LCA software, and smart tags (Pedersen and Andersen 2013). Consequently, it is also difficult for one company to make a real change toward sustainability, as it requires the active commitment of everyone in the supply chain. Sustainable cotton is given as an example that requires the involvement of all stakeholders, from local farmers to brand owners and retailers.

Companies can implement green supply-chain management (GSCM) to enhance their core competitive advantage and support CSR. GSCM involves of all product processes—raw material production, product manufacturing, recycling, reusing, and remanufacturing. These processes must comply with environmental protection regulations (Kainuma and Tawara 2006). The GSCM strives to achieve what any individual organization on its own could not possibly achieve: minimized waste and minimized environmental impact, while assuring maximized consumer satisfaction and healthy profits.

Zhu et al. (2005) proposed four ways to implement GSCM: (1) EMS implementation; (2) asking suppliers to enhance environmental performance and collaborate with their customers; (3) eco-design, in which companies reduce raw material/energy usage and design products able to be recycled and remanufactured; and (4) investment recovery, in which companies sell excess inventory/material, scrap, and used materials.

During the financial crisis of 2008, Wu et al. (2012) explained that the global apparel market contracted tremendously. Global apparel orders of brand companies were canceled or postponed. In addition, many developed countries formulated environmental regulations. Environmental protection groups and apparel brand companies proposed new environmental protective standards and restrictions, such as the Oeko-Tex standard, blue signs, global organic textile standard, restricted substances list, ethical trading initiative, and clean clothes campaign. These standards and restrictions require textile and apparel manufacturers to refrain from the use of toxic materials or harmful processes. They are a few examples of the many areas in which CSR can contribute to resolving problems.

Diverse concepts exist of what CSR issues are considered to be relevant and the sort of solutions ultimately thought to be desirable. The global dimension makes it the duty of corporations to voluntarily compensate for regulatory deficiencies (Christmann and Taylor 2001). CSR can be used to limit the risks of inappropriate behavior by firms, their subsidiaries, and suppliers, which could affect their reputations and operational performance.

5 Conclusions

The complex environments in which countries operate with heterogeneous legal and social demands often makes it unclear which activities can be considered legitimate and which are not unacceptable. Social, economic, political, and legal

factors affect countries differently and result in different institutional dynamics and organizational behavior. Through globalization, the legal framework is weakened, while the (national) moral context of managerial decision-making is fragmentized (Scherer and Palazzo 2011).

CSR establishes a new way of doing business that combines success and the creation of value with a respectful and proactive attitude towards stakeholders. The CSR movement has been a global phenomenon, although there are important intraregional variations in practice. Some initiatives are more voluntary than others, as companies may or may not be under legal and ethical pressure to adopt them.

Vogel (2005) is very much of the mind that CSR will not become fully implemented until mainstream companies begin reporting that CSR is critical to their performance. CSR will be successful only to the extent that it adds to the bottom line and can be specifically delineated as having made such an impact. However, Balmer et al. (2011) argued that business scandals, catastrophes, and malpractices have generated heightened interest in ethical standards and corporate social responsibility.

In order to support CSR, governments and society should strengthen enforcement of regulations, improve institutions, and generally enhance the governance environment. Stakeholders—mainly customers—could help focus attention on key issues, particularly labor conditions, consumer rights, environment impacts, transparency, and accountability. Managers can play a key role in introducing CSR by identifying drivers, desired outcomes, and the sort of practices that will lead to the best results. The engagement of stakeholders in a dialogue is essential to advance the CSR agenda.

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The Sustainable Apparel Coalition and the Higg Index

Shanthi Radhakrishnan

Abstract The Sustainable Apparel Coalition (SAC) seeks to lead the apparel industry toward a shared vision of sustainability built upon a common approach for evaluating sustainability performance. By developing a common tool—the Sustainable Apparel Index—the SAC enables apparel industry companies to measure the environmental and social impact of apparel production throughout the product lifecycle, from design to end of use or recycling of the product. The potential impact of the Sustainable Apparel Coalition is enormous. SAC member companies (including brands, retailers and manufacturers) are estimated to be responsible for more than one third of the apparel and footwear produced globally. The SAC has built a strong foundation and made significant progress since its launch in 2010. As the coalition looks forward, there are a few key challenges that members must be prepared to overcome in order to reach shared sustainability goals. The Higg Index, announced by the SAC, is primarily an indicator-based assessment tool for apparel and footwear products that was launched in 2012. The Higg Index has a suite of self-assessment tools dealing with facility, brand, and product and asks practice-based, qualitative questions to gauge environmental sustainability performance and drive behavior for improvement. It is a learning tool for both small and large companies to identify challenges and capture ongoing improvement. It targets a spectrum of performance that allows beginners and leaders in environmental sustainability, regardless of company size, to identify opportunities. The SAC has established a strong foundation of organizational culture and progress, faces both opportunities and challenges, opens membership to any interested company in the apparel sector and drives the Index tool through further iterations and industry adoption. As the organization grows and evolves, it must retain its unique culture and speed at the same time that it balances membership growth, which may bring evolving expectations around sustainability aspirations and engagement to the coalition. The SAC must look forward in order to achieve its long-term vision of transforming apparel industry such that it produces no unnecessary environmental harm and has a positive impact on the people and communities associated with its

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activities. The organization is poised to build on its success with strong momentum and member commitment. Translating the coalition's accomplishments and lessons learned across the apparel industry (and to other industries) will be the true measure of SAC's success.

1 Environmental Impact of Products

1.1 Introduction

Every product used by the consumer has an impact on the environment. Many consumers today do not know the extent to which these products impact the environment—low or high. A product is considered to be eco-friendly when it is made, used and disposed of in a manner that would reduce the harm to the environment when compared to a product that was manufactured and used without any environmental concern. However, consumers have become more conscious of these impacts and are spelling out their preferences for eco-friendliness, thereby forcing the manufacturer to adopt clean technologies all along the supply chain to produce environmentally friendly products (Challa 2014).

All products that are manufactured cause environmental degradation, either during manufacture, use, or disposal. This can be evaluated by looking at the different phases of the product's lifecycle and taking action at the phases where it will be most effective to reduce the environmental impact. However, the lifecycle of a product is long and complicated, covering many areas with many people involved in each phase. A remedial measure or policy may not be possible to address this aspect but a variety of voluntary and mandatory tools will help to achieve this objective. These include economic instruments, bans on certain substances, environmental labelling, voluntary agreements and product design guidelines (IPP 2014).

1.2 Principles for the Assessment of the Environmental Impact of Products

To facilitate the assessment of environmental impact, the final consumption of an environment/place has been categorized by the European Commission Communication on Integrated Product Policy into product categories. The classification may divide the total consumption of products into categories based on any of the said methods. The major divisions may be based on the functional areas of consumption, such as transportation, clothing, health care and recreation. The second method may be based on consumption domains, where one category forms a contributing factor to the other category (e.g. transportation being a contributing factor to health care or

recreation). The third method may be on the basis of product groupings that are subclasses of the consumption domains (e.g. transportation may be further divided into subclasses such as rail, road, ship and air). The other classification can be as a homogenous product group or individual product groups, such as medium-range diesel cars (homogenous) and a specific diesel car (individual).

Further two approaches have been identified by the organization to undertake studies on environmental assessment. The bottom-up approach starts with the selection of a product, followed by the completion of a lifecycle assessment (LCA). The top-down approach begins with input and output data compiled by statistical agencies, followed by the production and consumption analysis of an economy. The most important environmental impact categories used in most of the studies were global warming, acidification, photochemical ozone formation and eutrophication. Apart from these categories, ozone layer depletion, human toxicity, eco-toxicity, land use and depletion of nonrenewable resources were taken into account (Tukker et al. 2006).

It is difficult to measure and express a product's overall environmental impact, so the LCA is a useful tool for such use. The first step is to select a functional unit (e.g. a product) and the next process is to set boundaries for the analysis. The classic LCA is carried out on a cradle-to-grave basis, which assesses the environmental impact of extracting and gathering raw materials, assembling the product, transporting it to the user and disposing or recycling at the end of the product's useful life. The next step is to conduct a lifecycle inventory, which involves the tracking of every single part of the product back to its raw material origins. The lifecycle inventory generates large amounts of data, which have to be grouped into different categories (11 or 12 categories) representing the particular impacts on humans, ecosystems or resources. Finally, the LCA report quantifies the total impact of the product on each category. The International Organization for Standardization (ISO) has a set of processes that govern a LCA. According to the ISO, the analysis must be done from cradle to grave and the resources, processes and calculations performed in the analysis must go through a peer-review process conducted by third parties (Palmer 2012).

1.3 Assessment and Promotion of Green Products

To promote a market for greener products and to strengthen the product-focused green policies, many instruments can be used. The policy of differentiated taxation such as reduced value-added tax for eco-labelled products,extends producer responsibility to new areas and the use of governmental laws provides new guidelines forenvironmental protection. These measures could capture the attention of the consumer, who is more likely to use greener products once the price is lowered. When the consumer demand for green products increases, markets are likely to provide them. However, the consumer needs information about the products in order to choose from the wide variety of products available in the market. This requires a

wider labelling policy and relevant, credible information about the product. Environmental impacts cannot be addressed once the product is introduced into the market and attention should be focused on environmentally friendly product design. Improvements in product design can be made by improving the flow of lifecycle information and eco-design guidelines, integrating environmental considerations into the manufacturing processes and involving relevant stakeholders to review the approach. Education on the need for greener and eco-friendly products and the use of case studies and examples would help to strengthen the design and manufacture of green products. LCA is a very useful tool for the evaluation of products in the areas of materials, energy, transportation and end of life.

Another measure adopted by the German government was the formation of a national environment help desk, which serves as a platform for obtaining a good flow of information between the environmental experts and stakeholders. This database will be used for the standardization processes. It has been reported that 80 % of the standardization is European and international standardization. There is a need for a high degree of expertise, which can be found in industry and academia from all parts of the globe, as environmental issues differ from country to country. In Germany, the national environment help desk consists of the secretariat and a steering board. The standardization activities with regard to the environment are communicated regularly to the stakeholders by means of newsletters. Experts from nongovernmental organizations (NGOs) and universities are invited to take part in the standardization process and to report back to the help desk. The European Environmental Citizens Organization for Standardization was founded jointly by the WWF European Policy Office, Friends of the Earth Europe, Birdlife International and French and Danish NGOs. The European Environmental Citizens Organization is working toward a standardization process, with priority for the environment (European Commission 2001a).

The European Commission conducted a series of conferences on environmental policy, with discussions highlighting the importance of LCA and eco-design guidelines. A collaboration between the design centers and the industry needs to be promoted. In this context, a study was conducted to identify and analyze the state-of-the-art activities in the field of eco-design and the methods by which this information can be transferred to small- and medium-sized enterprises by means of workshops and dissemination activities. The lifecycle inventory and LCA were considered as tools to form the database for standardizing and optimizing with due concern for the environment (European Commission 2001b).

One of the economic instruments for evaluating the environmental impact of products is externality valuation. Usually, the measurement of externalities is minimal when compared to the internal costs. In most cases, the impacts are due to consumer use; also, because, the supply comes from global sources, the impacts occur abroad. The problematic areas include the external cost of landfills, the attribution of transport cost, the method of costing resource use and the impact of carbon. Furthermore, only a small part of the overall lifecycle impact is associated with a small company; the majority is distributed along the product supply chain as well as the other phases of the lifecycle of products. The impacts should be

measured in production, consumption and waste management. A high degree of variation exists between different products and the transportation and landfill issues could even vary within the same product. The evaluation criteria for economic instruments should include environmental and economic efficiency, the effects on innovation, their administrability and political acceptability; the incentives provided by the economic instruments should be applied based on the desired behavior and impact. Environmental taxation is based on environmental impacts; therefore, it is essential to measure the environmental impacts and quantify them in terms of monetary value.

Economic instruments have been extensively used in Sweden and more than 50 billion safekeeping receipts were raised in terms of general energy taxes, taxes for issues such as use of solvents and chlorofluorocarbons and others concerning the use of batteries, chemical fertilizers, pesticides, sulfur, CO_2 and differentiated taxation on fuel. Other schemes introduced were the implementation of the EU Landfill Directive, the UK Greenhouse Gas Emissions Trading Scheme, the UK Packaging recovery note, the Norwegian system of weight-based waste taxes and used furniture recycling projects. Producer responsibility should be considered on a more individual basis and incentives for environmental investments should be promoted (European Commission 2001c).

1.4 Measures for Reducing the Environmental Impact of Products

The Department for Environment, Food and Rural Affairs and the Department of Energy and Climate Change and Environment Agency in the United Kingdom have made sincere efforts to assess the environmental impact of consumer products. Many of the products are imported from all around the world; hence, the environmental impacts are distributed across the world (Encouraging businesses to manage their impact on the environment. https://www.gov.uk/government/policies/. Accessed 30 Apr 2014). The Product Sustainability Forum is a collaborative agency with retailers, suppliers, academics, NGOs and government representatives who joined together to measure, communicate and improve the environmental performance of products, with WRAP as the secretary for the forum (Product Sustainability Forum 2014). PAS 2050:2011 is a freely available specification that provides a methodology for assessing the lifecycle of greenhouse gas emissions for goods and services. This was the world's first structure for calculating the carbon footprint of products, published in 2008. Currently, PAS 2050 has many specifications in individual sectors for the effective assessment of the carbon footprint of products, identification of problems and reduction of carbon emissions in the supply chain (BSI 2014).

Product Environmental Footprint and Organization Environmental Footprint are organizations who are involved in the selection of proposals for tool development to calculate the environmental footprint of products. This selection will be a sample of

the market and is based on the diversity of product groups, availability of lifecycle data and product category rules. The selection of proposals was carried out by a committee of policy officers from different sectors of the General of the European Commission. The Directorate General, Environment and the European Commission Joint Research Centre have worked in tandem for the development of a technical guide for the calculation of the environmental footprint of organizations, which also includes the carbon footprint. The methodology has been developed based on the Lifecycle Data System Handbook, the Global Reporting Initiative, WRI GHG Protocol, CDP Water Footprint, ISO 140064 among others (EC 2014a, b).

Currently, the concern is not only for the manufacture and distribution of the products to the consumer but also the effects of each action involved in the sourcing, manufacturing and supply chain of the product on the environment, society and the welfare of living beings worldwide. Many organizations are working to make people aware of the effects of product development and the responsibility of both the industry and the consumer in actively making wise decisions to adopt eco-friendly attitudes and actions. Since the textile and fashion industries occupy vital positions in the world economy and contribute to a large extent to environmental pollution, concerns for reducing these impacts compelled leaders in the apparel and footwear industries to form an organization called the Sustainable Apparel Coalition, which worked toward eco-friendliness and sustainability to make the future better.

2 Introduction to the Sustainable Apparel Coalition

The world's textile and apparel industry is a 3 trillion industry that includes the manufacturing, marketing and retailing of textiles and garments. This industry has been considered as an approach for industrialization, economic progress and national development. According to the World Trade Organization, China has been leading the world with regard to exports in the field of textiles and apparel, followed by the European Union and India. The Association of Southeast Asian Nations (ASEAN) region is considered to be the biggest competitor to China in terms of being a low-cost manufacturing center and export hub. The ASEAN region, which includes Korea, India, Vietnam and Cambodia, has become one of the fastest growing trade associations. The predictions are that China will remain the leader in textile and apparel sourcing in the Asian region, because no other country can match China in scale, infrastructure, efficiency and stability. Other countries would have to invest significantly to increase productivity and meet the stringent quality demands (Speer 2014; Wikipedia 2014).

Despite the recent recession, strategic moves taken in this sector have saved the industry from various problems. Every industry should concentrate on keeping stock levels low, as well as on being flexible and in tune with the consumer's needs and wants, emphasizing lean management and strong supply chain networks. Ecological friendliness was the main motto and consumers have been very much

aware of its impact, seeking out products that complied with ecological standards. Consumers paid more attention to water conservation, particularly when there was low usage of water for production with zero discharge into the environment.

The governments of various countries have safeguarded their industries by implementing globally focused strategies and policies. Intellectual property rights and free-trade pacts have contributed to the industry's well-being. Profit margins have also increased for industries that have entered into specialized fields of manufacturing and for niche products with an emphasis on stringent quality.

Another development worth mentioning is the formation of the Sustainable Apparel Coalition, which helps industries to rate their products with a numerical sustainability score in order to provide data to customers with regard to the extent the manufacturer has contributed to the conservation of the environment. The Higg Index is one such tool for the assessment of a product's sustainability, which raises a manufacturer's consciousness of the design, choice of raw materials, manufacturing processes, finishing, packaging and distribution through the use and recycling of the product (Martin 2013; Reichard 2013).

Flexibility, sustainability and change are the key words for growth and progress. Industries that simply maintain production in terms of the routine scheduling and orders will soon vanish from the competitive global market. In the near future, the big winners will be manufacturers who are willing to move swiftly and definitively when faced with innovative opportunities. This trend will be centered on the mindset of the consumer and the consumer's awareness, thus leading to solid demand and increasing profits in the coming decades.

2.1 Background

The fashion industry is a popular industry among consumers, but it has a huge effect on many environmental, social and governance concerns. The textile industry prepares the base materials and the fashion and apparel industry converts these materials to suit the desires and needs of consumers; both industries are responsible for high utilization of energy, water, chemicals and resources from cotton to petroleum. The poor onsite conditions of the textile factories and working environment have caused many problems for the workers and operators, forming the basis for social reforms. In addition, the precarious supply chain upon which many manufacturers rely to develop apparels can cause many problems for merchandisers and retailers. The challenges faced by apparel manufacturers and retailers, along with incidents such as the Rana Plaza in Bangladesh and the crisis in Cambodia, led the clothing industry giants and nonprofit organizations to launch an association called the Sustainable Apparel Coalition (SAC), which aims to reduce the environmental and social impacts of the apparel industry around the world (Kayne 2011).

The SAC is a trade organization with brands, retailers, manufacturers, government and nongovernment organizations and academics as members, who together represent more than one third of the global apparel and footwear market. The SAC

Fig. 1 Logo of the sustainable apparel coalition (19)

was founded by a team of sustainability leaders from the global apparel and footwear industries, with the aim of addressing the current social and environmental challenges in the industry (Fig. 1). This organization seeks to highlight sustainability through a multistakeholder arrangement by evaluating and measuring the sustainability of apparel and footwear products, thereby giving rise to technological innovations and actions. This organization has more than doubled its membership and revenue in the 2 years since its inception. (SAC 2012a).

2.2 Mainframe of Sustainable Apparel Coalition

The organizational structure of SAC consists of a board of directors, consisting of eminent industrialists and professionals from various organizations around the globe, headed by a board chair. The members of the board of directors have a rich background in industry and sustainability issues and they form the mainframe of the coalition (SAC 2012b). The board is supported by a team who works toward the goal of SAC. The team members include an executive director, vice president, collaboration projects manager, environmental sustainability manager, implementation lead, product manager, membership development lead and an environmental sustainability analyst. The team members have vast experience in industry, product management, project management, development of assessment tools and sustainability issues (SAC 2012c, d). These members are responsible for the planning, execution and evaluation of the different activities of the coalition and contribute to the sustenance and development of the organization.

2.3 Vision and Mission of the Sustainable Apparel Coalition

The vision of the SAC is to promote an apparel and footwear industry that does not produce unnecessary environmental detriment and supports a positive impact on the people and communities involved with its activities. The coalition was founded by global sustainable leaders in the apparel and footwear arena who recognize the

importance of addressing the current social and environmental challenges facing the industry. The mission of the coalition is to lead the industry towards sustainability based on tools for measuring and evaluating apparel and footwear product sustainability performance, thereby providing opportunities for technological innovation. With the vision and mission established, this organization is working currently towards the development and adoption of the Higg Index, a suite of tools for measuring and assessing the environmental and social performance of apparel and footwear products (SAC 2012e).

The purpose of the SAC is twofold. The member organizations will formulate plans to reduce the impact of the apparel industry with regard to the consumption of water, chemicals and waste generation. This can be achieved by the coordinated efforts of coalition members, industry and supply chain partners by lifecycle transparency for clothing, coupled with an assurance that fair employment practices and safe working environments are provided to the workers in the apparel industry.

Secondly, the SAC will develop an assessment tool for the measurement of environmental and social impacts. Based on the indices developed by Nike and the Outdoor Industry Association, namely Apparel Environment Design Tool and Eco Index, version 1.0 of the Higg Index was developed. This tool assesses energy, water and chemical utilization by the industry and product lifecycle. A firm can then compare their results with those of their peers to create an awareness and improve performance by way of resources and guidelines. These efforts will reduce costs and will eventually develop customized assessment tools for specializations such as footwear (Kayne 2011).

As a collection of assessment tools, the Higg Index was launched on December 11, 2013. Its focus is on the standardization of the measurement of environmental and social impacts of apparel and footwear products across the product lifecycle throughout the value chain.

2.4 Outcomes of the Sustainable Apparel Coalition

Outcomes envisaged by the SAC include five important areas of apparel or product manufacturing, as shown in Fig. 2. The first aspect, water use and quality, targets the improved efficiency of water usage and reuse in the cultivation or production of raw materials and manufacturing of products. Its main feature is to minimize the effluent load and quantity of water discharges associated with apparel manufacturing and eliminate the impact on the neighboring environment and local communities. The development of alternatives to conventional washing practices are also considered to reduce the need for water use in garment care.

The second outcome, energy and emissions, aims to minimize the use of direct and embedded energy and carbon in apparel products, with the intention of reducing the use of resources and greenhouse gases. It also aims to promote design and technology in the creation of apparel products that lessens carbon impacts, such as reducing the need to use heating and air conditioning systems.

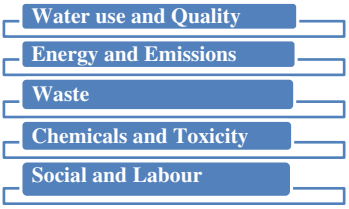

Fig. 2 Outcomes of sustainable apparel coalition

Minimizing waste in all operations, the supply chain and the end stage of apparel products, as well as the effective use of textile waste as raw materials or recycling of waste for further use, is the third outcome. Generally, the use of chemicals in the apparel supply chain—namely in the cultivation and production of raw materials and manufacturing of apparel products—results in environmental and health hazards if these materials are not handled efficiently.

The fourth outcome is the reduction and effective management of chemicals and toxicity to safeguard the environment. The final outcome deals with the human concern for fair, safe and nondiscriminatory workplaces, as well as to network with industry and supply chain partners to attain lifecycle transparency about the social and ethical performance of all companies and products (SAC 2012f).

2.5 Membership Benefits

The benefits of joining the SAC are many, as the apparel brands and products are evaluated by consumers using quality and benchmarking systems. These benefits fall under three heads—business value, leverage and leadership. When manufacturers and business partners become aware of the measurement of sustainability performance, they will look out for ways to promote operational efficiencies in energy, material and water use, thus resulting in benefits in these areas of production and management of resources. The process of benchmarking performance with industry peers or against a set of standards will bring about a positive change in practices and technology. Rating performance using indexes will help to evaluate the supplier management practices and the risk areas for improvement and capacity building. The process of duplication and assessment fatigue can be avoided by collaborating on a single index and the resources spent in measuring and reporting can be reduced. Networking and sharing of best practices with other industry leaders and promotion of industry-wide projects will hasten innovation in technology and practices. This collaboration will serve to reduce costs for individual companies involved in developing the index and related tools. On the whole, networking and collaboration can unite many apparel and footwear industries under a common forum to work for sustainable and developmental activities.

The SAC is an organization with the power and ability to influence people, events and decisions because it has a wide network of industries and multistakeholders under its wing. It is equipped with a databank of resources and information, which can serve the industry as a whole. This leverage can help to unite the highly fragmented textile and apparel industry for improvements that will promote change. It could also address systemic issues that cannot be addressed by any individual industry, ensure credibility and broad acceptance of the framework and help the industry to come to the forefront using measurement methods and regulations for reporting on product impacts.

The SAC will help in capacity building by taking part in the development and use of sustainability measurement tools, strengthening brand value and consumer recognition. The methodology of sustainability assessment will bring the industry to the forefront as a role model for other sectors. The quality of leadership and recognition will build a foundation for the overall development of the industry in a sustainable manner (SAC 2012g).

The global textile and apparel industry has moved from the agrarian age to the technological era, passing through many phases of change as new ideas and technologies emerged. These ideologies have been incorporated in the industrial system to serve the fundamental needs of the society and customer demand. Challenges that have arisen during these eras have transformed the industry into a competitive one, equipping itself to surpass these tests and emerge as one of the global leaders among industries. The greatest challenge facing the industry is the green transformation of the global economy, which calls for transparency in the supply chain of products and their life cycles. All the stalwarts of industry have started scrutinizing their production processes and side effects and are looking out for new solutions to help to save the environment from pollution. These green concerns have led to the development of many organizations that have devoted their energies toward sustainability. The Sustainable Apparel Coalition is one such organization, calling for the networking of many stakeholders and providing ways and means of assessing the results of industrial actions to reduce carbon footprints and save the natural resources and environment for future generations.

3 Higg Index

3.1 Overview

The Higg Index is a set of assessment tools that are used to evaluate the environmental impact of apparel and footwear products. The index was initially released on June 26, 2012 as the Higg Index 1.0, and it has been used by many organizations —both SAC members and nonmembers. The Higg Index 1.0 used a Microsoft Excel interface and worked on qualitative indicators for assessment. The sustainability topics were related to the environment, and the product category was apparel. The Higg Index tools used were the environment-based brand module,

facility module, and product module. Approximately 44 materials were included in the Material Assessment Data and the Material Sustainability Index used basic indicator questions on the environment. The weightages for the environment modules were equal, but an option was given to choose from custom settings or SAC-recommended weightages.

The Higg Index 2.0 was released on December 11, 2013. It is based on tools such as the Eco Index, Nike's Apparel Environmental Design Tool, Global Social Compliance Program reference tools and social/labor practice tools, such as the SAI Social Fingerprint and FLA Sustainable Compliance Initiative. After a pilot testing period and use of the second version by many organizations for over 14 months, the Higg Index 2.0 was introduced. This tool helps to standardize the methodology for measurement and evaluation of the environmental performance of the apparel products all along the supply chain in three levels—namely the brand, product and facility levels. The scope of the Higg Index 2.0 is to assess the environmental and social/labor performance of apparel and footwear products. It is based on lifecycle analysis spanning the entire lifecycle of apparel products, encompassing raw materials, manufacturing, packaging, transportation, use and end of life. Retailing has not been included in this phase but is being considered for future use (SAC 2012h).

The Higg Index 2.0 is a tool that educates small and large companies to recognize challenges and sustain improvement. The self-assessment tool helps scientific learning by means of identifying the vital aspects of environmental sustainability and opportunities that will provide improvement. This index is the basis for future operations and efforts to ensure sustainability and is the starting point for the commitment, learning, and collaboration among stakeholders. Regardless of the company size, it allows beginners and leaders in environmental sustainability to detect opportunities by means of a spectrum of performance tools. The organizations who use this index can start from any module that is most comfortable to them, after which they can branch out whenever suitable to other Higg Index tools. There is no hard-and-fast rule to use all the modules (SAC 2012h).

3.2 Suite of Tools: The Higg Index 2.0

The Higg Index 2.0 tools fall under three heads: facility tools, brand tools and product tools, as shown in Fig. 3. The facility tools include Facility Module: Environment—Apparel/Footwear and Facility Module for Social/Labor—Apparel/Footwear beta. The facility module for the environment helps to assess the performance of materials, packaging and manufacturing facilities, whereas the second module is used for the social and labor performance of materials, packaging and manufacturing facilities.

There are three brand tools. Environment: Apparel is used to assess apparel products with special reference to the specific environmental practices at the brand level. The brand module Environment: Footwear functions the same as the previous module but the product is footwear. The brand module Social/Labor: Apparel/

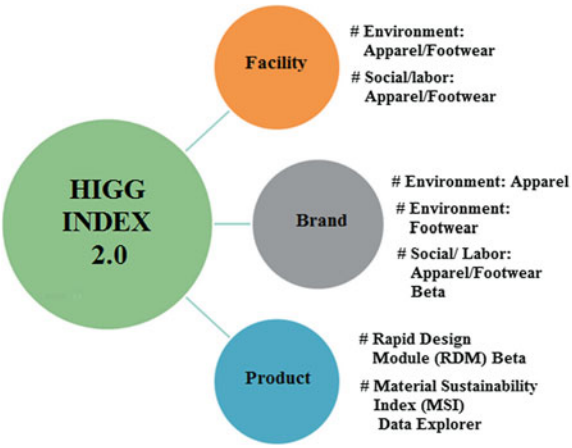

Fig. 3 Higg Index 2.0—suite of tools (SAC 2012h)

Footwear Beta is used to assess the specific social and labor practices for both apparel and footwear at the brand level.

The Rapid Design Module (RDM)–Beta and the Material Sustainability Index (MSI) Data Explorer are the two assessment tools for measuring the impact of products. The most important feature required is a product design that leads to sustainability. The RDM helps to guide designers toward sustainable product design by providing vital data and the support framework to enable them to make the right decision. The MSI Data Explorer is an online interface that helps the users to understand the method and strategy behind the MSI Base Material Scores used in the RDM–Beta. It also serves as a platform for the submission of data to improve the quality of the material scores or help in the addition of new materials (SAC 2012h).

The MSI is based on the data derived from the lifecycle assessment, which deals with cradle-to-gate information on apparel and footwear products. This module was originally developed by Nike and then incorporated into the SAC Higg Index, thereby measuring the environmental and social performance of apparel and footwear products. The lifecycle assessment takes into account the raw material origin and processing involved, premanufacturing, actual material/product manufacturing and the postmanufacturing processes. The assessment is usually taken in two stages —namely from raw material to the intermediate stage as phase I and the intermediate stage to the final product as phase II (SAC 2012i). A 50-point scale with 13 individual indicators is used to score the impact of base materials.

The key improvements between the Higg Index 1.0 and Higg Index 2.0 are summarized in Table 1.

The environment impact areas under consideration for the evaluation of product sustainability across the entire lifecycle of a material are chemistry, energy, greenhouse gas intensity, water and land use intensity and physical waste. The land use intensity concentrates on the origin of the raw material in phase I and is not considered elsewhere in the material lifecycle. Table 2 gives the contribution and scores for each factor under an evaluation of base materials (SAC 2012j).

Table 1 Comparison of Higg Index 1.0 and Higg Index 2.0 (SAC 2012h)

	Higg Index 1.0	Higg Index 2.0
User interface	Microsoft excel	Web tool and microsoft excel
Assessment type	Qualitative Indicators	Qualitative indicators + facility quantitative data (data values are not scored)
Sustainability topics		
Environment	Yes	Yes
Social/labor	No	Yes
Product categories		
Apparel	Yes	Yes
Footwear	No	Yes
Value chain area		
Higg Index tools	Brand module (environmental) Facility module (environmental) Product module	Brand module (environmental + social/labor) Facility module (environmental + social/labor) Rapid design module—beta
Validation	None	Pilot of validation protocol for environmental facility module
Material assessment (MSI)	44 materials	46 materials, with 2 new and 2 updated from public data submission
Chemistry	Basic indicator questions (environment); MSI	Incorporate content from chemicals management module and refer users to full assessment: social/labor
Benchmarking	None	Enabled through web tool
Section weights (environmental modules)	Equal weighting is default, with option to choose custom or SAC-recommended weightings	SAC-recommended weightings are default, based on survey of SAC members

The SAC and stakeholders can review and compare material data and scores because the MSI dataset is open source. This will help to bring about collaboration and transparency in data across the apparel and footwear industries (SAC 2013a, b).

The RDM–Beta is an original product to test the efficiency of a tool that aims to provide education and guidelines to apparel and footwear designers to study the impact of their design creations on the environment. This is a modified version of the Higg Index 1.0. It allows the designers to get involved in the process and methods of lifecycle assessment and the methods by which the materials are assessed for sustainability through the MSI. The RDM–Beta is a product-focused tool, which helps to gather information that will be useful for the modification of the tool. The feedback from members has resulted in the formation of a post-2.0 module task force, which aims to develop a broader strategy for the product module in the Higg Index (SAC 2012j).

Table 2 Material sustainability index scores (SAC 2013b)

Impact area	Indicator	Maximum points
Chemistry	Carcinogenicity	2.5
	Acute toxicity	2.5
	Chronic toxicity	2.5
	Reproductive toxicity and endocrine disruption	1.4
	Subtotal	9
Energy and greenhouse gas (GHG) intensity	Energy intensity	4.4
	GHG intensity	6.6
	Subtotal	11
Water and land use intensity	Water intensity	9.4
	Land use intensity	3.6
	Subtotal	13
Physical waste	Hazardous	6.8
	Municipal solid waste	4.3
	Industrial	3.4
	Recyclable/compostable	1.7
	Mineral	0.9
	Subtotal	17
Grand total		*50*

3.3 Areas for Improvement in the Higg Index

Although the Higg Index 2.0 was introduced after analysis, pilot testing, and feedback, there is always room for improvement. The index format will tend to change according to the situation, challenges and real-time situations. Some of the areas of improvement are discussed below. The needs of the users in the industry are varied and require tools that would help them to make sustainable choices. Product assessment tools can be improved by the RDM–Beta, which continues to test various theories on how to get the necessary sustainability information for making critical decisions. The index should provide facility for the inclusion of quantitative data and metrics. Qualitative questions should be substantiated with numerical data, thereby providing accurate information on environmental performance, such as energy use data (SAC 2013c).

The scoring system can be improved by a thorough and systemic review of scoring principles and their application to the index and support data on point allocations. The scoring of packaging can be improved by the Material Sustainability Index. The section weighting could be improved by using a panel approach involving a larger group of stakeholders and a multicriteria-based approach to allocate weights. Consistent benchmarking could be assured by aligning one set of weights to enable a product comparison for business decisions and communication

with customers. Many brands, facilities and suppliers usually invest in key certifications and standards; the index should prescribe equivalents and fit a set of questions that would address these certifications. The Material Sustainability Index needs to be continuously refined as the database expands and more data, information and methodologies become available when there is an increase in industrial and stakeholder engagement. The SAC should develop an assurance process to help organizations build confidence in response to third-party assessments (SAC 2012h).

4 Assessment Tools for Apparel and Footwear Products

The textile and apparel sector is an important and emerging industry that relies heavily on manufacturers and the labor force, thus making the supply chain very fragmented and risky and thereby leading to a major sustainability challenge. Sustainability issues are very stringent and call for transparency throughout the supply chain. In California, the Supply Chain Act requires all companies with an annual gross turnover exceeding $100 million to publicly disclose the nature and scope of the corporate compliance efforts to prevent human trafficking, slavery and child labor in their global supply chains. Furthermore, the sustainability issues inside the region or industry face regulations that safeguard the workers' rights and preferences, such as the Bangladesh Accord and the Bangladesh Worker Safety Alliance. The zero discharge of hazardous chemicals initiative (2011) compels the footwear and apparel industries to work with their suppliers and contract factories to eliminate all releases of toxic substances and hazardous chemicals into global water sources. Legislation and reform in the area of sustainability have changed the outlooks, manufacturing and industry environments and evaluation methods and tools for assessment are used to quantify the sustainability parameters (Ceres 2011).

4.1 Tools for the Assessment of Environmental Impacts

The SAC quantifies product lifecycle impacts in a standardized way with the help of the product category rule guidance document. The product category rule guidance document consists of 80–90 methodological questions, which are common across all categories of products. A review process was carried out to ensure that the document is in line with the current best practices and is devoid of duplication and potential errors. The SAC has created three PCRs based on the review and reports: one for t-shirts, one for coats and jackets, and one for slacks and shorts (SAC 2013d).

The Outdoor Industry Association Sustainability Working Group is currently collaborating with SAC to develop sustainability indexes for apparel, footwear, and equipment. There are three categories of facility tools that are to be used by facilities, vendors and manufacturers to assess specific facility sites. The facility modules are for Environment/Social-Labor: Apparel/Footwear/Equipment. The brand modules

are used to assess apparel or footwear product-specific environmental practices at the brand level. The brand modules are for Environment: Apparel/Footwear and Social-Labor: Apparel/Footwear–Beta. The product tools are used to understand the impact of products, which include the MSI and RDM–Beta. All these tools are grouped under the Higg Index (Outdoor Industry Association 2014).

The Outdoor Industry Association's Chemicals Management Working Group has developed the Chemical Management Framework, which is a comprehensive assessment tool to guide companies along the entire apparel and footwear product chain towards better management of chemicals for regulatory compliance to sustainable chemistry innovation. The goal of this framework is to eliminate hazardous chemicals in consumer products and their emissions in the workplace and environment. The Eco Index is one such self-assessment tool, which works towards the same goal jointly developed by the European Outdoor Group and the US Outdoor Industry Association (ISPO 2014).

Nike Inc's Environmental Apparel Design tool is designed to reduce the environmental footprint of apparel and footwear products. This tool uses a numeric scoring system based on the data filed by the manufacturer for each specific category. The category points are added together and then ranked within a range: good, better, best or needs improvement. About 60 % of the environment impact of the garment is related to materials. The evaluation is in terms of issues including energy, chemistry, carbon dioxide, water, land use and waste. The Material Assessment Tool gives scores for materials based on 21 metrics in specific impact areas. The scores for materials range from 0 to 100, with assessment values such as an additional 5 points for garments that use a single-fiber raw material because they are totally recyclable; conversely, 5 points may be deducted for coating and laminating fabrics with a dissimilar material (Eco Textile 2014).

The Sustainability Reporting Framework helps in measurement, disclosure, and accountability to internal and external stakeholders for the organizational performance towards sustainable development. Like many other sustainability tools, it works on economic, environmental and social impacts and can be used for benchmarking, demonstrating and comparing the performance of the industry. The Sustainability Reporting Framework (Fig. 4) consists of principles for defining report content and ensuring the quality of reported information. This includes standard disclosures made up of performance indicators and other disclosure items, as well as guidance on specific technical reports. Indicator protocols exist for each of the performance indicators present in the guidelines and provide definitions, compilation guidance and information to assist with report writing. The sector supplements provide information on how to apply the guidelines in the given sector. The technical protocols provide guidelines on issue of reporting, setting the report boundaries and working in unison with all other parts of the framework. This sustainability tool works for issues such as economic, environmental, social, human rights, society and product responsibility (RG 2011).

RDC Environment specializes in the quantification of the environmental impact of products through lifecycle assessment, carbon footprinting, inventory for greenhouse gases, energy audits and waste and water management projects. This

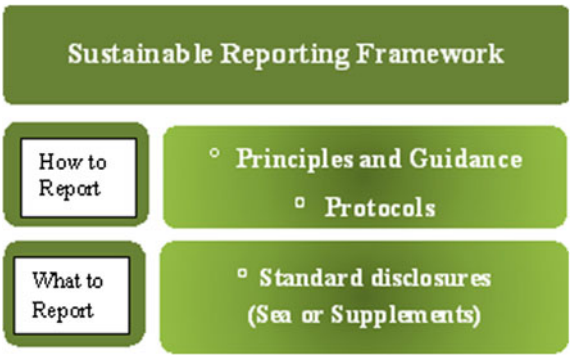

Fig. 4 Sustainability reporting framework (RG 2011)

tool is based on transparency, ethics and objectivity and provides advisory services and consultancy services for environmental studies. This software uses preintegrated LCA methodologies and is standard-compliant with ISO 14040-44: 2006 and with the product category rule. This tool identifies the hotspots for assessment and provides comparisons with other organizations or within the same organization before and after implementation of steps to promote sustainability (RDC Environment, LCA Tools. http://www.rdcenvironment.be/. Accessed 2 May 2014).

4.2 Lifecycle Assessment

LCA is a global analysis of the direct or indirect impact of a material, process or service from raw material extraction to the end of life of a product. This tool has a four-step approach:

(1) Definition of methodology and needs
(2) Data collection and LCA modelling
(3) Data classification
(4) Tool interface customization and development

The first step is to define and fix the criteria for the allocation of system boundaries and the scope of the study, the fixation of LCA methodologies and specifications to be used in the tool, such as the provision for ecodesign action, environmental footprint for labelling or work with suppliers. The second step is to collect the two types of data necessary to build the LCA model—namely, the activity data (e.g. quantity of tons produced, yields of production) and the emission factors (quantity of CO_2 generated per process). To achieve the required precision with minimum effort, the data collection and selection of external sources were performed in an iterative manner, as recommended by the International Reference Life Cycle Data System Handbook. The first iteration deals with rough data collection, with minimum and maximum values; association of the assumptions based

Table 3 Data classification (Ooms et al. 2012)

	Data accessibility (cost of data research)	
	Easy →	Hard
Influence on the results + ↓ −	Specific	Half-specific
	Half-specific	Generic

on the textile producer; the use of general or average data for the background and the presentation of preliminary results to identify the key processes and parameters. The second iteration would include additional data collection and fine-tuning of the parameters that have a significant impact. The last iteration will eventually give reliable conclusions. The activity data included bibliographic reviews of national, international or European data while the emission factor dealt with a review of main LCA databases at European or international levels and inventory data, as well as data based on the experiments and visits performed previously (Ooms et al. 2012; Wolf et al. 2012; EC-JRC-Institute for Environment and Sustainability 2010; Wolf et al. 2011; EC-JRC 2008).

The third step is data classification (Table 3) which includes specific data (the data entered into the tool by users), half-specific data (default values entered due to lack of knowledge or cost factor) and generic data (the entered default values not accessible in the interface).

The last step is to develop tool interfaces in response to step 1 and step 3 and to define data and export results. The results are used to assess ecodesign action, calculate the environmental footprint, work with suppliers to improve their processes and improve specific and half-specific data reliability. A standard version and an expert version are available for use. The standard version deals with the initiation of LCA and eco-design, whereas the expert version develops LCA and eco-design skills through the industrial supply chain (Ooms et al. 2012; Paragahawewa et al. 2009).

4.3 Social Lifecycle Assessment

Today's consumers are conscious of their choice of products and their impact on the environment and local economies. The evaluation will include choosing products that will result in less pollution or greater sustainability. The product choices will have social and socioeconomic effects on workers and entire communities where the production takes place. These social and socioeconomic effects are the major focus of a social or socioeconomic lifecycle assessment (S-LCA). This assessment also facilitates the social responsibility of the companies by providing information about the potential social impacts on people caused by the activities in the life cycle of the products offered to the consumers. The S-LCA, when combined with the environmental lifecycle assessment (E-LCA), will result in a holistic approach and will move toward sustainable production and consumption.

The S-LCA methodology has four major steps: goal definition, scope definition, inventory analysis, and impact assessment (UNEP 2009; LCI 2013). The nature of social impacts may be either negative or positive when compared with a specific human value or standard prescribed by the society or law. The primary concern of the E-LCA is the protection of environmental qualities in line with the values of society with regard to environment. The areas of protection by the E-LCA are human health, natural environment, natural resources and manmade environment. The S-LCA has another dimension, human dignity and well-being, added on to the areas of protection to supplement the human health factor. The ultimate goal of the S-LCA is to improve the social conditions throughout the lifecycle of the product with the central concept of human well-being.

The goal of S-LCA studies is to compare the extent of negative social impacts and the greatest social benefits of two similar products manufactured by different methods, thereby providing information to consumers to help them to make ethical choices. The second goal is to identify the hotspots in the production process or manufacturing centers that have negative social impacts, the short-term results and the long-term impacts, the victims of the impacts and how these can be addressed. The main stakeholders include workers/employees, the local community, society (national and global), consumers and value chain actors. Further categories that are under consideration for inclusion are NGOs, the state and future generations.

The system boundaries are set using the ISO 12044 framework and the social indicators are assessed at the organizational level rather than the individual level. The S-LCA indicators are categorized as quantitative, qualitative and semi-qualitative. In E-LCA, the impact of indicators is based on the numerical values of endpoint indicators, whereas the S-LCA uses midpoint and endpoint indicators. Some endpoint indicators in S-LCA are mortality, morbidity, autonomy, safety, security, tranquility, equal opportunities, participation and influence. The inventory analysis collects data on the social impacts to be considered in relation to behavior of the company towards the stakeholders. The impact of the assessment is based on the grouping of data based on the social setup to provide substantial conclusions. This is a difficult task and requires a great deal of correlation of data and classifying the data to get results. The general steps to achieve the objective of the S-LCA are the identification of significant social issues, such as infringement to human rights or labor laws, evaluation of the study in terms of completeness, consistency, appropriateness of methodology with respect to goal and scope, conclusions and recommendations based on the goal and scope of the study and finally reporting the involvement and participation of stakeholders in the particular case under study.

There are many limitations of S-LCA because it is a new process and not many studies have been undertaken. There is much debate on the appropriateness of the methodology, inclusion of stakeholders and interpretation of data. Practitioners should be skilled in LCA as well as in social science, corporate social responsibility and social impact assessment. In S-LCA, the use phase has not been included because it is very difficult to assess; hence, this stage of assessment requires further development. The field is still in the early stage and requires a lot of input from many social researchers and experienced socialists (Subic et al. 2013).

4.4 The Capability Assessment Tool for Sustainable Manufacturing

In general, performance apparel and footwear have a heavy carbon footprint due to pollution, extensive use of nonrenewable resources and waste during manufacturing. An example for the extent of the environmental impact of sports apparel at the different stages of the lifecycle of the product is shown in Table 4. The art of reducing or alleviating these impacts is highly dependent on the skill of the faculty and management to identify and implement these improvements within the particular environment.

Green manufacturing is a relatively new concept. The industry needs to develop knowledge, skills and values to incorporate such concepts into the manufacturing system. This is possible only when sustainability targets are set and monitored by efficient and capable personnel. Traditionally, environment management systems and sustainability frameworks encourage environmental awareness and focus on strategy and decision making. However, an assessment framework is essential to identify capability gaps in order to achieve the environmental sustainability targets and to encourage suppliers to take part in environmental initiatives. Due to the many gaps in the existing systems, it was essential to develop a new framework to assess the particular capabilities across the supply chain of the manufacturing industries, which could be applied to a broad range of industries. The new framework had to be objective-based with a focus on the environmental footprints and associated capabilities at the manufacturer's level, thereby enabling provisions for real value additions to different types of manufacturers.

The Capability Assessment Tool for Sustainable Manufacturing is used to identify the gaps in capabilities and associated training and development requirements all along the supply chain for sustainable manufacturing. The first step for assessing a supplier's capability with regard to sustainable manufacturing was to

Table 4 Environmental impacts across the lifecycle of sports apparel

Lifecycle stage	Environmental impact
Raw materials (growth, acquisition, and processing)	Resource consumption, greenhouse gas emissions, air/water pollution and toxicity, soil degradation/contamination, biodiversity/land use, solid and hazardous waste
Fiber production (natural and synthetic)	Greenhouse gas emissions, air/water pollution and toxicity, soil degradation/contamination, biodiversity/land use
Clothing production and garment assembly	Greenhouse gas emissions, air/water pollution and toxicity, soil degradation/contamination, biodiversity/land use
Packaging	Solid and hazardous waste
Distribution	Greenhouse gas emissions
Retail	Solid and hazardous waste
Use	Resource consumption, solid and hazardous waste
End-of-life management	Greenhouse gas emissions, solid and hazardous waste

Table 5 Sustainable manufacturing framework

	Cluster	Applied outcome
Resource management	Energy efficiency	Reduce energy use Maximize alternative energy resources
	Water efficiency	Reduce water use Increase alternative water supply
	Material efficiency	Optimize material flow and usage Manage inventory and usage
Emission management	Control and reduce Environmental Flow	Implement and apply waste management hierarchy Handle, store, treat and dispose appropriately Prevent groundwater and land contamination
	Carbon emissions	Account for carbon emissions Reduce carbon emissions
Improved environmental management practices	Effective environmental management system	Enhance auditing and environmental monitoring performance Comply with environmental systems
	Environmental decision making	Implement industrial clustering and resource pooling Undertake risk assessment (environmental and business) Identify, develop and implement business cases for sustainability improvement
	Continued environmental improvement	Lead environmental management initiatives Innovate for environmental improvement (including process optimization)

develop a Sustainable Manufacturing Framework (SMF), shown in Table 5, in consultation with the manufacturer and participating suppliers along with a review of the sustainability targets and documents of the manufacturer and similar global manufacturers.

Assessment of 170 capabilities can be done for areas of concern, such as managing of energy, water, resources, carbon emissions and waste as well as environment management practices for sustainability. Environmental indicators and initiatives set by the manufacturer are grouped under eight clusters of the framework and environmental capabilities and the associated indicators are classified under three management categories: resources (energy, water and material), emissions (greenhouse gases and waste) and the environment (ISO 14001 etc.). The Sustainable Manufacturing Framework formed the basis for the development of Comprehensive Capability Metrics Assessment Tool, which used a five-point Likert scale for assessment. Four assessment methods were selected: a walk-through assessment based on observation of capability in work activities, a questionnaire based on simulated workplace activities, interviews through responses to verbal

questions and work samples or projects indicating prior demonstration of capability. The number of methods used for assessment depended on the need and requirement. Each assessment method had a set of questions to be answered by a focus group and the overall score of the cluster was generated using the following formula:

$$C = \frac{1}{2NA}\sum_{n-1}^{N}\left(\sum_{n-1}^{Mn}\frac{\left(\left(\sum_{a-1}^{A} C_a\right)_{method1} + \left(\sum_{a-1}^{A} C_a\right)_{method2}\right)}{M_n}\right)_n$$

where C is the overall average score of the cluster (a number between 1 and 5) calculated by an assessment group i; A is the number of assessors; N is the number of applied outcomes under the cluster being assessed (1, 2, or 3 as per formula); M_n is the number of capabilities under the applied outcome of n (n varies from 1 to N), which is a number between 5 and 16 depending on how many capabilities are listed under the applied outcome; and C_a is the score given to a capability by an assessor based on any method used for assessing that capability.

The results of the assessment are compared with the minimum expectations of the manufacturer in terms of applied outcomes and clusters, and the gaps in the capabilities are identified followed by the formulation of a capacity-building training program for the suppliers to enable them to attain knowledge and skill for meeting the environmental targets set by the manufacturers. The sensitivity analysis will show the cluster-based overall results determined by the different assessors, which are reviewed as the assessment is conducted by two or more independent representative assessors. The difference in the scores was used to calculate the maximum effect of such a difference in the overall score of the cluster. The results also reveal the degree of agreement between the different assessors and also helped to identify the lacunas among the suppliers, showing the need for training and improvement, which will lead to the achievement of the environmental targets (NAEM 2014).

5 Future Directions

The Sustainable Apparel Coalition has been leading the apparel industry toward a vision of sustainability built on a common approach for the evaluation of the performance of the stakeholders with regard to sustainability. This coalition has a commitment to leadership to steer the apparel and footwear industries in the right direction of ethical, social and environmental practices. The members of the SAC are from varying perspectives, interests, and locations; the coalition has nurtured an open culture of equality, respect, and transparency, thereby promoting unity and faith in the members to move towards sustainability. This organization has formulated many tools and indexes for assessment with great speed and efficiency and is making progress with great planning and dedication. However, many important

factors have contributed to the success of the organization, starting with committed organizations and members, planning of meetings to collaborate and deliver results, involving members in index development and highlighting leadership and work towards opportunities, innovation and action. The future holds promise for sustainable development due to the forecasts and opportunities that are focused, discussed and developed. Some of the trends and initiatives are discussed here to demonstrate the future role of sustainability.

5.1 Macro Trends for the Future

The National Association for Environmental Management has been tracking corporate environmental management programs and has documented the emergence of corporate sustainability. They have identified the trends for the global future in terms of global sustainability and environmental management. The top leadership companies have turned their attention toward these trends. They envisage that environment management has many factors woven together, contributing to complex business problems and the sustainability curve.

- Resource Management: The current major resource issues are energy and water management. Energy programs for the conservation of energy, alternatives to fossil fuels and energy efficiency are being formulated; the primary focus of water is being highlighted by programs focusing on water risk assessments, water conservation visions and the development of site-specific strategies.
- Product Sustainability and Compliance: Regulations such as REACH and RoHS have ensured that many industries are pursuing a number of programs to bring sustainability to their products. These include product labelling, carbon footprint assessment, green chemistry and reduction of upstream impacts.
- Supply Chain Transparency: Companies are focused on seeking data from their suppliers to fulfill the compliance standards of creating data sheets for potential risks in the supply chain, manufacturing methodology and end-of-life recycling.
- External Reporting Requirements: Reporting has become an essential part of sustainability and materiality has become a rubric for external environment, social and governance reporting.
- Employee Engagement: This factor has become a top priority in 2014 and cultural changes at all levels are facilitated by adopting new ways to bring about the change.
- Climate Change Adaptation: Most companies have started the process of conducting a comprehensive climate risk assessment of their operations and are involved in developing the results into climate adaptation plans.
- Next-Generation Sustainability Goals: The strategic planning of sustainability goals has begun and goals have been set by many companies to mature in the coming years. People have become conscious and this process will continue for the future.

The concepts that will enable us to fulfil the goals of the future are *integration of sustainability* at all levels of the organization, *engagement* in valuing future prospectives in the environmental and social context. *Transparency* has become a business initiative for product stewardship and for suppliers with business-to-business orientation. *Collaborative efforts* will lead to shared benefits, problem solving and realizing the capacity of companies and *resilience* to enable an industry to become responsive, interdependent and ultimately flexible and adaptive (Yoemans 2014).

A common idea until recently was that many manufacturers were unable to reach a majority of the consumers to convey their ideas for sustainability. Hence, sustainability issues were discussed only with stakeholders, NGOs, investors and specific media. The Social Media Sustainability Index 2013 has helped industries to convey the concepts of sustainability to far-reaching consumers, who are responsible for spreading the message of sustainability at the product, brand and facility levels (DEFRA 2010).

5.2 Future Action Plans

The action plans with regard to sustainability and environmental protection activities are many. The participation of industries and manufacturers in sustainability actions will surely increase over time. Projects such as increasing the public understanding of sustainable clothing, unlocking consumer behavior for sustainability benefits, using sustainable fibers and fabrics that move forward, reducing energy and chemical intensity in clothes cleaning and maximizing end-of-life clothing reuse and recycling would prove to be useful to industries and provide data for sustainable solutions. Development of regulations, policies and voluntary groups would serve to bring awareness to and streamline sustainability issues. Members of the group and stakeholders can participate by giving suggestions and consumers could give their views and feedback for a more strategic approach.

Action plans in areas such as improving environmental performance across the supply chain, consumer trends and behavior, awareness, media, education and networks, market drivers for sustainable clothing and instruments for improving traceability along the supply chain would bring about changes in the minds of both the business community and the consumer to improve the sustainability of clothing. The prime areas of change for the consumer would be to ease the impacts of buying, maintaining and disposing of clothes. For the business community, this would require developing and offering ranges of clothing that have enhanced social and environment sustainability qualities; informing and helping consumers about areas where they can impact a change; bringing about better environmental, labor, trade and animal welfare practices; establishing traceability all along the apparel supply chain; and working with the government and other stakeholders to identify and implement best practices. The Department for Environment, Food and Rural Affairs, UK, suggests that many case studies and policies should be carried out on a global level, such as the Green Public Procurement and the International SCP

Policy aimed at improving the supply chain among manufacturers who export to the UK. This organization also suggests influencing consumers through a direct government environmental website, where web pages could be developed to advise consumers on how they can reduce the environmental footprint for their clothing consumption (TFIA 2014).

Many important initiatives are being undertaken around the globe to promote sustainability and ethical supply. Clean Energy Future is an official website of the Australian Government that outlines the plan for a sustainable and prosperous country. This forum links with all the programs administered by various government departments under the Clean Energy Legislation and also has a section on assistance for the industry. The Ethical Clothing Australia website has a section for manufacturers and brands explaining the accreditation process and an ethical shopping guide for consumers, which shows a list of accredited brands that demonstrated legal obligations and standards were met throughout the supply chain. The Banksia Environmental Foundation is a nonprofit organization that promotes environmental excellence and sustainability through its award programs and other associated events. Some of the most prestigious awards include the Prime Minister's Environmentalist of the Year Award, the Environment Minister's Young Environmentalist of the Year Award, the Mercedes-Benz Research Award, and the Brian Robinson Fellowship. All these activities and initiatives show that the future looks promising for sustainability plans and accomplishments at all levels—the individual consumer, the community, society and governments across the globe (TARGET 2012).

Many organizations are involved in sustainability commitments with the help of sustainability focus teams. The first effort should be directed to sustainable living where consumers and members of the group will be empowered by the right information, tools and incentives to lead more sustainable lifestyles. Consumers should increase their selection of sustainable products to effectively balance price, performance and convenience. Smart use of resources, such as the effective use of space in retail outlets and improving connectivity between the organization and local communities, is necessary for future development. The responsible use of resources, eliminating waste and minimizing carbon footprint are some of the measures for sustainability commitments (Ulibarri 2011).

5.3 Challenges Facing SAC

The SAC planned to create a database to track the environmental impact and fair labor practices for the apparel and footwear industries. In this regard, the SAC would create a universal index to set standards for apparel manufacturing in terms of energy usage, fair labor practices, waste reduction and water quality. Eventually, the data collected will serve as a base to create a consumer label that would inform the consumer about the sustainability rating of the product (Kester and Ledyard 2012).

The key challenge facing the organization is to make the Sustainable Apparel Index workable and usable to ensure adoption of the tool by all industries and manufacturers in the related field. The standards that support sustainability and the real-time practices must be coordinated and negotiated to make it workable. This requires coordination across the globe and untiring effort to make the index part and parcel of the system. Apart from adoption of the tool, questions remain as to whether the data obtained is meaningful for benchmarking, how the data could be shared, and whether it will be useful to encourage the members to innovate and improve. The organization was environment focused when it launched the index in 2012, but the social and labor indicators have been added into the index and the progress in that direction is very slow. It has been difficult for the organization to come to a consensus regarding standards and metrics for the social and labor aspects and include them into the index.

The credibility of the index will depend on the verification of the data compiled by the members of the organization. Much time and effort are required for third-party verification, for which funds have to be allocated. The authentication of the reported data, the responsibility of additional monitoring to ensure the incorporation of the results and the associated costs have to be addressed. Some members of the coalition are keen on conveying their sustainability scores to the consumer to capture the market, while others are assessing the feasibility of the idea and feel that this communication would serve to confuse the consumer because many eco-friendly ideologies already exist in the apparel market. The SAC has to decide on its overall approach to communication and branding and must send a clear message at the product, brand and facility levels (Nike Inc 2012a).

The organization should aim for representation from around the globe by way of membership and members in the organizational setup. Apart from the board of directors and the working team, there should be an intermediary board/system that has representatives from all parts of the world. This will enable better understanding of the data collected, problems interlinked with product development, supply chain activities and consumer attitudes. The manufacturing environments, government policies, duties and taxes, infrastructure, equipment and process methodologies vary from place to place and require immense planning and analysis for implementation of schemes and systems. This process of sustainability, which is now under the purview of the industries and organizations, should move to a larger scale on a governmental and global level, so that essential requirements for tool implementation and coordination would be enhanced. Data, which is received from all around the world, must be catalogued and stored for future reference and use. Provisions should be allocated for sharing of knowledge, research and development, and efficient personnel employed for the analysis and interpretation of data to foresee and forecast the action plan for the futuristic years. Research conventions, conferences and symposiums should be held to serve as a platform for interactions between the members and the outside world. Results of the research platforms and organizations with regard to all features of sustainability should reach the manufacturers and consumers. This can succeed only when the research efforts are converted to industry-viable solutions through organizations devoted to this cause.

Promotional activities should be undertaken to create awareness among consumers and they should effectively create a long-lasting image that would encourage consumers to think in terms of sustainability and green economy. Funding for all of these activities should be raised from members, organizations, industries and other international sources. On the whole, the focus should be on sustainability, from the grassroot level to the highest authority.

The SAC has grown to great levels since its inception in 2010. The feedback received has highlighted that the Higg Index is being used as a common measurement tool by apparel and footwear industries and members in the supply chain to undertake sustainable practices to bring about change and improvement. This organization is unique and the development of a strong unified culture is a foundation for future increases in membership and the evolving expectations around sustainability. The transference of the lessons learnt across the apparel industry and its supply chain and communication of the accomplishments of the SAC to consumers, would help in moving the organization forward on the path of success.

6 Nike, Inc.: A Case Study

Nike, Inc. is the world's largest athletic footwear and apparel company, with a mission to inspire every athlete in the world to reach his or her fullest potential. The cofounder Bill Bowerman was a visionary who perceived human achievement through sport. Innovation is at the heart of the organization to serve athletes, which will form the basis of growth of the organization and in turn provides inspiration to achieve. Nike serves sports personnel with five distinct brands that have a powerful rapport with their customers. Sport-inspired lifestyle products including footwear, apparel, equipment and accessories are designed, developed and sold under the high-quality athletic performance gear category. Casual sneakers, apparel and accessories are designed, licensed and marketed by Converse, Inc. Hurley International LLC designs, markets and distributes surf and youth lifestyle footwear, apparel and accessories. The dynamic legacy, vision and direct involvement of Michael Jordan serves as an inspiration for the Jordan brand of premium footwear. Golf equipment, apparel, balls, footwear, bags and accessories are designed and marketed by Nike Golf.

Nike, Inc. has its headquarters near Beaverton, Oregon, USA. Contract factories in more than 40 countries manufacture products that are sold in nearly every country around the world. In 2013, Nike's global workforce was approximately 48,000 employees located worldwide. The company has more than 750 retail stores, 90 administrative offices and more than 110 sales offices and showrooms. Over the past 10 years, the revenue has more than doubled. It has been estimated that revenue will be $30 billion by the end of fiscal year (FY) 2015 and $36 billion by FY17. Strong growth has been estimated in the field of sports gear for running, basketball, football, men's and women's training sportswear and direct-to-consumer sales. Sustainability is one of the key drivers for innovation and continued

growth. The integration of sustainability into every aspect of the business is the aim of Nike and the greatest challenge is to explore ways that would enhance performance of the wearer in terms of design, materials and manufacturing (www.cmu.edu/teaching/designteach/teach/instructionalstrategies/casestudies.html. Accessed 1 May 2014).

A case study examines realistic, complex and content-rich events or situations that center on a problem or conflict. Usually, the facts surrounding the problem are highlighted as it becomes a source for discussion and debate. The case study is a link between theory and practice and between academy and industry. Case studies shed light on the parameters of the problem, the evaluation of courses of action, and the possible solutions to or the reasons and remedies for the problem (Nike Inc 2012b).

Sustainability, which was a domain for experts and ideologists, has become one of the key drivers of success for any industry or manufacturing company. In the future, we will likely find environments where competition for scarce natural resources will affect the cost and availability of raw materials for manufacturing. The traditional methods of manufacturing are slowly giving way to new sustainable models because there is immense pressure due to rising energy costs and greenhouse gas emissions. Regulations related to raw materials, labor practices and other issues are shaping the business environment to face these challenging demands.

Sustainable innovation is a current trend. At Nike, an executive-level committee for sustainable innovation was formed in 2011 to monitor and capitalize on opportunities by the adoption of new strategies on a commercial scale.

Sustainable innovations have been implemented based on a four-way approach using interconnected insights and disruptive innovations (Fig. 5). The first pillar for sustainability is the choice of materials for the products, which affects the entire value chain and the creation of a portfolio of sustainable materials (Nike Inc 2012c). Extensive work has been done on ways to improve the environmental attributes of materials for over a decade. The material rating tool—the upgraded version of Nike

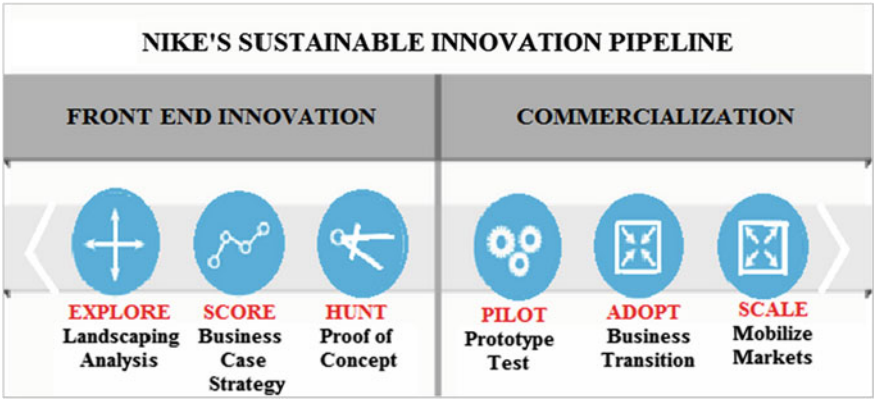

Fig. 5 Nike's sustainable innovation pipeline (Nike Inc 2012c)

Material Sustainability Index—is being used by designers and developers to identify affordable materials that meet environmental standards because materials form a substantial part of the product cost. It has been estimated that 60 % of the lifecycle environmental impacts of a product are due to raw materials and 25 % are accounted for by the manufacturing process. The remaining 15 % is allocated for transportation, retail, office facilities, packaging, use and disposal. The assessment focuses on the choice of materials used (recycled or recyclable), processing methods (showing reduced usage of energy, water, chemicals and waste), better choices (index creation, restricted substance list, policies, operating methods, and sharing of information with vendors and suppliers) and bringing choices to scale (increasing the scale and availability of new materials, enabling recycling of materials and sharing of intellectual properties).

The difficulty of making a choice among materials is overcome by the evaluation system for the environmental impacts of materials evolved at Nike, in which 80,000 materials have been assessed for their environmental impacts. The product design teams work in synergy with these results when choosing raw materials. Sourcing of the materials from independent vendors is based on the quality and the environmental impacts. In 2006, Nike introduced a design system (Considered Design) coupled with evaluation systems (Considered Indexes), which enables the product design teams to quickly select the proper material based on sustainability during the design phase. Training is given to the design teams and scoring targets are given for each season of products they design. The Considered Indexes make up 35 and 60 % of the score for footwear and apparel, respectively. Nike and affiliated brands have begun using these tools for the evaluation of their product designs and the tool is being modified and updated for the current environment.

The Material Sustainability Index (Fig. 6) is also applicable for material vendors and about 500 material vendors have been trained to use the Index. Material vendors are also given scores based on the criteria/standard that they have followed, such as complying with the restricted substance list, Nike water requirement program, global recycle standard and ISO 14001 certification. This will encourage the

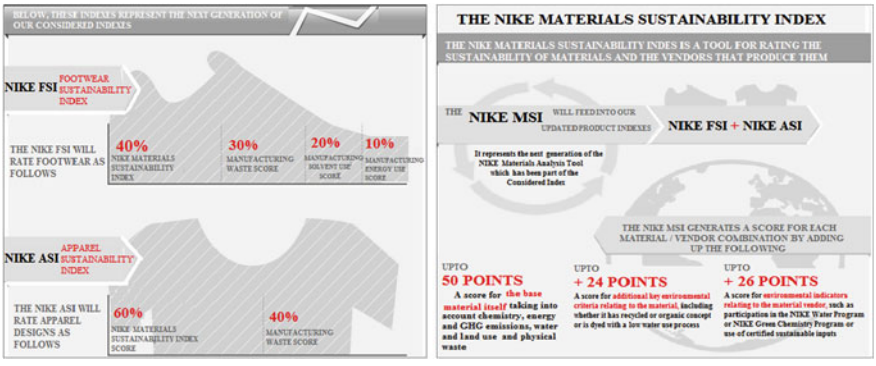

Fig. 6 Material sustainability index (Nike Inc 2012b, d)

vendors to develop more eco-friendly materials, which will fetch them higher MSI scores. The evaluation of the footwear and apparel products of the Nike Brand revealed that in FY 2011, approximately 97 % of the footwear and 40 % of apparel products met the baseline requirements. Efforts are being directed toward a 100 % achievement for both footwear and apparel by FY 2015 (Nike Inc 2012d).

The second pillar for sustainable innovation is prototyping and scaling sustainable sourcing and manufacturing models, which will affect the activities vital to the value chain. The vision of the organization is to create a sustainable supply chain that is lean, green, equitable and empowered across all the brands produced. The Manufacturing Index, launched in 2012, gives same weightage to the performance of a factory and sustainable manufacturing practices as it does to traditional measures of quality, delivery, cost and sourcing evaluation. The index measures the progress of the worker's health and safety, labor compliance, human resource management, lean implementation, energy and carbon management and other sustainability issues. The value chain of Nike is global, with more than 900 contract factories and 500,000 different products, each with its own environmental and social impacts. The supply chain is fragmented and complex and beyond the purview and power of this organization, making the building of a positive approach through contracts a challenge (Nike Inc 2012d).

Thee two indexes developed for sourcing decisions, the Manufacturing Index (MI) and the Manufacturing Sustainability Index, embed the Risk Index and performance indicators using the MI metrics. The Risk Index will be able to identify low factory performance based on the MI metrics. Features such as political risk, social/compliance risk, economic risk, infrastructure and climate risk are given an equal weightage of 25 % of the total score. These tools will help to identify low-risk, high-quality factories to manufacture sustainable products. A business system that works for continuous improvements and high-quality products while eliminating waste (time and material) is known as lean manufacturing. Changes in production processes, increasing leadership capabilities and the development of an empowered workforce will enable the production of a quality product in record time. The factories that manufacture Nike products are expected to meet the code of conduct and code of leadership standards, as prescribed by Nike. The environmental impacts of the contract factories, such as greenhouse gas emissions, waste generation, and the use of energy, water, and materials, are measured, monitored and reported to maintain sustainability.

Achieving an equitable supply chain is an important aspect of sustainability. In many contract factories, wage concerns, compensations, pay and benefits and skill development are some of the important features for a highly valued workforce to be able to produce quality products. Sustainability also encourages incentives and rewards for high-quality production, which will result in confidence, productivity and good management practices. Another drive in the contract factories is to bestow empowerment to the workforce by means of human resource management (HRM), training and support. A sustainable manufacturing training package for workers addresses issues such as lean manufacturing, HRM, health and safety, environmental compliance, energy management, environmental sustainability and freedom

for association. Thus, the manufacturing module works for the development of the factory as well as the workforce for sustainable production (Nike Inc 2012d).

Systemic analysis and carbon footprinting have revealed six areas of greatest impact on the environment: energy, labor, chemistry, water, waste and communities. All of these areas are interconnected and they need to be addressed in a progressive manner with commitment to reduce them to the lowest possible levels. The Nike Energy and Carbon program has found that 41 % of the contract factories have met the minimum requirements leading to improvement. The use of renewable energy for the retail stores in North America was through the purchase of Green-e-Certified American wind renewable energy certificates. Nike also has two global distribution centers for renewable energy in Laakdhal, Belgium and Iaichang, China. Furthermore, 33 LEED-certified stores were in operation in FY 2013; on average, these LEED-certified stores use 30 % less energy per square foot than standard designs. This lower consumption of energy showed a 2.8 % decrease in greenhouse gas emissions.

It has been assessed that 56 % of the carbon dioxide emissions are found to be in the raw material stage in the footwear chain. Reduction of process heat loss, improved energy management systems and proper synchronization of the energy field team and contract factories have brought about reductions in energy requirements. Equitable manufacturing and lean manufacturing are tools for reducing energy requirements. With regard to chemicals, many companies have joined the Zero Discharge of Hazardous Chemicals Coalition; this can be achieved by positive chemistry (use of environmentally preferred chemistries), rejection of toxins, chemical management and awareness training, material traceability and disclosure advancements. Commitments have been made for the phase-out of perfluorinated chemicals and the use of alternatives for these finishes. The assessment of the geographic impact of water and the use of waterless technologies have helped to save many industries. Waste reduction at manufacturing, recycling of shoebox waste, reduction in the weight of packaging materials and the recycling, reuse and repurposing of waste are some of the methods for addressing the problem of waste. Physical inactivity has led to many problems in health and the forum 'Designed to Move' will take care of this problem (Nike Inc 2012e).

Finally, the organization works with the underlying principle of building sustainability into the core of the business model, the operations and culture where innovation is conceived, shared and commercially applicable. The commitment requires an eye for sustainability in every field, with constant attention to the measurement and evaluation of the sustainable measures in order to find the right direction for growth and progress. This will bring about all-around development, market transformation and consumerism. Nike has done immense work to enrich our living space by working on sustainability. The company has partnered with many projects and legislations in this field and has worked in union with many other leaders in the industry. The formulation and execution of the tools for Higg Index has been used by this organization and the basis of all such work has been taken from Nike Inc. Many of the products manufactured by Nike have proven to be sustainable and there are many industries who will follow this leader in favor of sustainability.

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Making the Connection Between the United Nations Global Compact Code of Conduct for the Textile and Fashion Sector and the Sustainable Apparel Coalition Higg Index (2.0)

Miguel Ángel Gardetti

Abstract The Sustainable Apparel Coalition (SAC) is an industry-wide group of more than 100 leading apparel and footwear brands, retailers, suppliers, nonprofits, and nongovernmental organizations working to reduce the environmental and social impacts of apparel and footwear products around the world. The SAC Higg Index 2.0 is primarily an indicator-based tool for apparel that enables companies to evaluate material types, products, facilities, and processes based on a range of environmental and product design choices. The United Nations Global Compact (UNGC) is a strategic policy initiative for businesses that are committed to aligning their operations and strategies with 10 universally accepted principles in the areas of human rights, labor, environment, and anti-corruption. The first "sectorial" initiative of the UNGC is the Code of Conduct and Manual for the Fashion and Textile Industry, which is totally aligned with the Global Compact principles. This chapter introduces SAC Higg Index 2.0 and the UNGC Code of Conduct, in addition to describing their principles or constituent tools. The chapter also analyzes the differences between both initiatives, putting forward some thoughts based on the impacts of the fashion and textile sector. However, because every company is unique, this work is not intended to prescribe the only way to develop sustainable strategies in the textile and fashion sectors.

Keywords Sustainable Apparel Coalition (SAC) · United Nations Global Compact (UNGC) · UNGC Code of Conduct and Manual for the Fashion and Textile Sector · SAC Higg Index 2.0

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1 Introduction

In 2000, consumers spent approximately US$1 trillion worldwide buying clothes. Around one-third of sales were in Western Europe, one third in North America and one quarter in Asia (Make Trade Fair and Oxfam International 2004). Seven percent of total world exports are in clothing and textiles. Significant parts of the sector are dominated by developing countries, particularly in Asia, and above all by China. Industrialized countries are still important exporters of clothing and textiles, especially Germany and Italy for clothing and the United States for textiles. According to Allwood et al. (2006), developing countries now account for half of the world's textile exports and almost three quarters of the world's clothing exports.

Because of the size of the sector and the historical dependence of clothing manufacture on cheap labor, the clothing and textile industry is subject to intense political interest and has been significantly shaped by international trading agreements. Estimating the number of people working in these sectors is extremely difficult, due to the number of small firms and subcontractors active in the area and the difficulty of drawing boundaries between sectors (Allwood et al. 2006). According to statistics from the United Nationals Industrial Development Organization Industrial Statistics Database, approximately 26.5 million people work within the clothing and textiles sector worldwide (International Labour Organization (ILO) 2006). Of these 26.5 million employees, 13 million are employed in the clothing sector and 13.5 million in the textiles sector. These figures are only people employed in manufacturing—not retail or other supporting sectors (Allwood et al. 2006).

Against this background, there is no doubt that the textile (and fashion) industry is important in the economy. However, taking into account the concept of sustainability, this industry often operates to the detriment of environmental and social factors (Gardetti and Torres 2011). Therefore, this chapter presents two initiatives: the Sustainable Apparel Coalition (SAC)'s Higg Index 2.0 and the United Nations Global Compact (UNGC)'s Code of Conduct and Manual for the Fashion and Textile Industry. The main purpose of both organizations and their relevant initiatives are to have textile and fashion companies and brands reduce their (negative) social and environmental impact throughout their supply chain. Moreover, this chapter presents and describes the elements of both initiatives, analyzing their differences and providing thoughts in the light of the impacts of this sector. Finally, some recommendations are made.

2 Methodology

The methodology used to prepare this chapter is based on the analysis of the SAC's Higg Index 2.0 and the UNGC's Code of Conduct and Manual for the Fashion and Textile Industry, in the areas of human rights, labor rights, environment, anticorruption, and fashion specifics (designers, modeling, animals, transparency, etc.). The analysis includes many of the socioenvironmental impacts caused by the

industry today, ending with a comparative table that summarizes the strengths, opportunities, weaknesses, and threats.

To discuss and reflect on the SAC Higg Index 2.0 and the UNGC Code of Conduct and Manual for the Fashion and Textile Industry, the former was divided into three levels, which are described in Appendices I and II. The analysis conducted in this paper, based on the list of the UNGC Code of Conduct principles (see Table 7), only deals with the first two levels of the Higg Index 2.0.

3 The SAC Higg Index 2.0 and the UNGC Code of Conduct and Manual for the Fashion and Textile Industry

3.1 An Introduction

In February 2011, large companies in the textile and fashion sectors presented a multistakeholder alliance in order to establish a set of sustainability indicators to be used throughout the clothing (or apparel) industry—what Chouinard et al. (2011) called the "value chain index."[1] The SAC was subsequently created, with the aim of transforming the industry into one that produces no unnecessary environmental harm and has a positive impact on the people and communities associated with its activities. According to Poldner (2013), SAC's members are convinced that they cannot face the social and environmental challenges in the textile supply chain on their own, [2] and that they should strike a balance between their own goals and the SAC's goals.

Once the SAC's founding circle reached 30 members, they were divided into work groups and subgroups based on members' interest and experience (Poldner 2013). In 2009, 18 months after its creation, SAC's members had grown to include 40 companies, accounting for over 30 % of the global clothing and footwear market share.

The Higg Index 1.0, which was only focused on environmental aspects, was released on June 26, 2012 and has been used by hundreds of organizations, both SAC members and others. The Higg Index 2.0—an evolution based on version 1.0, which includes social and labor aspects—was released on December 11, 2013.

The UNGC is the result of a world characterized by glaring and unsustainable imbalances and inequities (Kell 2003). This is a joint initiative of the United Nations Development Program, the Economic Commission for Latin America and the Caribbean, and the World Labor Organization, in an effort to enable corporate social responsibility development and foster human rights, labor standards, environmental protection, and anticorruption. The main goal of the UNGC is to help

[1] This has also been the focus of other initiatives, such as The Sustainability Consortium, a group made up of companies, universities, and government agencies.

[2] Through multistakeholder engagement, SAC seeks to lead the industry toward a shared vision of sustainability built upon a common approach for measuring and evaluating apparel and footwear product sustainability performance, which will spotlight priorities for action and opportunities for technological innovation.

align corporate policies and practices to universally concurred and internationally applicable ethical goals.[3] That is, by means of business voluntary commitment, the Global Compact is an initiative for promoting a new corporate culture on how to manage businesses. Its real essence is to create an ever-growing labor network (McIntosh et al. 2004a, b) supporting companies through learning and knowledge sharing, exercising leadership as a corporate citizen, and hence exerting influence on others through their behavior (Fuertes and Goyburu 2004).

The UNGC Code of Conduct and Manual for the Fashion and Textile Industry, the first sector-specific initiative of the UNGC, was developed by the Nordic Institute Clean and Ethical (NICE), which is a project of the Nordic Fashion Association with the support of the city of Copenhagen and Denmark's Ministry of Business and Growth.

Appendix III shows the members of the Sustainable Apparel Coalition that also adhered to the Global Compact, as of April 2014.

3.2 The Higg Index 2.0

The Higg Index 2.0 is a self-assessment tool designed to (1) measure the sustainable impact on the apparel and footwear sector throughout the value chain and (2) provide for smoother relationships with the stakeholders. This tool includes both quantitative and qualitative environmental and social/labor indicators (Sustainable Apparel Coalition). The former are based on lifecycle thinking and span the apparel lifecycle (material, manufacturing, packaging transportation, use, and end-of-life), based on the Eco Index and Nike's Apparel Environmental Design Tool. The latter are based on the worker lifecycle, using some initiatives in such connection (e.g., the Global Social Compliance Program, SAI Social Fingerprint-a program of raitings, training and tool designed to help companies to help measure and improve social performance, FLA Sustainable Compliance Initiative which goal is to develop sustainable compliance tools and training materials for all code requirements to be use in the internal compliance programs of participating companies.).

This index has three application levels; the objectives and tools are described in Table 1.

The three levels were described by Chouinard et al. (2011), who stated:

> To appreciate how these three views mitigate impacts, imagine the CEO of the casual apparel maker in a meeting with the head merchant of the company's largest customer. The merchant declines to place an order, informing the CEO that the brand's overall VCI -Value Chain Index- rating is too low to meet the retailer's standards. Having lost the sale, the CEO tells the VP of Design that all products for next season must have cumulative better

[3] The principles stem from four key agreements: The Universal Declaration of Human Rights, The International Labour Organization's Declaration on Fundamentals Principles and Rights at Work, The Rio Declaration on Environment and Development, The United Nations Convention Against Corruption.

Table 1 Higg Index 2.0 levels, objectives, and application tools

Level	Objective	Tools
Brand	To assess product-specific environmental/social and labor performance at this level	Environment (apparel)
		Environment (footwear)
		Social/Labor (apparel/footwear)—Beta
Facility	To assess specific environmental and social and labor performance materials, packaging, manufacturing suppliers facilities	Environment (apparel/footwear)
		Social/Labor (apparel/footwear)—Beta
Product	To assess product-specific impact	Rapid Design Module—Beta
		Materials Sustainability Index (MSI) Data Explorer

Source Sustainable Apparel Coalition

VCI ratings. The VP conveys this directive to his team. A designer on the team starts work on a cotton blouse. She begins by specifying traditionally grown cotton, but her design software tells her that the VCI rating for that material falls short of the new sustainability goals. She then selects a vendor offering organically grown cotton, but the score is still low because she has sourced the cotton in western China, where irrigation is drawing down an aquifer faster than rainfall can replenish it. Scanning the VCI tables, she lights upon another option, a vendor in southern India buying from farms that are watered by region's rainfall. She completes her selection of materials and reaches the sustainability score she and her bosses have targeted.

3.2.1 The HIGG Index Tools

Because the UNGC Code of Conduct refers to the textile and fashion sectors, the following analysis describes the Higg Index 2.0 only as it relates to these sectors (see Table 2).

Table 2 The Higg Index 2.0 tools analyzed in this chapter

Level	Objective	Tools analyzed in this chapter
Brand	To assess product-specific environmental/social and labor performance at this level	Environment (apparel)
		Social/Labor (apparel/footwear)—Beta
Facility	To assess specific environmental and social and labor performance materials, packaging, manufacturing suppliers facilities	Environment (apparel/footwear)
		Social/Labor (apparel/footwear)—Beta
Product	To assess product-specific impact	Rapid Design Module (RMD)—Beta
		Materials Sustainability Index (MSI) Data Explorer

Source Sustainable Apparel Coalition

A. *Brand level*

A.1. Environment (apparel)

This tool, which scores in terms of an ideal, consists of seven areas with the same relative weight, which are divided into different aspects; in turn, each of them has a specific relative weight (see Table 3). The scoring system of the Higg Index was designed to drive behavior change. In the Index (2.0), points were heuristically assigned to each indicator question to potentially drive actions, decisions, and practices that lead to better sustainability outcomes.

Table 3 Areas and aspects included in the environment tool on the brand level

General	Internal sustainability performance and accountability
	Supplier tracking and risk assessment
	Product life cycle assessment (LCA)
	Chemicals management system
	Public reporting and verification
Materials	Materials program
	Chemical responsibility greater than the restricted substance list (RSL) content and transparency
	Chemical responsibility: restricted substance list (RSL) verification/ certification
	Chemical impact reduction management (i.e., "Sustainable Chemistry Program")
	Materials selection and approval procedures
Packaging	Packaging program
	Packaging restricted substance list (PRSL)
Manufacturing	Manufacturing program
	Environmental guidelines for manufacturing suppliers
	Water use/conservation
	Manufacturing efficiency: seconds/reject rate reporting
	Continuous improvement programs with manufacturing suppliers
	Sampling program
Transportation	Optimizing modal type, distance, and weight/volume
	Maximizing utilization of transportation assets
	Carrier selection
Product care and repair service	Product care and repair service program
	Repairability design standards
	Design for durability and longevity (quality assurance feedback mechanism)
	"Product Care" communication to consumers
	"Repair Service" communication to consumers
End Of Use (EOU)	EOU program
	Design policies for EOU streams
	EOU collection/processing infrastructure
	EOU communication to consumers

Source Sustainable Apparel Coalition website

Table 4 Areas and aspects included in the social/labor tool on the brand level

Company's internal social/labor performance management	Company's internal workplace standards
	Company's internal employee orientation and development
Company's social/labor performance management system for partners in the value chain	Social/labor performance management system for value chain partners
	Monitoring and continuous improvement in the value chain
	Company's integration of social/labor performance requirements to the business
External engagement, community impact, transparency and public disclosure	Engagement and collaboration
	Community impact
	Transparency and public disclosure

Source Sustainable Apparel Coalition website

A.1. Social/Labor[4] **(apparel/footwear)—Beta**

This tool, which scores in terms of an ideal, has three areas with a specific relative weight, which are, in turn, divided in relevant aspects within each area (Table 4).

B. *Facility level*

B.1. Environment (apparel)

This tool consists of a detailed description of the facility profile and its production, such as apparel, footwear, home textiles, equipment, or others. Moreover, it includes the environmental aspects and the three levels defined for each of these aspects (see Table 5).

B.2. Social/Labor (apparel/footwear)—Beta

This tool, which scores in terms of an ideal, has three areas, each with a specific relative weight, similar to those described for the brand level. These areas consist of relevant aspects. Table 6 shows the areas and their relevant aspects within the social and labor framework.

C. Product Level[5]

Nike's Material Sustainability Index (MSI) is the result of more than 8 years of researching, compiling, and analyzing publicly available information on a wide variety of materials. The full SAC membership voted to include the Nike MSI in SAC product indexes in June 2012.

In 2003, we began developing Nike MSI to provide a practical method to help designers make informed, real-time decisions about the potential and various

[4] Bair et al. (2014) provided insight into the potential for the market to protect and improve labor standards and working conditions in global apparel supply chains. It examines also the possibilities and limitations of market approaches to securing social compliance in global-manufacturing industries.

[5] This paragraph is based on the paper called *Nike Materials Sustainability Index*, prepared by Nike Inc. in 2012.

Table 5 Areas and aspects included in the environment tool on the facility level

Environmental management system or program	Level 1
	Level 2
	Level 3
Energy use and greenhouse gas (GHG) emissions	Level 1
	Level 2
	Level 3
Water use	Level 1
	Level 2
	Level 3
Wastewater/effluent	Level 1
	Level 2
	Level 3
Emissions to air	Level 1
	Level 2
	Level 3
Waste management	Level 1
	Level 2
	Level 3
Chemicals management	Level 1
	Level 2
	Level 3

Source Sustainable Apparel Coalition website
Note Levels 1, 2, and 3 signify general thresholds of environmental practices. *Level 1* awareness, understanding, and baseline performance; *Level 2* planning and managing; *Level 3* implementing sustainability measures/demonstrating performance and progress

environmental impacts of material choices in the product creation process. Nike MSI calculates relative material scores for each of the more than 80,000 materials available to Nike product creation teams from 1,400 suppliers. These scores then feed into the Nike Apparel and Footwear Sustainability Indexes, helping designers to select materials with lower environmental impacts, as measured by Nike MSI.[6] However, the Higg Index 2.0 tool only includes 43 analyzed materials.

Nike MSI uses three categories of points—a base material score, material environmental attributes, and supplier practices—to achieve a robust scoring framework that delivers comprehensive materials assessments.

Base Material Score This category consists basically of four environmental impact areas:

- *Chemistry* (includes carcinogenicity, acute toxicity, chronic toxicity, reproductive toxicity, and endocrine disruption)

[6] It is important to note that Nike MSI is not intended to be a substitute for full lifecycle assessment studies, nor does it provide footprint endpoint data (Nike 2012).

Table 6 Areas and aspects included in the Social/labor tool on the facility level

Facility's labor and workplace performance management	Recruitment and hiring
	Compensation
	Hours of work
	Worker involvement and communication
	Worker treatment and development
	Health and safety
	Termination and retrenchment
Facility's labor and workplace performance management for the value chain	
External engagement, community impact, transparency and public disclosure	External engagement and collaboration
	Community impact
	Transparency and public disclosure

Source Sustainable Apparel Coalition website

- *Energy and Greenhouse Gases* (includes intensity of energy and greenhouse gas intensity)
- *Water and Land Use Intensity* (includes water intensity and land use intensity)
- *Physical Waste* (includes hazardous, municipal solid waste, industrial, recyclable/compostable, and mineral)

Material Environmental Attributes, comprising:

- Nike Green Chemistry Program Validation—Material Greening Effort (must participate in Nike Green Chemistry Program Commitment and achieve a "0" score before points can be gained)
- Water Conservation Option 1—Dye Method (suppliers are awarded water conservation points at the supplier or the material level, but not both)
- Recycled Content
- Organic Content
- Blends and Composites

Supplier Practices, basically consisting of:

- Restricted Substance List Program
- Nike Green Chemistry Program Commitment—Self-Evaluation of Chemicals and Facility (must participate in Nike Green Chemistry Program Commitment and achieve a "0" score before points can be gained through Nike Green Chemistry Program Validation)
- Nike Water Program
- Water Conservation Option 2—Supplier Facility Water Recycling (suppliers are awarded water conservation points at the supplier or the material level, but not both)

- Nike Energy and Carbon Program (suppliers are awarded water conservation points at the supplier or the material level, but not both.)
- Sustainability Certifications and Programs

3.3 The UNGC Code of Conduct and Manual for the Fashion and Textile Industry

On May 3, 2012, the UNGC presented its first sector-specific initiative, a Code of Conduct and Manual for the Fashion and Textile Industry jointly developed with the Nordic Fashion Association, and NICE (2012). This presentation took place at the Copenhagen Fashion Summit of that year. George Kell, Executive Director of the UN Global Compact, said: "As an industry facing serious and widely publicized social and environmental challenges, the fashion and textile industry is uniquely positioned to launch a sectorial initiative under the umbrella of the UN Global Compact. We are very excited about this effort and look forward to collaborating with NICE and its partners" (Nordic Fashion Association, 2012).

> There was a second launch during the Rio+20 Summit, with the purpose of boosting this new initiative, in the activity titled "Changing the World through Fashion: Contribution to Sustainable Development by the Fashion and Textile Industry." In this new activity, Mr. Kell emphasized "the importance of changing the fashion and textile sector" and said that "this new impetus was backed by the Global Compact."

Why a Code of Conduct? Kaway (2009) stated it should be used "not only due to the subcontracting chain system used in this industry but also due to the fact that the Textile and Clothing industry is mainly a labor industry, that is, the use of manual workers is high if compared to other machinery manufacturers sectors, and therefore creating an environment more favorable for abuses to occur in this sense."

While this UNGC Code includes the ten principles of the United Nations Global Compact,[7] it provides additional specificity from a sector perspective, adding six principles within a varied range of topics that pertain to the fashion and textile industry relative to an area called ethical conduct.[8] Table 7 shows the 16 principles of the code, matching them with the compact, sector specificity, and relevant areas.

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[7] For more information about the Global Compact, please visit www.globalcompact.org. Additionally, to implement its principles, refer to: Fussler et al. (2004). For more academic papers, please refer to: McIntosh et al. (2004) and McIntosh et al. (2004a, b). The Journal of Corporate Citizenship Issue 11 (2003) special issue on Global Compact and McIntosh M, Waddock S and Kell G (2004) Learing to Talk—Corporative Citizenship and the Development of the UN Global Compact (2012). Greenleaf Publishing, Sheffield.

[8] The textile and fashion industries are subject to a great deal of criticism because they basically foster the consumption of goods that people do not necessarily need. Therefore, we need a proactive approach to create ethical relations regarding animal treatment, design process, body image ideals, mining or precious stone extraction, and supply chain transparency.

Table 7 UNGC Code of Conduct: principles and subject areas

Code of Conduct principles		
1. Support and observe human rights protection	*Global compact*	Human rights
2. Not be an accomplice to abuse of rights		
3. Support the principles of freedom of unionization and the right to collective bargaining		Labour rights
4. Eradicate forced and obligatory labor		
5. Abolish any form of child labor		
6. Eliminate discrimination based on job and occupation		
7. Support a preventive approach to environmental challenges		Environment
8. Foster greater environmental responsibility		
9. Promote development and dissemination of green technologies		
10. Businesses must act against corruption in all its forms, including extortion and bribery		Anti-corruption
11. Animals must be treated with dignity and respect. No animal must be deliberately harmed or exposed to pain	*Sector specificity*	Ethical conduct
12. Businesses and their designers must work actively to encourage and support sustainable design		
13. Businesses must, through their choice and treatment of models, promote a healthy lifestyle, and healthy body ideals, and the models' minimum age must be 16 during fashion weeks and other occasions where the workload is excessive.		
14. Businesses must work towards transparency in their supply chain		
15. Businesses must work towards a stronger commitment throughout their supply chain to reinforce the development of a secure mining industry		
16. All businesses involved must at all times be open and accessible for announced, semi-announced, and unannounced audits for monitoring and evaluation of compliance with the Code of Conduct		

For each of these principles, the Code explains:

- What it means to act in accordance with the Code of Conduct (i.e., the goal of each principle)
- Why each principle is important
- An explanation for the above, and
- How to do it (recommendations).

Furthermore, your will find important facts and information on where to learn more about creating a long-term viable and sustainable business. Note that the Code is applicable not only to the brand (or the company owner of the brand), but also to every partner, both in the country and abroad.[9]

[9] According to the Code, the brand is responsible for developing an ethical and sustainable supply chain in the company.

Likewise, the Code includes some peculiarities, which are described below:

(a) In the labor right area, it delves deeper into working hours, based on ILO Convention No. 1 on working hours; contracts of employment; sick leave and holidays with pay, based on ILO Convention No. 152 on paid vacations; complaint filing systems; occupational safety and health, based on the ILO Plan of Action 2010–2016: ratification and effective implementation of the occupational safety and health), and home work.
(b) In the environment area, and in connection with principles 7 and 8, it highlights the waste and water topic, while referring (within the framework of principle 9) to the use of chemicals, energy use, carbon dioxide emissions, and atmospheric emissions in general.
(c) As to monitoring and evaluation, it provides an analysis of value chain development based on three levels of risk—basic, high, and advanced—suggesting some guidelines for each of them. They are as follows:

Basic Level

- Include corporate social responsibility (CSR) clauses or the UNGC Code of Conduct in supplier contracts and begin working towards integration.
- Conduct informal (Code-based) audits when visiting suppliers for other reasons.

High Level

Make a detailed mapping of all suppliers in order to be able to assess them in accordance with their specific risk level. Operating in the fashion industry typically means maneuvering in high-risk countries.[10]

Advanced

- Send out a self-evaluation questionnaire, partly to get an initial knowledge of the suppliers' performance level within CSR, and partly to point out to the requirements in the Code of Conduct.
- Create a good dialogue with suppliers so that they perceive the self-evaluation process as part of their long-term relationship.
- Conduct formal audits solely concentrating on environmental, social, and ethical issues. Both announced or unannounced audits are possible, each of which has various advantages.

[10] Here, the UNGC Code of Conduct suggests considering the Danish Institute for Human Rights' Human Rights and Business country risk analysis.

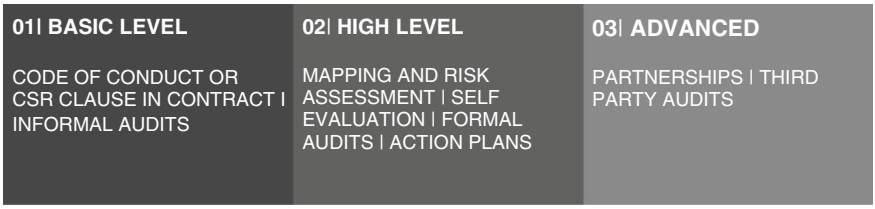

Chart 1 UNGC Code of Conduct: principles and subject areas. *Source* NICE Code of Conduct and manual for the fashion and textile industry (May 2012)

Chart 1 shows the above description, as well as the suggestions for each risk level.

(d) The code states that risks may be influenced by various factors, including spending, country, category, and the nature of the transaction, in addition to how critical the supplier is to your business. Broadly speaking, the more critical the supplier is, the higher the generated overall risk will be. Therefore, it is important to divide suppliers into three categories, depending on how critical replacing them is:

- highly critical (meaning that replacing the supplier would be extremely costly and disruptive);
- semi-critical (meaning that replacing the supplier is possible but it is time consuming and partly costly);
- less critical (suppliers can be replaced as necessary).

(e) The code suggests that an audit should begin with a meeting with the supplier's management (including the person responsible for implementing the Code, a human resources representative, and even the local union representative) where the outline for the audits is reviewed and discussed, and which should deal with the "how's" explained in each principle within the framework of the Code.

4 Discussion, Reflection and Conclusions

The Universal Declaration of Human Rights describes human rights as 30 separate articles that can be organized into four areas (United Nations Global Compact, 2013):

Equality (prohibition of discrimination on the bases of race, color, sex, language, religion, political beliefs or affiliations, national or social origin, property, or birth).

Life and Security (rights to life, liberty, and security, and the right to be free from slavery or torture; a just legal system; and equal protection under the law).

Personal freedom (rights protecting personal privacy for family, home, thought, religion, opinion, and property ownership).
Economic, social, and cultural freedoms (right to social security, to work, equal pay, to form and join unions, to rest and leisure, and to adequate health care and well-being).

According to Rulli and Justo (2012), some of the most important characteristics of human rights can be described as follows:

Human rights are founded on respect for the dignity and worth of each person.
Human rights are universal, meaning that they are applied equally and without discrimination to all people.
Human rights are inalienable, in that no one can relinquish his or her human rights or have his or her human rights taken away.
Human rights are indivisible, interrelated, and interdependent, for the reason that it is insufficient to respect some human rights and not others. In practice, the violation of one right will often affect respect for several other rights. All human rights should therefore be seen as having equal importance and of being equally essential to respect for the dignity and worth of every person.

While Dickson et al. (2009) stated that human rights are an essential part of business social and environmental responsibility, the Higg Index 2.0 does not explicitly include this area. On the contrary, these rights, in a broad sense, are fully addressed in the UNGC Code of Conduct and Manual for the Fashion and Textile Industry. As this Code was prepared in 2011, it fails to include the "Guiding Principles on Business and Human Rights—Implementing the United Nations 'Protect, Respect and Remedy' Framework," which was also developed in that year by a team led by John Ruggie for the UN Human Rights Office of the High Commissioner.[11]

The cut-make-trim stage[12] (in which cloth is cut and sewn into garments or other textile products) is a largely manual operation with key sustainability impacts being social rather than environmental. Converting pattern pieces to garments requires workers at sewing machines—an inexpensive, mechanically simple technology. This results in a "mobile and itinerant" industry that is relocated to whichever area of the globe has the cheapest labor costs and standards. Therefore, as stated by Fletcher (2014), manufacturers compete with each other for a place in the supply chain of retailers and big brands, which puts downward pressure on labor rights and

[11] The Guiding Principles, also known as Ruggie's model, require that companies have a policy commitment to respect human rights and proactively take steps to prevent, mitigate, and, where appropriate, remediate their adverse human rights impacts (United Nations Human Rights Office of the High Commissioner, 2011).

[12] Not only in its preparation do we find serious social impacts, but also in cotton picking we find migratory workers, undocumented immigration, and child labor. In the last case, see "The Children Behind our Cotton," developed by the Environmental Justice Foundation (2007) or, for more general issues, such as health and the inefficient use of water, see "The White Gold: the True Cost of Cotton," also developed by the Environmental Justice Foundation (2005).

working conditions. These impacts were studied by both academics and organizations, including Allwood et al. (2006), Draper et al. (2007) for Forum for the Future; Dickosn et al. (2009), Smestad (2009), Ross (2009), Lieutier (2009), Gwilt and Rissanen (2011), Siegle (2011), War on Want (2011, 2012, 2013), Labour Behing the Label (2011), Balatti (2013), Bair et al. (2014). That is why labor rights are addressed in both initiatives. However, it should be noted that there is well-documented evidence that, over the past 25 years, the labor rights of few workers in the apparel industry are respected, as stated in the UN Universal Declaration of Human Rights (United Nations, 2013) and the ILO Declaration of the Fundamental Principles and Rights at Work (International Labour Organization, 2013). We are referring to low wages,[13] long working hours, irregular employment and immigration, child labor,[14] forced labor, union-busting, sexual harassment, nonpayment of severance pay, abusive conditions, and gender inequality.[15]

One of the more detailed studies addressing the environmental impacts of these industries was, without a doubt, *Fashioning Sustainability: A review of the Sustainability Impacts of the Clothing Industry*, prepared by Stephanie Draper, Vicky Murray, and Ilka Weissbrod in 2007 for the World Wildlife Fund. This study analyses the impacts in different processes of the chain, including the following.

> *Obtaining fiber as raw material* The use of pesticides during this process leads to health problems for workers and causes soil degradation and the loss of biodiversity. Water is such a necessary element in the processing of cotton, in particular, that this crop has been called the "thirsty crop." While the use of agrochemicals tends to be reduced, the use of genetically modified organisms for such purpose could lead to another type of impact. In turn, many of the synthetic fibers are derived from a nonrenewable resource, such as oil. In general, environmental abuse combines with ethical issues when there is an excessive use of water and when land for food production is usurped.
> Considering the whole *textile chain, from spinning to consumer use,* it cannot be ignored that the use of chemicals may have carcinogenic and neurological effects, may cause allergies, and may affect fertility. During both of these processes and consumer care, large amounts of water and energy are used and, in general, nonbiodegradable wastes are produced. These stages also involve the generation of carbon dioxide emissions (CO_2).

Both the SAC Higg Index 2.0 and the UNGC Code of Conduct and Manual for the Fashion and Textile Industry cover the mitigation of environmental impacts. In this regard, it should be noted that the Nike MSI is a tool that helps one to quickly assess the impact of 43 materials.

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[13] The report titled "Tailored Wages. Are the big brands paying the people who make our clothes enough to live on?," prepared by Anna McMullen et al. for Clean Clothes Campaign, funded by the European Union and presented in March 2014, states that Inditex, Marks and Spencer, Switcher, and Tchibo are companies that have been working "a little" in this sense, but not enough yet.

[14] A very interesting case to read about this topic is "When Clothes for Children are made by Children" (Delalieux 2013).

[15] Almost 70 % of workers in the apparel industry are women (Hernandez 2006). In the clothing industry, women generally sew, finish, and pack clothes. Supervisors, machinery operators, and technicians are usually men, who earn more.

Principle 10 of the UNGC Code of Conduct and Manual for the Fashion and Textile Sector, referring to "anti-corruption" and derived from the United Nations Conventions Against Corruptions, is not addressed in the Higg Index 2.0. Corruption has a negative impact on social and economic development, as well on the environment, and it undermines the positive effects of good business practices (UN Global Compact 2012), in addition to increasing the legal and reputation risks.

Besides Principle 10, the Higg Index 2.0 fails to include the principles below:

Principle 11 Animals must be treated with dignity and respect. No animal must be deliberately harmed or exposed to pain.
Principle 12 Businesses and their designers must work actively to encourage and support sustainable design.
Principle 13 Businesses must, through their choice and treatment of models, promote a healthy lifestyle and healthy body ideals, and the models' minimum age must be 16 during fashion weeks and other occasions where the workload is excessive.
Principle 14 Businesses must work towards transparency in their supply chain.
Principle 15 Businesses must work towards a stronger commitment throughout their supply chain to reinforce the development of a secure mining industry.

Issues such as the increasing number of species in danger of extinction and the current focus on animal rights have fueled the debate among consumers, in some cases even resulting in high-profile personalities taking a public stand in terms of these ethical issues (Krüger et al. 2012).

Fletcher (2008) stated that the textile and fashion sector should help "cultivate new aspirations." In this, designers play a vital role as key components, capable of fostering change towards a model that provides for a balanced combination of processes, people, and the environment. According to Clark (2009), 80 % of the social, environmental, and cultural impact of fashion is determined during the design stage, which places a huge amount of responsibility into the hands of the designer (Earley 2007).

Despite the glamour of fashion shows, the fashion world can be cruel and full of sacrifices and secrets. Christine Hart, a former model who worked for 10 years on the runways of Milan, Paris, and New York, described it in her book "The Stories Models Never Tell" (2011). This book revealed her experiences in a profession that even considered her to be "too old" because she started out at 25 years old, after graduating with a degree in law: "Having an education gave me an invaluable background to navigate these waters, infested with sharks and piranhas," she explained. The dictatorship of beauty, as defined by Hart (2011), implies setting canons of so-called perfection defined by a minority. Setting these canons through fashion, advertising, and all their supports is a million-dollar business.

For its part, transparency implies going beyond statutory requirements towards a full and honest disclosure of business activities, strategies, and current impacts, including both costs and supply chain. However, the long, complex, and fragmented

fashion supply chain lowers transparency and control and creates a disconnect between the few who reap the benefits from fashion and the many who pay the social and environmental costs (Martin 2013; Gjerdrum Pedersen and Andersen 2014.)

Mining and the production of precious metals and stones entail a high cost for both nature and native communities. The misuse of mercury in gold mining has highly harmful consequences, not only for the environment and biodiversity, but for the health of craft miners and their families as well. As for diamonds, those coming from conflict areas threaten responsible business, because diamonds are extracted from war areas and often sold to fund the activities of a military leader or violent group.

Both initiatives—the UNGC Code of Conduct and the Higg Index 2.0—promote monitoring, evaluation, and auditing. Table 8 shows a summary of their relationships. While neither of these initiatives includes consumers, the UNGC Code of Conduct has an indirect allusion to them: it states that Communication on Progress[16] is the tool used by businesses and brands to communicate with their stakeholders—and consumers are among them. This is no minor detail: it is not only Erhenfeld (1999, 2002), and Suzuki and Dressler (2002) who place sustainability at the individual level. Presas (2001) claimed that a real transition to sustainable development requires a new way of thinking.

However, a sustainable society is not possible without sustainable individuals (Cavagnaro and Curiel 2012). That is, individual capacities seem to be at the heart of the issue. These definitions should lead to a more responsible attitude from the consumer. They refer not only to water and energy consumption and chemicals and detergent use, but also, according to Fletcher (2008), to how consumers should handle the pressure to compare themselves to others through the accumulation and display of possessions, the continuous replacing of things (which, in the fashion world, means that every new item requires another "matching" item), and the cultural obligation to experience everything and take consumption as part of a continuous process of identity formation. That would require the use of a collective learning mechanism for all types of environments and stakeholders and the creation of the necessary space for a structure of dialog on what our vision of sustainable society is. Table 9 briefly illustrates the strengths, opportunities, weaknesses, and threats of both initiatives. To conclude, the organizations and brands that make up these sectors—textile and fashion—can lead the change and create the space mentioned by Fletcher (2008).

[16] According to the paper prepared by Fuertes and Goyburu (2004), Communication on Progress "is a report endorsing the commitment of the entities subscribing the Global Compact, and, more importantly, it is a tool to maintain the initiative credibility." However, according to Gardetti (2006), today more than ever, it is a communication tool whereby the company can gradually build trust. This "communication" describes a company's progress in terms of each principle during a given period of time.

Table 8 Relationship between the UNGC Code of Conduct and the Higg Index 2.0

Code of Conduct principles			Higg Index 2.0		
			Brand level	Facility level	Product level
1. Support and observe human right protection	*Global compact*	Human rights	–	–	–
2. Not to be an accomplice to abuse of rights					
3. Support the principles of freedom of unionisation and the right to collective bargaining		Labor rights	X (see Tables 3 and 4	X (see Table 6)	X (some comments about health—Paragraph C)
4. Eradicate forced and obligatory labour					
5. Abolish any form of child labour					
6. Eliminate discrimination based on job and occupation					
7. Support a preventive approach to environmental challenges		Environment	X (see Table 3)	X (see Table 5)	X (see Paragraph C)
8. Foster greater environmental responsibility					
9. Promote development and dissemination of green technologies					
10. Businesses must act against corruption in all its forms, including extortion and bribery		Anti-corruption	–	–	–

(continued)

Table 8 (continued)

Code of Conduct principles			Higg Index 2.0		
			Brand level	Facility level	Product level
11. Animals must be treated with dignity and respect. No animal must be deliberately harmed or exposed to pain	*Sector specificity*	Ethical conduct			
12. Businesses and their designers must work actively to encourage and support sustainable design					
13. Businesses must, through their choice and treatment of models, promote a healthy lifestyle, and healthy body ideals, and the models' minimum age must be 16 during fashion weeks and other occasions where the workload is excessive.					
14. Businesses must work towards transparency in their supply chain					
15. Businesses must work towards a stronger commitment throughout their supply chain to reinforce the development of a secure mining industry					
16. All businesses involved must at all times be open and accessible for announced, semi-announced and unannounced audits for monitoring and evaluation of compliance with the Code of Conduct			X	X	X

Table 9 Strengths, weaknesses, opportunities, and threats between the UNGC Code of Conduct and the Higg Index 2.0

Strengths		Opportunities	
UNGC Code of Conduct	SAC Higg Index 2.0	UNGC Code of Conduct	SAC Higg Index 2.0
Initiatives of the UN Global Compact	Initiative of the Sustainable Apparel Coalition	To change the industry's status quo at a global level	To improve organizations' performance facing society
Sound support of the United Nations	Initiative proved in many companies members of the Coalition	Change leaders may be trained based on these initiatives[a]	
Multi-stakeholder initiative	Includes labor rights and environmentally-related aspects	Although a few experiences have been conducted, this is an opportunity to lead the change	
Includes human rights with a very broad vision		To improve organizations' performance facing society	
Includes labor rights and environmentally-related aspects			
Includes the corruption issue			
Weaknesses		*Threats*	
UNGC Code of Conduct	*SAC Higg Index 2.0*	*UNGC Code of Conduct*	*SAC Higg Index 2.0*
Few experiences worldwide	Although it has been proven in companies members of the Coalition, the experience is limited with respect to the entire industry (no experiences in small companies)	It may be the case of unfavorable macroeconomic and political contexts, poor labor and environmental legislation, hindering their integration	No experiences in small organizations

(continued)

Table 9 (continued)

Strengths		Opportunities	
UNGC Code of Conduct	SAC Higg Index 2.0	UNGC Code of Conduct	SAC Higg Index 2.0
Implementation cost Does not include consumer's issues	Implementation cost	Industry's status quo	It may be the case of unfavorable macroeconomic and political contexts, poor labor and environmental legislation, hindering their integration
	Temporarily, the initiative is restricted to members of the Coalition and their vendors		Industry's status quo
	It is a multi-stakeholder initiative, but limited to members		
	The SAC consists of members whose reputation can be questioned		
	It does not include human rights to the extent they should be included		
	It does not include the corruption issue		
	It does not include fashion specific areas such as: the designer's role in promoting sustainability; modeling; transparency and treatment towards animals		
	It does not include consumer's issues		

[a] For example, in 2013 the Argentinean Chapter of the United Nations Global Compact began to develop the Training Program for Change Leaders in the Textile and Fashion Sector [Programa de Formación de Líderes para el Cambio en el Sector Textil y de la Moda] based on UNGC Code of Conduct, with plans to spread it to other Latin American chapters

5 Going Forward

The process of transforming the industry into something more sustainable—and more sensitive to our needs—takes time. It is a long-term commitment towards a new way of producing and consuming that requires widespread personal, social, and institutional change.

The two initiatives analyzed in this paper, the UNGC Code of Conduct and Manual for the Fashion and Textile Sector and the SAC Higg Index 2.0, supplement each other (the former is qualitative and the latter is a quantitative initiative) and may help broaden the debate on the textile and fashion industry, which is currently focused on technical and commercial details regarding dyeing technologies, the value chain, and the search for alternative fibers. According to Flechter (2008, 2009), to broaden the discussion means to integrate issues such as consumption, fashion, globalization, and physical and mental health; each of these items reflects the cultural visions and social standards behind the textile industry. Therefore, it is necessary to connect with other disciplines, industries, communities, and international groups, beyond their own boundaries (Gjerdrum Pedersen and Andersen 2014).

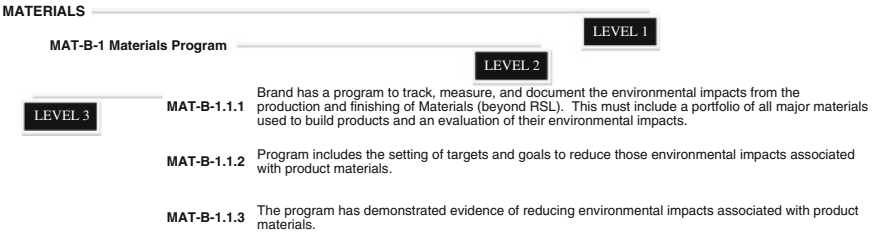
The paradox for the textile and fashion sector is that, for its survival, the workforce depends on a system that seems to be destroying the world's capacity to withstand such a force.

According to Poldner (2013), one of the problems with the Higg Index is that it is based on the structure of the Eco Index of the Outdoor Industry Association and the Apparel Environmental Design tool developed by Nike, which focus on a specific type of industry. Therefore, it might be difficult to adjust to other sectors, such as high fashion. Another problem is that those indexes were developed using widely criticized criteria, as they accept chemicals banned by other organizations. However, according to Dickson et al. (2009), implementing codes of conduct and monitoring procedures can be seen as a first generation of solutions to eradicate the poor labor standards in apparel manufacturing companies.

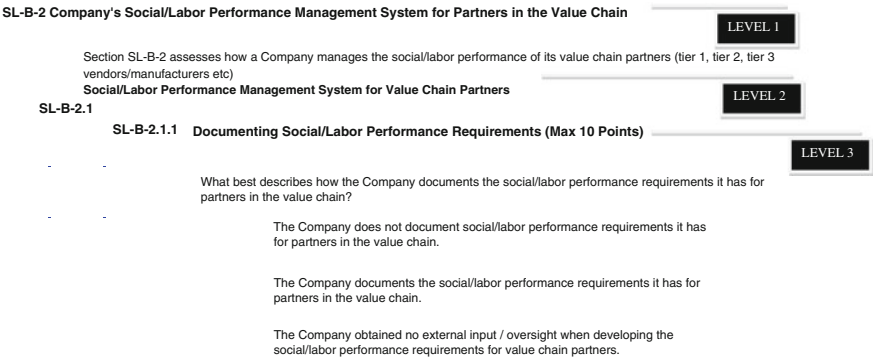
Supply chain sustainability is a key component of corporate responsibility; therefore, the management of environmental, social, and economic impacts contributes to an improved business decision-making process (Sisco et al. 2010). When a factory building collapsed in Bangladesh, killing hundred of workers, it was not the first time the long and complex textile and fashion supply chain shocked the world and drew the (negative) attention of politicians, the media, human rights groups, etc. In fact, this incident displayed the textile and fashion industry's tragic social and environmental performance climax over decades. Hence, and beyond any comparison, it becomes important to work on a single initiative to be accepted and implemented in the short term.

Academia can make a new contribution by "opening" the UNGC Code of Conduct and Manual with a deeper approach in mind, delving into each principle to analyze the recommended guidelines and compare them to level 3 of the SAC Higg Index 2.0.

6 Appendix I Environmental Levels (Material)



7 Appendix II Social Levels (Material)



8 Appendix III Members of the Sustainable Apparel Coalition (SAC) as of April 2014 and Their Relation with the UN Global Compact (UNGC)

Tables A.1 and A.2.

Table A.1 Sustainable Apparel Coalition website and UN GlobalComnpact website

SAC	Adheres to the UNGC	SAC	Adheres to the UNGC	SAC	Adheres to the UNGC
Adidas	**x**	Ann Inc		Huntsman	**x**
Asics		C&A		Invista	**x** (as DuPont)
Burberry	**x**	Gap	**x**	Lenzing	
Coca Cola	**x**	H&M	**x**	Li and Fung	
Columbia		Inditex	**x**	Mas holding	**x**
Brooks		JC Penney		Novazymes	**x**
Desigual		Kohl's		Pinneco research	
Ecco		LL Bean		Pratibha	
Eilen Fisher		Mountain Equipment		Ramatex	
Esprit		Nordstrom		Rubia natural colors	
Fénix outdoor		Otto group	**x**	Saitex	
Hanes brands		Rei		TAL apparel	
IC companys	**x**	Target		Teijin	
Kering	**x**	Wal-Mart	**x** (Chilean Affiliate)	Toray Industrie	
Levis	**x**	Artistic Milleners		Bureau Veritas	**x** (Lithuanian Affiliate)
loomstate		Arvind Mills		Cotton Inc	
Madura fashion		Avery Denissson		Malwee	
Marmot		Bayer material science	**x**	Williams-Sonoma	
New Balance		Charming trim		1888 Mills	
Nike	**x**	Clariant	**x**	Archroma	
Patagonia		Cristal group		Birla Cellulose	
Pentland Brand	**x**	Dupont	**x**	Clailar	
Puma	**x**	DyStar	**x**	CWS-boco	**x**
Pvh		Esquel	**x**	Hirdaramani Group	
Reckitt		Gildan		Hong Kong Non Woven Fabric Ind.	

(continued)

Table A.1 (continued)

SAC	Adheres to the UNGC	SAC	Adheres to the UNGC	SAC	Adheres to the UNGC
VF		WL Gore		KG Denim	
Keen		Lululemon Athletica		Lubrizol	
Makalot		TLC Tiong Liong Corp		Freudenberg Vildona	**x**
Wah Fung Group		Bluesign Technologies		Control Union	
Green Earth Cleaning		Hellmann Worldwide Logistic	**x**	Indicate	
Reseat Carbon		SGS		Vérité	
Xeros Cleaning					

Table A.2 Sustainable Apparel Coalition website and UN GlobalComnpact website

SAC	Adheres to the UNGC	SAC	Adheres to the UNGC
European Outdoor Group		American Apparel and Footwear Association	
FLO cert		Cradle to Cradle Products Innovation Institute	
Outdoor Industry Association		International Wool Textile Organisation	
Oeko Tex		Aid by Trade Foundation	
Better Cotton Initiative		Duke Center for Sustainability and Commerce	
Caux Round Table	**x**	Environmental Defense Fund	
Fairtrade Intl		Natural Resources Defense Council	
Danish Fashion Institute	**x**	The Sustainable Fashion Academy	
Made by		Sustainable Fashion Business Consortium	
Environmental Protection Agency		The Swedish School of Textiles	
Solidaridad Network	**x**	University of Delaware	
Textile Exchange		Utrecht University	
World Resources Institute			

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Environmental Adaptation by Small and Medium Sized Textile and Garment Companies in Vietnam—Is Governance an Issue?

Nga H. Nguyen, Robert J.S. Beeton, Anthony Halog and An T. Duong

Abstract Institutional theory emphasizes the social context in which firms operate and explains the role of institutions in shaping organizational responses. Following this theory, if a firm fails to conform to institutionalized norms, its legitimacy and survival is threatened. This chapter uses institutional theory as a tool to understand the influence of current institutional mechanisms on the adaptive capacity of textiles and garment small- and medium-sized enterprises (SMEs) in Vietnam in response to national and international environmental requirements. Field work undertaken in Vietnam in 2013 enabled 21 interviews with policymakers, experts, and textiles and garment enterprises. The interviews revealed a number of problems with the current environmental legislation as well as the governance system in Vietnam. These problems are considered as barriers for the environmental adaptation process at textiles and garment SMEs in Vietnam.

Keywords Environmental adaptation · Textiles and garment · SME · Governance

1 Introduction

To understand a complex and dynamic system such as environmental adaptation, we need to understand not only the attitudes of key actors and systems of concerns but also the larger context in which the system operates (Boccara 2004; Moser and

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Ekstrom 2010). The larger context of environmental adaptation for small- and medium-sized enterprises (SMEs) is the organizations and their institutions.

The terms "organizations" and "institutions" are often confused. Organizations are players or groups of individuals who are bound together by some common purposes to achieve objectives, whereas institutions refer to the framework that applies the rules, regulations, and norms governing organizational behavior. Organizations in this chapter are companies. More specifically, they are textiles and garment SMEs in Vietnam. Institutions in this chapter are the framework of rules and mechanisms, which govern the behaviors of these companies and drive them toward environmental adaptation. Consequently, governance is of interest at both the public sector and corporate scales.

Public sector governance involves the management of public common resources and public administration including regulations. In the commercial environment, good governance is critical to forming and maintaining both external and internal relationships, and governments are often assessed against indicators of good governance by international bodies (Stefano and Adele Del 2005). These indicators include participation, consensus, accountability, transparency, responsiveness, efficiency, equitability, and legal compliance (Freeman 1984; Mol 1995).

In parallel and interacting with public sector governance, corporate governance faces challenging issues. In developing countries, expectations of corporate behavior are often in conflict with the demands of the "real" local competitive environment. The resolution of this is becoming as important in the world economy as is the governance of countries. Corporate governance defines the relationship of a company with society and is the system by which business corporations are directed and controlled (van Koppen and Mol 2002). It specifies the distribution of rights and responsibilities among different individuals and groups in the corporation. It provides a set of rules and procedures for making decisions through which the company objectives are set and performance is monitored. Complexity is added as globalized norms of corporate governance are framed by a "first-world" culture and promulgated in globalized supply chains to a varying extent.

This chapter aims to (i) understand if institutional mechanisms influence whether the textile and garment SMEs in Vietnam adapt to national and international environmental requirements or not; and (ii) explore a set of institutional conditions under which environmental adaptation at textile and garment SMEs in Vietnam is likely to occur.

The chapter begins with the cultural and historic context of industry in Vietnam. It goes on to explore how evolving government policy has driven change, resulting in the current structure of SMEs. The chapter then presents a narrative and institutional theory framework to examine the organization of textiles and garment SMEs and role of governance in their environmental behavior and adaptation. The chapter closes with a discussion of future directions for the industry in a changing world.

2 Background to the Study

2.1 Cultural and Historical Context

There are distinct periods in the history of Vietnam that have shaped today's institutions and society (Adger et al. 2001). These are the period of the Dynasties; the Colonialism period, which included the American war; and the most recent period of renovation from 1986.

The years of the Imperial Dynasties were marked by the wars with China, who heavily influenced Vietnam's technology and culture. The Vietnamese became familiar with the Chinese writing systems and the Chinese learning and arts. They adopted the ancient Chinese political system, which was based on Confucianism. This ideology stresses the importance of education, supposing that people were naturally good but needed education and a good example set by their superiors to keep them that way. It also stresses the moral development of individuals based on five basic relationships: father/son; subject/ruler; husband/wife; elder brother/younger brother; and friend/friend. The government in a Confucian society ideally favors morality rather than coercion.

Nevertheless, the Vietnamese interpreted Confucianism differently in many circumstances (Cima 1987). For example, in contrary to the Chinese, who emphasize loyalty to rulers only, the Vietnamese Confucianism stresses both loyalty to rulers and a sense of patriotism. Also, while the Chinese Confucians were against law and punishment, Vietnamese practice demonstrated a faith in legalist approaches.

China's historical cultural influence on Vietnam began to dwindle in the late nineteenth century (Le 2012). This occurred with the abolition of the test of Confucian's knowledge in all civil service examinations. However, after more than a thousand years of domination, the Chinese's cultural influences on Vietnam could not disappear overnight. The country's history of Confucianism, which has traditionally emphasized respect for authority, combined with many years of central planning has meant that citizens often defer to the will and views of the government (Hostovsky et al. 2010). In other words, public involvement in the operation of the Vietnamese government is still limited.

The French expanded its colonies into Vietnam starting in the 1850s, which was accompanied by a big shift in the operation and governance of Vietnam. The French colonialists brought European-style administration to Vietnam and greatly influenced the Vietnamese culture, including the spread of Catholicism and the adoption of Latin alphabet. To date, Vietnam is the only nation of Indochina that uses the Latin alphabet to write the national languages.

In 1930, when Ho Chi Minh established the Indochinese Communist Party, Vietnam started on the road to communism, and the influence of the Union of Soviet Socialist Republics (USSR) was considerable. Large numbers of Vietnamese people went to the USSR to study, and new administrative systems, economic structures, and planning models based on examples in the USSR were introduced. The cultural life of the Vietnamese was influenced by government-controlled media

and the cultural influences of socialist programs from communist nations such as the Soviet Union, China, Cuba, and others (Jamieson 1993).

Following the reunification in 1975, Vietnam entered a new period—a period of evolution with many challenges. "The aftermath of war, social evils, the mass flow of refugees, …, the dispute at the northern border, the isolation and embargo from the United States and Western countries, plus continual natural calamities…put Vietnam under tremendous tough challenges" (Hieu 2010, p. 6). The country was devastated. Then, the government started its socialist practice and followed Soviet-style "development-at-all-costs" economic policy, favoring heavy industry and commerce. However, this policy only focused on meeting production targets. Environmental considerations were not included in production and development decisions. Resource inputs, such as water, were considered to be free, resulting in the inefficient use of natural resources. Factories used old technologies, many of which were provided by Russia and China from the 1950s and 1960s. Technical assistance was also provided. Pollution and other environmental impacts of industry were very high, resulting in serious environmental problems such as deforestation, soil erosion, contaminated water sources, and reduced wildlife habitat (Sikor and O'Rourke 1996).

In 1986, the government launched a renovation program (known as "Đổi Mới"),[1] transforming into a market-oriented economy and stepping into the process of globalization. Apart from the aim of generating economic growth, environmental protection and sustainable development have become important parts of the reform. In 1993, the government promulgated a Law on Environmental Protection[2] for the first time. Subsequently, a series of decrees, directives, and circulars were issued to implement the law, such as Decree No. 175-CP dated 18th October, 1994; Decree No. 26-CP dated 26th April, 1996; and Directive No. 36-CT/TW dated 25th June, 1998. The government also encouraged the development of environmentally friendly industries as economic substitutes for natural resource exploitation.

2.2 *Industrialization and the Challenges of Environmental Management*

Under the post-1986 economic reform, Vietnam has begun to achieve concrete results, including sustaining an economic growth rate of 8–9 %. Industrial activities are the main contributor to this. At the 8th Vietnamese Communist Party's congress

[1] "Đổi Mới" is the name given to the economic reforms adopted at the 6th Vietnamese Communist Party's Congress in 1986, when the country was facing an economic crisis. The reforms included an agreement on the need for policy reforms aimed to move to a multi-sector, market-oriented economy, with a role for private sector to compete with the state in nonstrategic sectors.

[2] The Law on Environmental Protection was passed on December 27th, 1993 by the National Assembly, and went into effect on January 10th, 1994. The law provides for the protection of the environment with a view to protecting the health of the people, serving the cause of sustainable development of the country, and contributing to the protection of regional and global environments.

(1996), industrialization and modernization through the year 2020 was set as a national goal. Agriculture's share of economic output has continued to shrink, from about 25 % in 2000 to less than 22 % in 2012, while industry's share increased from 36 % to nearly 41 % in the same period (OECD 2013). With its rapid economic growth, Vietnam is perceived as a tiger cub—a younger cousin of the East Asian tiger economies.

However, like many other countries, the Vietnamese government faces significant conflicts between developmental goals and environmental protection. In addition to rapid growth, there is also a shift towards more polluting industries. Many economic projects have been granted with licenses to operate without proper consideration for environmental protection. Untreated waste water from factories was discharged directly into the rivers, causing water pollution. Substances and dust from industries caused air pollution. Other industries, such as food processing and aquaculture, also made the pollution loads increase. The social cost of this rapid industrialization has been high (Mol and Buuren 2003).

Although the government is committed to protect the country's ecosystems and natural environment, Vietnam continues to experience many challenges in environmental management. A lack of funds, trained personnel, political will, and institutional structures severely constrain the effectiveness of state environmental agencies (Clausen et al. 2011). Other challenges are substandard levels of technology, low ratios of sustainable technological development and change, limited economic incentives toward greening industrial production, limited and unreliable environmentally relevant information (Pham 2006; Angel and Rock 2000; Le 2006), and limited public involvement (Hostovsky et al. 2010).

2.3 SMEs in Vietnam

There are different definitions of SMEs. In this study, we use the definition specified in Decree 56/2009/ND-CP[3]: "Small and medium-sized enterprises are business establishments that have registered their business according to law and are divided into three levels: very small, small and medium according to the sizes of their total capital (equivalent to the total assets identified in an enterprise's accounting balance sheet) or the average annual number of labourers." Table 1 further explores this definition for each sector of the economy.

In Vietnam, any enterprise that meets the requirements of either the criteria for the number of employees or the criteria on the amount of capital is considered to be an SME. Regardless of the forms of its ownership, SMEs can be private enterprises, state-owned enterprises, foreign-owned enterprises, and joint stock or joint venture companies.

[3] Decree 56/2009/ND-CP dated 30 June 2009 stipulated supporting measures for SMEs (replacing Decree 90/2001/CP-ND).

Table 1 Definition of SMEs in Vietnam per sector

	Very small enterprises	Small-sized enterprises		Medium-sized enterprises	
	Number of laborers	Total capital	Number of laborers	Total capital	Number of laborers
Agriculture, forestry, and fishery	10 persons or fewer	VND 20 billion or less	Between over 10 persons and 200 persons	Between over VND 20 billion and VND 100 billion	Between over 200 persons and 300 persons
Industry and construction	10 persons or fewer	VND 20 billion or less	Between over 10 persons and 200 persons	Between over VND 20 billion and VND 100 billion	Between over 200 persons and 300 persons
Trade and service	10 persons or fewer	VND 10 billion or less	Between over 10 persons and 50 persons	Between VND 10 billion and 50 billion	Between over 50 persons and 100 persons

Source Decree 56/2009/CP-ND

There are no exact data indicating the number of SMEs in Vietnam. However, the United Nations University World Institute for Development Economics Research (UNU-WIDER 2011) showed that more than 95 % of total enterprises in Vietnam are SMEs. The distribution of enterprises in terms of size varies significantly across industries.[4] The proportion of SMEs is high in the food processing sector (93 %), but considerably lower in the leather and footwear sector (50 %) and textile and garment sector (73 %).

SMEs in Vietnam play a vital role in the economy. They employ more than 50 % of the labor force in the country and contribute to 31 % of the GDP.[5] In recent years, the number of nonstate enterprises has increased dramatically. The most important organizational form of private enterprise in Vietnam is household firms. The next largest group are the industrial cooperatives and quasi-cooperative production groups.

Despite SMEs being the engine of growth in Vietnam, these enterprises face significant difficulties. Access to finance remains the most serious problem for SMEs in Vietnam (UNU-WIDER 2011). Almost 40 % of SMEs in Vietnam are considered credit-constrained. Finding sufficient funding is difficult, and many SMEs have had to turn to investment funds for both money and management assistance (David Richards et al. 2002). Additionally, unskilled labor, a lack of land for business premises and weak supporting services in the areas of technology and information are significant problems for of SMEs in Vietnam (Harvie 2001; UNU-WIDER 2011).

[4] General Statistic Office. Statistical Yearbook. Hanoi, 2004.

[5] General Statistic Office. Statistical Yearbook. Hanoi, 2004.

2.4 Vietnam's Textile and Garment Industry

The textile and garment industry in Vietnam has developed rapidly in recent years and has become a vital activity within the country's economy. In term of total production, it is the second biggest industry in Vietnam (after the oil and gas industry), accounting for 31 % of total industrial products. The production capacity in 2005 increased fivefold compared to the production capacity of 2000 (Nguyen 2011). Exports in 2011 reached $15.8 billion USD, an increase of nearly 38 % compared to 2010. In 2012 and 2013, despite of many challenges in production and business, exports still earned a record US$ 17.15 billion and US$ 19 billion, respectively (Viettrade 2012; VNS 2013)

With a labor force of more than 2 million people working in more than 3,800 companies (TextileWorld 2012), Vietnam's textile and garment industry has become one of the strongest players in the global market. It ranks fifth worldwide in textile and apparel exports. The industry is considered to be a very important producer and exporter. However, it is also one of the most serious polluters. At each of the stages typically required to make a garment product, there are negative environmental impacts, with dyeing and finishing having the greatest impact on the environment. Figure 1 schematically sets out the production process and the environmental impacts at each of the stages.

There are four main steps in the textile and garment production process: yarn fabrication, fabric production, dyeing and finishing, and sewing. SMEs normally operate one or two stages of this process. For example, some companies only produce yarn or fabric; some produce fabric and also provide dyeing services. Only a few large companies in Vietnam operate all four stages of the production process.

Currently, raw materials are mainly imported from overseas. About 400,000 mt of cotton is consumed annually, of which 35 % is imported from the United States, 32 % from India, and 19 % from South Africa (TextileWorld 2012). Some is

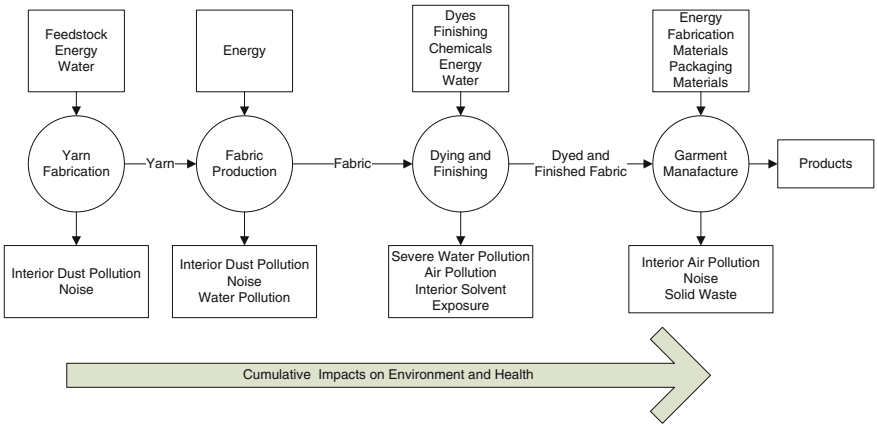

Fig. 1 The production process and its environmental impacts

imported from other countries, such as Pakistan, Brazil, Australia, and Indonesia. Materials imported into Vietnam have to comply with the quarantine regulations in Vietnam, including requirements for environmental protection.

The main environmental problems of the yarn fabrication and fabric production are dust and noise. Dust arises from fiber and fabric scraps. Noise comes from the operation of the spinning or weaving machine. In addition, some small companies are still using coal and firewood, and the emissions (including some hazardous chemicals such as SO_2 and NO_2) are polluting the air.

Dyeing and finishing operations consume a vast amount of water, energy, and inorganic chemicals. If wastewater is not properly treated before discharging into the environment, it has well known and serious impacts on the environment. Duong (2006) reported that more than 90 % of the textile companies in Vietnam are violating environmental requirements.

To control environmental pollution from the textile and garment industry, the Vietnamese government has implemented many policies and measures, mainly following the traditional command-and-control system of environmental regulations, such as end-of-pipe treatment solution, fines and penalties, relocation, and even forced closure of polluting enterprises. In addition, Vietnam has started introducing environmentally friendly technologies and business practices directed at achieving cleaner production.

However, current practices of environmental protection and environmental management at textile and garment companies, especially SMEs, remain poor. Many do not meet the national standard requirements of environmental management practices. They are equipped with old manufacturing technologies, which result in both inefficient use of resources and high emissions. Environmental protection technologies are luxurious to such enterprises. Some tried to install pollution control facilities. However, due to lack of adequate monitoring, most of these facilities have not been put into operation for economic reasons (Pham 2006)—they are just to show to environmental inspectors.

Although most of the textile and garment companies have been relocated to suburban districts or industrial zones, the problem of location remains increasingly problematic due to the fast rate of urbanization. Pham (2006) observed that more and more companies are becoming parts of residential neighborhoods. When these SMEs cannot adopt a proper environmental protection technology, the pollution caused by their production activities is almost certainly having serious impacts on the health and daily lives of the people.

2.5 Environmental Legislation in Vietnam

From the mid-1990s, the government of Vietnam has implemented many policies and measures to limit the environmental impacts from industries. These mainly follow the traditional command-and-control system of environmental regulations, such as end-of-pipe standards, air emission standards, treatment solution, fines and

penalties, relocation, and even forced closure of polluting enterprises. In addition, Vietnam has started introducing more proactive approaches, such as cleaner production systems, environmental management systems, and the employment of better technologies to achieve the improvement that is required by such approaches.

Since the passage of Law on Environmental Protection (LEP) in 1993, a wide range of decrees, directives, and circulars were issued to realize the goals of environmental regulation and enforcement. The LEP was followed by other policies related to environmental management, such as the Prime Minister's Directive 200/TTg on "Ensuring the clean water and environmental hygiene for rural areas", the Inter-Ministerial Circular 142/MTg on "Guidelines on environmental impact assessment for operating establishment" (issued in 1994), and the Circular 715/MTg on "Guidelines on environmental impact assessment for foreign direct investment projects" (issued in 1995). The passage of the Mineral Law in 1996 and the Water Resource Law in 1998 were also signs of the government's concern for the country's environmental problems.

Another important step in national environmental control was the formation of the Ministry of Science, Technology and Environment (MOSTE) in 1993, which is responsible for environmental management. In 1995, the Vietnam Standards Institute within MOSTE issued national environmental standards, including standards on ambient air quality and the maximum allowable concentrations of hazardous substances in ambient air (inorganic and organic).

The main tool to achieve pollution control from SMEs in Vietnam was the Environmental Impact Assessment (EIA). Both existing and new firms are required to undertake an EIA. However, the EIA process is costly and time-consuming for many Vietnamese SMEs. Thus, in 1999, a circular on environmental registration was promulgated by the MOSTE to simplify the environmental approval procedure for SMEs. SMEs are now required to obtain an environmental license or certificate on pollution control instead of carrying out an EIA.

After the establishment of the Ministry of Natural Resources and Environment (MONRE) in 2002, the state management of environmental protection at central level was transferred from MOSTE to MONRE. The newly established provincial department of natural resources and environments (DONREs) are responsible for the environmental management involving SMEs in their provinces.

The Law on Environmental Protection was amended in 2005. Together with this, numerous other decrees, directives, and circulars were also issued to instruct the implementation of these regulations. However, it has been shown that the enforcement of environmental regulations in Vietnam is still very weak (O'Rourke 2002; Dao and Ofori 2010). Responses to environmental problems from the business community in Vietnam are diverse (Dao and Ofori 2010). Only a small number of big companies—especially those with international supply chains—are demonstrating good environmental protection practices. The majority of SMEs continue to have poor environmental performance.

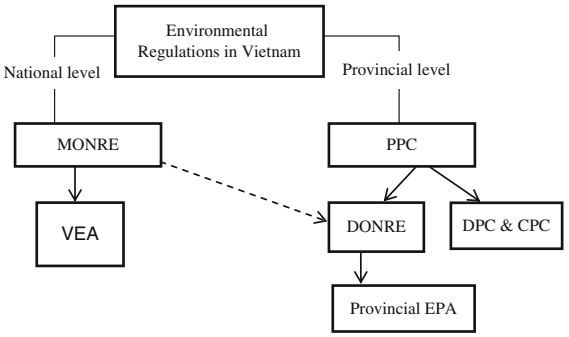

Fig. 2 Government agencies responsible for environmental monitoring in Vietnam

2.5.1 Issuance and Monitoring of the Government's Environmental Regulations

The environmental regulations in Vietnam are issued by the Vietnam Environment Admistration (VEA), which is under MONRE. The Provincial People's Committees (PPCs) are also able to issue environmental requirements, which are particularly applied to their provinces.

The monitoring of environmental regulations is conducted at both the national and provincial levels. At the national level, VEA takes the main responsibility for monitoring the environmental performance of all companies operating in Vietnam through their network of environmental inspectors. At the provincial level, the DONRE and the provincial Environmental Protection Agency (EPA), in cooperation with the commune and district level People's Committee (CPC and DPC), are responsible for the environmental performance of the companies in their province. The provincial DONREs are under the management of PPC but under the technical supervision of MONRE.

Provincial EPAs are parts of DONRE. Figure 2 illustrates these relationships.

3 Evaluating Governance and Environmental Adaptation

In this chapter, we use institutional theory as a tool to evaluate the governance issues related to environmental adaptation for textiles and garment SMEs in Vietnam.

Institutional theory initially suggested that a strong motivating force behind firm behavior is socially based and embedded within institutions (Meyer and Rowan 1977; Scott 1987). The term "institution" refers to the formal or informal sets of rules, regulations, norms, and understandings that organizations and individuals are expected to follow (Meyer and Rowan 1991).

More recently, Scott (2008) reported the maturation of the theory and differentiated institutions by the types of institutional forces that shape them. This insight was elaborated on by Bruton et al. (2010) as follows:

- *Regulative pillar*: represents models of behavior based on sanctions and conformity. Behaviors are guided by rules, monitoring, and enforcement, which stem primarily from government legislation and industrial agreements and standards. These rules provide guidelines and can lead to organizations complying with laws or may require a reaction if there is a lack of laws or regulations in the firms.
- *Normative pillar*: represents models of behavior based on obligatory dimensions of social, professional, and organizational interactions. Behaviors are guided by what is appropriate (values) or expected (norms). Normative institutions exert influence because of a social obligation to comply, rooted in social necessity or what an organization should be doing.
- *Cognitive pillar*: represents models of individual behavior based on subjectively and constructed rules and meanings that limit appropriate beliefs and actions. The cognitive pillar may operate more at the individual level in terms of culture and language.

The three pillars vary substantially in the type of institutional order they support. They are different in motives for compliance, logics of action, mechanisms, and indicators employed. Each offers a different rationale for claiming legitimacy, whether by being legally sanctioned, morally authorized, or culturally supported (Bruton et al. 2010).

In this chapter, we only focus on the regulative pillar of the environmental adaptation process in textiles and garment SMEs in Vietnam. This reflects the early evolutionary state of the industry, in which government legislation, industrial standards, and customer requirements are paramount. We go on to assess if the current governance system has any influence on the environmental adaptation process at these companies. In interviews with company managers, nongovernmental organizations (NGOs), and government officials, focused questions, with follow ups, were used in long interviews.

Underpinned on institutional theory and the regulative pillar of the environmental adaptation process informed by a literature review (Nguyen et al. 2014) and preliminary interviews, we developed focused questions for interviews with company officials of textiles and garment SMEs in Vietnam:

1. What environmental requirements does your company have to comply with?
2. How easy or difficult do you find responding to these requirements?
3. How does the current governance system influence the environmental adaptation process at your company?

Similar focused questions for NGOs, experts, and governmental officials were developed:

1. What are the environmental requirements that the SMEs in the garment and textile industry currently have to comply with?
2. How do these companies react to these requirements?
3. How does the current governance system influence the environmental adaptation process at your company?

A total of 21 interviews were conducted; of these, 8 interviews were with government officials, 3 were with NGOs, and 10 were with SMEs. The number of interviews for each group stopped when theoretical saturation was reached (Flick 2002; Robson 2002). Theoretical saturation occurred at a small sample size, suggesting homogeneity of issues faced in the industry. The interviews revealed a number of problems with the current environmental legislative as well as the governance system in Vietnam.

4 Current Environmental Requirements at Textile and Garment SMEs in Vietnam

The environmental requirements for textile and garment SMEs in Vietnam can be identified in four main groups. The first group is the Law on Environmental Protection 2005 (LEP). LEP is applied to all kinds of economic facilities in Vietnam, including all sizes (large, medium, small) and all types (state-owned, private, foreign-owned, joint stock, joint venture) of enterprises. The second group consists of regulatory documents issued by the government, such as decrees and decisions. The third group are regulatory documents issued by ministries and provincial governments, such as standards, directives, and circulars (in this case, regulations are mainly from the MONRE). The last group is the requirements from the customers. Table 2 summaries the key environmental requirements that the textile and garment SMEs in Vietnam have to comply with.

The Law on Environmental Protection (52/2005/QH11), which was adopted on 29 November 2005 and took effective in 1 July 2006, is the most important environmental legislative in Vietnam. The law and its related decrees and decisions provide a foundation for environmental management activities in Vietnam. Within the 3 years from 2011 to 2013, a total of 18,400 violations of the law were prosecuted, resulting in total punishment fines of 196 billion Vietnamese dongs (MONRE 2014). However, after 8 years, the implementation of the law is patchy and environmental degradation continues; the law has become more complicated, with differing views on how to proceed.

On one hand, the government and the public took a view that the law and its decrees are not strict enough. The fines applied in Decree 117/2009/ND-CP are not high enough to prevent enterprises from violating the environmental protection law. Many companies are willing to pay the penalties rather than to make investments in environmentally friendly technologies. Some companies have been equipped with modern wastewater treatment plants, but they have not used them because the operational costs are high.

> Very few firms have pollution emissions monitored because fines are inadequate to incentivize expensive investment in pollution control equipment and polluters do not face criminal sanctions, a senior environmental economist from Ministry of Natural Resources and Environment said in our interview.

Table 2 Key environmental requirements for textile and garment SMEs in Vietnam

No.	Name of the requirement
1.	Law on Environmental Protection 2005
2.	Decree 80/2006/ND-CP, detailing and guiding the implementation of a number of articles of the law on environmental protection
	Decree 21/2008/ND-CP, amending and supplementing a number of articles of the Decree 80/2006/ND-CP
	Decree 179/2013/ND-CP on regulations for penalties for violations against environmental protection (a revision/amendment of decree 117/2009/ND-CP)
	Decision 1788/QD-TTg of the Prime Minister on the plan for managing the polluted enterprises in the period from 2012 to 2020
	Decree 25/2013/ND-CP on fees for discharging wastewater
	Decree 29/2011/ND-CP, stipulating the requirements of strategic environmental assessments, environmental impact assessments, and environment protection commitments
3.	Circular 32/2013/TT-BTNMT: national technical standards on the environment, including national standards on the air quality (QCVN 05:2013/BTNMT) and national standards on the mud level arising from the wastewater treatment process (QCVN:50:2013/BTNMT)
	Circular 47/2011/TT-BTNMT: national technical standards on the environment, including national standards on industrial wastewater (QCVN 40:2011/BTNMT)
	Circular 39/2010/TT-BTNMT: national technical standards on the environment, including national standards on noise (QCVN 26:2010/BTNMT)
	Circular 63/2013/TTLT-BTC-BTNMT issued by MONRE and Ministry of Finance to instruct the implementation of Decree 25/2013/ND-CP
	Circular 26/2011/TT-BTNMT, detailing the requirements of Decree 29/2011/ND-CP
	Decision 16/2008/QD-BTNMT and QCVN13:2008/BTNMT: national standards on wastewater treatment in textiles and garment industry
	TCVN 5945: 1995 industrial wastewater discharge standards
	Decision 64/2003/QD-TTg (closure, upgrades in technology or investment in wastewater treatment systems)
	Others: requirements from the customers (e.g. the 39 standards from Nike)

On the other hand, all companies interviewed think the environmental regulations in Vietnam are too hard. It is too difficult for them to implement these requirements because they do not have enough human and financial resources to do so. They consider these regulations to be big barriers for the development of their business.

> Current requirements are too hard for such small companies as us, one of the company managers said.

One of the reasons why the current requirements are too hard for the companies is that they are being copied from the environmental laws of developed countries, and these are not easily implemented in Vietnam. This was verified by several

informants and confirmed by one representative from the textiles and garment association:

> Current laws and regulations are developed based on international experience (copies of other countries') and therefore they are not feasible in Vietnam's context. Many of them are too difficult to implement if there is no help from the government. The companies will worm their own way in complying with these requirements.
>
> For example the requirements on the concentration of waste water (NH3-N for instance) are copies of environmental law in foreign countries so they are too hard for Vietnamese companies. The policy makers must have not had any knowledge or experience in textile industry. Many requirements are not suitable for our sector, one of the managers said.

Furthermore, according to many interviewees, current regulations are quite "unfair." First, the implementation of the laws should not be the same among different sizes and types of companies.

> We divided companies into large, medium and small ones. Why didn't we divide the requirements on environmental protection into different groups which are suitable for different groups of enterprises? It is unfair for the small companies if they have to comply with the same regulations as the large ones. SMEs are weak in both technical capacity and financial resources. Their response to the regulations cannot be the same as large ones.

Second, the monitoring and enforcement policies were not applied fairly enough among different types of companies.

> Many state-owned companies, especially the ones in the army, violate the law but they are not punished or if they are punished the punishment is also much lower than the one for private companies. State-owned enterprises have more privileges than private ones. The government cannot shut down state-own enterprises but they can ask private ones to shut down.

Environmental regulations have become increasingly stricter since 1993. Policymakers have been trying to improve the current environmental legislative in order to best suit the new situation. Various decrees have been continuously issued in order to clarify and better explain how to implement the law. For example, after the Vedan scandal,[6] it was found out that Decree 80/2006/ND-CP was too broad (not detailed enough about the quantity of wastewater); therefore, Decree 117/2009-ND-CP was developed to further guide local authorities in handling violations of environmental protection law. After 2 years of implementing Decree 117/2009/ND-CP, it was determine that some punishments were not harsh enough and were still too general. Thus, Decree 179/2013/ND-CP was adopted.

However, the current law and its decrees are still controversial and claimed to be unsuitable for Vietnamese SMEs. In addition, many provisions overlap or contradict with the provisions of other laws (UNDP 2013).

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[6] Vedan scandal: Vedan is a Taiwanese MSG maker who started business in Vietnam in 1991. The company was accused of polluting the river in 1994, 1995, 2004, and 2006. It was suspected of having wastewater discharging directly to the river, but this was not uncovered until 2008 when a hidden pipe discharging directly into the river was found.

On the other hand, companies will try their best to comply with the requirements of customers because it determines the survival of their business.

> Regarding to the requirements from the customers, we have to try our best to comply with them, otherwise we cannot get the orders.

Nevertheless, not all the customers have requirements for environmental protection and environmental management. Those who do tend to be big customers, and most of these are based overseas. The small domestic customers only care about prices and designs. In some cases where customers have strict environmental requirements but do not place big orders, the companies may not comply with those requirements:

> If the requirements are too hard, then we have to accept to lose the orders because we cannot afford such big investment.

In general, many problems exist with the current laws and regulations on environmental protection in Vietnam. None of the textiles and garment SMEs interviewed were happy with the current requirements. They all tried to respond to these requirements at the minimum level. They either try to defer the implementation of the requirements, ignore them, or are willing to pay a fine if necessary.

5 Current Public and Corporate Governance Systems

Public governance in Vietnam has two elements. First, it is concerned with the implementation of the government policy on environmental management. Second, it considers the relationships between the government and the companies regarding responsibility and accountability for environmental management. Corporate governance is the system by which companies are directed and controlled. It provides a set of rules and procedures for making decisions related to environmental management.

5.1 Public Governance

Table 3 shows the different levels of environmental authorities in Vietnam. At the national level, the main authorities of textile and garment SMEs are the Ministry of Industry and Trade (MOIT) and the MONRE. MOIT is the line ministry and acts as the management agency for the textile and garment sector. This ministry promulgates legal documents that guide the sector on professional issues, some of which relate to environmental matters. However, although MOIT has an agency (which is equivalent to a department) with a mandate for environmental protection and environmental management, the environmental issues regarding production within the textile and garment sector are still predominantly in the purview of MONRE.

Table 3 Main environmental authorities in Vietnam

No.	Authorities for inspecting and monitoring environmental performance
1.	MONRE/VEA
2.	Other ministries such as MOIT, Ministry of Police and Ministry of Public Security (C49)
3.	PPCs
4.	DONRE, Provincial EPA
5.	District and Commune People's Committee
6.	Management Board of Industrial Park

MONRE is the highest national environmental agency. It issues the circulars to implement the Law on Environmental Protection and takes responsibility for improving the environmental performance of industries via Environmental Impact Assessment appraisal and the promulgation of environmental decrees, standards, and programs. In practice, MONRE authorizes the VEA to execute the implementation of environmental policies in the whole country. VEA is a subsidiary body under MONRE to advise and assist the Minister of MONRE in the field of environmental management and to provide public services in compliance with the laws.

At local level, the relevant stakeholders in the environmental adaptation process for Vietnam's textile and garment SMEs are the city/provincial People's Committee (PC), the DONRE, the Department of Industry and Trade (DOIT), and district and commune PCs. The city or provincial PC is the highest government body. DOIT is responsible for the sector development and DONRE is in charge of environmental issues in their city or province. Both are under the technical supervision of MOIT and MONRE, but they operate under the direct management of the city or provincial PC. Similarly, the offices of Natural Resources and Environment within the district and commune PCs are under the technical supervision of DONRE, but are directly managed by their PCs.

In practice, environmental issues at companies, including textile and garment SMEs, are mainly monitored and managed by the provincial EPA, which is under DONRE. EPA's main mandates include: (i) giving advice to the DONRE Director on environmental implementation at the provincial level; (ii) giving guidance to organizations and individuals in the provinces to implement environmental regulations and standards; and (iii) cooperating with the inspectors to monitor the environmental performance of the organizations and individuals in the provinces.

Almost all of the interviewees complained about the overlaps among these enforcement authorities. First, there existed some jurisdictional overlaps in issuing permits, licenses, and supervising EIAs. For example, several agencies, such as MONRE, PPCs, and DONRE are involved in issuing licenses for discharging wastewater. The management boards of the industrial parks also have different regulations about discharging wastewater. Overall, the companies claim that this is very confusing.

> There are some overlaps between different functional and jurisdictional authorities, making us really confused. We have to submit our reports to too many people. And sometimes it is really difficult because the information is inconsistent and unclear.

Second, there exist some overlaps in inspecting and imposing penalties on noncomplying companies. According to regulations on governing administrative sanctions and penalties, both the People's Committee, including DONREs at local level and professional agencies such as MONREs and the Ministry of Police (including their inspectorates), are authorized to impose a broad spectrum of sanctions (warnings, fines, penalties) on noncomplying facilities. Therefore, they all have the same legal authority to carry out inspections and impose sanctions against environmental violators. The companies claimed that this was confusing.

> We have to receive the authorities visiting for an inspection of our factory for 6 to 7 times a year. It took a lot of time, a manager complained.

The LEP includes some guidance for cooperation between functional agencies in administrating inspections and enforcement actions. For example, enforcement actions require the involvement of several functional agencies, including local People's Committees, police, and professional agencies. In practice, however, there is insufficient cooperation between these agencies, resulting in the local PPCs handling most enforcement cases. PPCs dominate the environmental inspectorate in enforcement because of their greater human resources and their ability to mobilize the police force.

However, a lack of professionally trained officials in charge of environmental protection remains a challenge for environmental protection agencies, especially at the local level. The inspection quality is different, making the competition unfair among the companies.

> The companies inside the industrial parks are inspected by the inspectors of the industrial parks. The companies outside the industrial park are inspected by the inspectors of the Department of Natural Resources and Environment. The inspection quality is so much different and therefore it is unfair in many cases.

Moreover, corruption is not an uncommon issue. Many companies are willing to pay the inspectors so that they overlook their noncomplying activities. For them, paying a corrupted "fee" is cheaper than doing the real environmental protection. In some cases, the local authorities do not want to monitor the environmental performance of the companies in their areas because those companies are too small or too poor to pay the penalties. In other cases, the local authorities suffer from political power, either not punishing the companies because of orders from higher level authorities or because they have to sacrifice the environmental targets in order to achieve their economic targets. In fact, the great efforts by the central government and the community to protect the environment are in vain if local authorities determine that local economic development has the top priority.

Another big issue for the current governance system is the inefficient support from the government. There are a number of supporting programs in terms of both

technology and finance, but accessibility is very hard. The procedures for getting incentives are also very complicated.

> We don't have anything to mortgage when accessing capital from the bank. Very few of us could access to financial support from the government.

While acknowledging that the government's resettlement plan[7] is necessary, many textile and garment SMEs found it difficult to implement without the support from the government.

> The industrial zones only lend a big piece of land (for example 5,000 m^2) while we don't need such a big area and we could not afford it. Furthermore, many provinces don't accept dying and textile companies. Only 4 among 61 provinces accept textile companies to locate within their administrative area.

Many textile SMEs companies have to choose any place that is affordable or they have to close down their business. Most of them are running very unsettled businesses.

In short, many interviewees—both governmental officials and SME managers—agree that the government has failed in effectively implementing environmental regulations in Vietnam. On one hand, they cannot shut down all of the enterprises who do not meet the environmental requirements because that eliminates the textile industry from economy, resulting in negative social and economic impacts. On the other hand, they have to tighten the requirements relating to the environment because of a commitment to sustainable development, international pressures, and public discontent. While not intractable, these issues pose a considerable problem for government.

5.2 Corporate Governance

Corporate governance in terms of environmental protection and environmental management in textile and garment SMEs in Vietnam is quite weak. None of the companies interviewed have any official rules and procedures requiring environmental compliance. They react to the environmental requirements from the government and the customers on a case-by-case basis. They do not allocate annual budget for environmental protection but use the contingency fund for environmental issues if needed. In many cases, environmental issues are not integrated in the company's policy or business strategy. If plans for environmental protection exist, they only exist on paper and are not implemented unless requested by the customers.

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[7] Ho Chi Minh City People's Committee released decision No.80/2002/QĐ-UB dated July 8th, 2002 on the approval of the "Relocation of Polluted Enterprises to Industrial Zones Programme". Following this decision, many textile companies were required to move out of residential areas and relocate to industrial zones.

> The law requires the companies to develop annual plan about environmental protection, but implementation is still different from what they planned.

None of the companies interviewed had any staff members who were directly in charge of environmental management. Environmental issues are dealt by purchasing officers, administrative officers, or even financial officers. These staff members are not provided with any training on environmental management. Although both the managers and staff are quite well aware of the importance of complying with environmental requirements, they do not consider these issues to be important or a priority for their business.

6 Conclusions and Recommendations

A general comment from the interviews and observations at textile and garment SMEs in Vietnam is that these companies do not actively comply with environmental requirements. Arguably, while governance is an issue influencing SMEs' proactiveness and capacity in adapting to environmental requirements, the evidence is weak. The influence that does exist comes from government legislation on environmental protection and the current local governance system.

SMEs consider the current environmental requirements to be hard, infeasible, and unfair. However, if the requirements are from the customers, the companies will put more effort into implementing them. Therefore, one of the most effective potential legislative tools is likely to be trade agreement. In other words, environmental requirements should be formulated on the basis of commercial reality.

The current public governance system reveals a number of problems, such as overlaps between jurisdictional and functional authorities, corruption, and insufficient support from the government. It is hoped that the amended Law on Environmental Protection (2005) will resolve these problems. Specifically, as the new LEP is deployed, it needs to address the following issues:

- Amending provisions to clearly assign tasks of environmental protection and enforcement among agencies at all levels to avoid jurisdictional and functional overlaps.
- Information on the duties and mandates of the inspectorates need to be accessible by the companies.
- Providing a strong legal basis of incentives for reporting corrupted cases as well as mandating stronger penalties and other sanctions for those who are corrupt.
- Providing a stronger legal basis for public participation in environmental compliance and enforcement, including a regime to report on corrupted cases.
- Increase investment and government budgets both at the central and local levels for environmental protection. Investment needs to be made in supporting programs for SMEs, such as a relocation program for polluted textile and garment companies to green field areas that are outside current urban areas.
- Providing support to SMEs to assist in adjustment and adaptation.

For the corporate governance to be improved, training on environmental protection and environmental management is a must. Stricter regulations on integrating environmental issues in companies' policies and business strategies should be developed. There should also be more support and incentives from the government to the companies who are willing to proactively undertake environmental management practices.

This chapter has only focused on the regulative pillar of institutional theory. We recognize the importance of all three institutional forces, including the normative and cognitive pillars. Further research on this issue, with a focus on all three pillars, is needed to identify a more comprehensive set of institutional conditions, under which environmental adaptation at textile and garment SMEs in Vietnam is likely to occur.

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Sustainable Measures Taken by Brands, Retailers, and Manufacturers

Thilak Vadicherla and D. Saravanan

Abstract Sustainability is a triple bottom line that includes three aspects—namely the environment, economics, and society. A lot of emphasis has been placed on the brands, retailers, and manufacturers because the customers not only purchase their products but also observe the sustainable practices followed by brands, retailers, and manufacturers. Topics discussed in this chapter include the code of conduct for suppliers; supplier rating, which is based on key performance indicators; and incentives for the adoption of best practices, disclosure of carbon footprint, fair trade and social compliance, use of sustainable materials (organic cotton, better cotton, recycled or reclaimed fibers), ways and means of improved water, and material and energy efficiency by brands, retailers, and manufacturers.

Keywords Annual sustainability report · Carbon footprint disclosure · Fair trade and social compliance · Energy efficiency · Sustainable materials

1 Introduction

The entire world seems to be obsessed with single term these days—sustainability. The kind of attention that sustainability has evoked for the past 3 decades or so raises plenty of questions. Customers' increased awareness of sustainability is creating responsible global citizens who have started using sustainability practices to the extent of their personal capacities, but a lot is now expected from these global citizens. Customers and consumers take cues from their brands, retailers, and

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manufacturers about trends, styles, efficiency, technologies, and features. In light of this, we must understand how to measure sustainability.

What are the elements of sustainability? Sustainability is a triple bottom line that includes the environment, economics, and society. How can we understand the interplay of the elements of sustainability? Can sustainability be measured? If so, how can we measure it?

Sustainability can be measured. It considers all aspects related to the quantitative basis of the informed management of sustainability. Many metrics are presently available and many are still evolving. Metrics used for the measurement of sustainability include indicators, benchmarks, audits, indexes and accounting, assessment, appraisal and other reporting systems. For instance, the Consultative Group on Sustainable Development Indicators combine multiple sources of data and form an aggregate sustainability index. Examples of sustainability indices include air quality, energy sustainability, environmental performance, environmental sustainability, environmental vulnerability, and sustainable society, among many other indices. A benchmark is a point of reference for a measurement that assesses trends and measures progress once established. The sustainability performance of a company or organization is measured using sustainability auditing and reporting. ISO 14000, ISO 14031, the natural step, and triple bottom line accounting are some popular auditing procedures. Sustainability indicators can be classified (http://en.wikipedia.org/wiki/Sustainability_measurement) into descriptive indicators (description based), performance indicators (target based), efficiency indicators (improvement based), policy effectiveness indicators (policy based), and total welfare indicators (better off). The latest developments include the Global Reporting Initiative and green accounting, which focuses on environmental reporting and costs.

Lately, many people have been keenly observing the sustainable measures taken by leading brands, retailers, and manufacturers. This chapter highlights some of these sustainable measures, such as those included in Table 1, to form a roadmap. All the measures involved in the roadmap are elaborated in this chapter.

2 Sustainable Measures Taken by Brands

2.1 Adidas

Athletes never stop trying to improve their performance. This well-known quote has become synonymous with the sustainable efforts of Adidas, helping the company to win the coveted SAM Gold Class, Sector Leader Award for Sustainability, obtain recognition by the Dow Jones Sustainability Index, and released the highly appreciated Olympic Collection for London 2012 (http://www.adidas-group.com/en/sustainability/reporting-policies-and-data/sustainability-reports/). Adidas participates in many industry-wide initiatives related to sustainability, including the Fair Labor Association, Fair Factories Clearinghouse, International Labour Organization

Table 1 Sustainability Measures

Brands, retailers, and manufacturers	Sustainability measures
Brands: Adidas, Burberry, Eileen Fisher, Esprit, Levi's, Nike, Patagonia, Puma Retailers: C&A, Gap, H&M, JCPenney, Target, Walmart	Supplier rating and auditing system based on certain key performance indicators
	Social compliance and fair wages
	Sustainable materials and life cycle assessment
Manufacturers: Dystar, Lenzing, MAS Holding, Novozymes	Sustainable collection
	Sustainable design tools
	Virtual technology
	Code of conduct or ethical trading policy
	Sustainable standards
	Digital and print campaigns focusing on sustainability
	Carbon footprint disclosure
	Energy-efficient practices

(ILO) Better Work Programme, Zero Discharge of Hazardous Chemicals (ZDHC) Group, and AFIRM Working Group. In addition, Adidas extends its support to the Sustainable Apparel Coalition (SAC) and the Global Social Compliance Programme, and it follows the Global Reporting Initiative guidelines and sustainable reports, the leading international benchmark for sustainability reporting systems.

Adidas has initiated audits of their suppliers on certain key performance indicators and rates them innovatively on their ability to deliver fair, healthy, and environmentally sound workplace conditions in an effective manner. The cumulative score of key performance indicators and the average score are rated as 1C, 2C, 3C, 4C, or 5C, as described in Table 2. Based on the rating, the suppliers are trained to build their capacity sustainably.

Adidas capitalizes on the expertise of their Social and Environmental Affairs (SEA) and Capacity Building and Development teams for the continuous improvement of workplace conditions of their suppliers. The company also has initiated a text messaging system and a worker hotline, through which employee

Table 2 Key performance indicators and scores of Adidas

Key performance indicators	PI score (%)	Rating
i. Management commitment and responsiveness	0–29	1C
ii. Management systems	30–59	2C
iii. Worker-management communication and industrial relations	60–79 (good or better)	3C
iv. Compliance training	80–89 (self-governance)	4C
v. Transparency in communication and reporting	90–100 (self-governance)	5C
vi. Compliance performance		

grievances are sent to the Adidas Group for redress, which has been proven to have a direct impact on workers' attitude. The strategic compliance plans of the suppliers are audited and enhanced by the Adidas Group's SEA team to identify the gaps in the plans and/or their implementation, which are then reported back into the strategic action plan. The report card process of Adidas is very transparent; it is executed by the SEA team, which measures the effectiveness of the compliance systems of the business entities in their daily operations. Fair wages at Adidas are determined from the social dialogue, balanced pay systems, and legal compliances.

Adidas strongly believes that the success of sustainability in innovation basically lies in a combination of the choice and manufacturing of materials and components. Measures, such as avoiding oil-based plastics, thinners, and lighter materials, have a huge impact on the environment. Adidas DryDye technology is a Polyester fabric dyeing process that uses no water (dye is injected into the fabric using compressed carbon dioxide), 50 % fewer chemicals, and 50 % less energy, but it shows greater dye retention in the fabrics than traditionally dyed fabrics; therefore, the technology is a truly eco-friendly process.

The London Olympics 2012 is well appreciated for its use of sustainable materials in the uniforms, torch relay kits, village wear, and training wear. The polo top for game-makers (100 % recycled polyester) and the Fluid Trainer shoe for Olympic volunteers (recycled and eco-friendly materials) boast an upper pattern efficiency of more than 70 %. Adidas achieved a 19 % reduction in the color palette used in the previous 2 years and set an ambitious target of reducing the same by 50 % in the Adidas Sports Performance Division.

Adidas's concept of Design for the Environment is an approach for the systematic application of environmental and human health considerations at the product design stage, with an aim to avoid/minimize significant environmental impacts and increase resource efficiency at all stages of a product's life cycle. Adidas's Element Soul, part of the Spring/Summer 2013 collection, is made up of sustainable fabrics and accessories manufactured using recycled polyester and soybean-based foams, with a one-piece injection mid-sole. The shoe contains only the essential items, resulting in a lighter shoe—two-thirds the weight of a standard show. All fabrics and apparel contain significant amounts of sustainable content, such as organic cotton, Better Cotton, and recycled polyester, which are manufactured using environmentally friendly dyeing processes (DryDye).

The Adidas Group is increasingly using virtual technology to reduce energy, materials, and waste generated and the quantity of physical samples required to design and sell new products. Through this paradigm shift in sampling, Adidas has been able to produce 600,000 fewer samples in the years 2011 and 2012 compared to 2010. The company has also introduced a three-dimensional design tool and started virtual product sales in more than half of the markets around the world. The company developed an innovative web-based catalogue to aid the sales of the Rockport Spring/Summer 2012 collection and was able to reduce the physical collections by 39 %. Standardized hand-tags across genders and business units, as well as single-wall transportation cartons with thinner and less paper than the

double-wall heavy cartons in the retailing and packing sections, are other initiatives taken by the Adidas toward reducing the environmental impacts of its activities.

In addition, Adidas has initiated attempts to reduce color-material combinations, trained cotton farmers through the Better Cotton Fast Track Program, encouraged suppliers to become members of the Better Cotton Initiative, established partial to full traceability of more sustainable materials (apparel products), reduced energy emissions in core suppliers, and achieved a Leather Working Group (LWG) silver or above rating for leather tanneries.

Implementation of green design requirements for new supplier buildings is another sustainable initiative of Adidas. Its unique *GreenENERGY* Fund, a global sustainability venture capital fund for energy efficiency and renewable energy projects, is being used to retrofit Reebok and Rockport stores in the United States. The Adidas Group is determined to reduce waste at their facilities. For example, canteen wastes are used for the production of bio-gas and electricity, and single-use paper cups were replaced with reusable cups made out of the materials left over from the paper production process. The company has established a Centre of Excellence in Retail and set up a Best Practice Library that allows sharing of current best practices, tools, and key performance indicators related to sustainability across the Adidas retail business. Adidas also has green teams that create awareness on sustainability, develops green ambassadors, and assists in waste collection. Adidas is committed to reducing not only the company's carbon footprint but also the information technology footprint by the use of green power management options for desktops and laptops, virtualization of servers, and data center consolidation.

2.2 Burberry

Burberry, founded in the year 1856 by Thomas Burberry, has become a well-known fashion label for innovative and functional (outdoor and extreme) purposes, particularly for the iconic Burberry coats and jackets in its collection (http://www.burberryplc.com/corporate_responsibility/burberry-beyond). With a strong commitment to ethical trading, sustainability, and environmental friendliness, Burberry has become a member of the UN Global Compact and uses the compact's ten principles. The company is an active member of both the Ethical Trading Initiative and Business for Social Responsibility, achiever of the Carbon Trust Standard, and is listed on the FTSE4Good Index. Burberry is also a member of the LWG, which supports improvements in transparency in the leather industry. Burberry does not use sandblasting on any of its products, manufactured or outsourced.

Even though the majority of Burberry products are manufactured in the Europe through outsourcing or near-sourcing, all of the Burberry suppliers are governed by the group's ethical trading policy, which also includes four policies on bribery and corruption, foreign contract labor, unauthorized subcontracting, and animal welfare to make the practices more ethical.

Table 3 Scope and significance of Burberry's commitment

Policy	Scope	Significance	Focus areas
Burberry Impact	Ethical trade and environmental sustainability aspects	Provides meaningful and lasting improvements to workers' employment and workplace conditions; reduces the environmental impact	People, product, process, and property
Burberry Engage	Encourages its associates to connect with Burberry Beyond framework	Volunteering programs, harnessing talent to give back to local communities	Inspiring young people in their local communities
Burberry invest	Supports innovative organizations and holds events in communities worldwide	Burberry donates 1 % of group profits before tax to charitable causes	Burberry Foundation assists young people in arts and design, oriented towards employment

Burberry Beyond, an initiative of the Burberry, encompasses all of the activities related to Burberry's commitment to driving positive social, cultural, and environmental impact globally, as monitored through policies such as Burberry Impact, Burberry Engage, and Burberry Invest (Table 3). Burberry also supports the next generation of creative talent through scholarship funds at the Royal College of Art (UK) and Ball State University (US).

2.3 Eileen Fisher

Eileen Fisher's Sustainable Campaign focuses on storytelling and 50% of its print advertisements carry an ampersand symbol [3], which signifies the information about the sustainable choices behind the clothing and the partnership with artisans of Spain and the holistic Bluesign standard. The company highlights the brand's mission to empower the women and girls and support leadership in women and girls by donating 10% of proceeds to them. Eileen Fisher's recycling initiatives have grown large, its profits from recycled clothing continues to support programs for women and girls.

Supplementing the print advertisements, digital campaigns feature the sustainable initiatives, in-store newspapers enable customers to read articles and interviews with Fisher, and various activities are featured on social media platforms such as Twitter and Facebook.

Eileen Fisher has become the first company to have Bluesign certified silks and also the first American fashion company to become a member of Bluesign. In addition, the company assesses water and energy usage to reduce the impact on

manufacturing. Customers who purchase products made from recycled materials receive rewards, which they can use in the showrooms or for online purchases.

Eileen Fisher's slogan is "The biggest change starts with the smallest act." The company has many sustainable options for consumers, such as wash less, switch to cold water, choose products from plants not petroleum, line dry, steam instead of iron, hand wash instead of dry clean, and green dry clean. The company supports traditional crafts and cultures throughout the world. At present, 25 % of Fisher's collections are made from sustainable materials, including fair-trade organic cotton knits, Bluesign certified eco-dyed silk, organic cotton, linen and wool, and sustainable and recycled fibers and coloration processes. Currently, Eileen Fisher makes seamless sweaters (knit garments without any seams) with fewer production stages and reduced waste.

Eileen Fisher's Peru Project focuses upon fair-trade wages and organic cotton as a part of a company-wide commitment to make fair-trade Peruvian knits as an important part of the sustainable collection. Eileen Fisher's Peruvian partners follow the guidelines of the Fair Trade Federation, who are committed to provide fair wages, support safe and healthy community workplaces, supply financial and technical support, ensure environmental sustainability, respect cultural identity, offer public accountability and transparency, build direct and long-term relationships, and educate the consumers.

2.4 Esprit

"Social and environmental commitment is part of Esprit's DNA"—this has been a motto of Esprit to implement and ensure sustainability in their operations (http://www.esprit.com/company/sustainability). To Esprit, sustainability means creating high-quality fashion that one can enjoy for a long time, and the company strongly believes that the people who make the company products must be treated fairly and respectfully along with the environment. This commitment means there should be no child labor, no forced labor, legal compensation, no involuntary overtime, no illegal or disciplinary deductions from wages, strict adherence to local law and regulations, no workplace discrimination, safe and healthy working conditions, no use of restricted chemicals, and minimized damage to the environment. Esprit's other initiatives include support for the Business Social Compliance Initiative and ZDHC, and the company is a founding circle member of the SAC.

The SAC was founded by a group of sustainability leaders from global apparel and footwear industries (http://www.apparelcoalition.org/). It seeks to identify common metrics and approaches to reduce the social and environmental impacts of apparel and footwear products. The major focus of the SAC is on the Higg Index, which measures the environmental impact of apparel and footwear products.

Esprit's mission statement of the year 1990—*Be informed, be involved, make a difference*—paved the way for the designers to look beyond the gamut of fashion and pay attention to the social and environmental impacts of apparel manufacturing.

As a result, the organic collection by Esprit was launched in the year 1992, projecting Esprit as a pioneer in the sustainable apparel market. Esprit uses organic cotton certified by the Global Organic Textile Standard, with traceability throughout the production process. In addition to organic cotton, Tencel, organic linen, and organic wool are also are used by Espirit for the production of garments. Recycled wool is made from wool waste, coming from pre- and post-consumer waste that would otherwise be going to landfills.

Esprit's Beachwear Collection 2012 was manufactured using recycled nylon fibers with a blend proportion of 70 % recycled nylon, subsequently enhanced to 82 % recycled nylon and 18 % spandex in the Beachwear Collection 2013. Some Esprit clothing items are manufactured using 100 % recycled polyester and cotton fabric wastes. Recycled collections show impressive results in the lifecycle assessment (LCA), with up to 75 % less use of water compared to the conventional products, facilitating the Global Recycle Standard certification.

Esprit has also been a part of I:Collect (I:CO), a Swiss-based recycling startup that resells clothing in the second-hand or vintage markets, since 2011 to encourage the people to bring back and deposit their old clothes and shoes in exchange for discount coupons to purchase new products. Esprit offers various sponsorships and talent competitions and also conducts workshops, giving young professionals a chance to present themselves to a broad audience.

Esprit supports sustainability awards as well as sustainable design competitions for young designers. The EcoChic Design Award supported by the Esprit is a sustainable fashion design competition organized with an aim to inspire young fashion designers to create mass-market clothing with minimal textile wastes.

2.5 Levi's

The Dockers Wellthread process is a classic example of how Levi Strauss is working to make its products more socially and environmentally sustainable (http://www.levistrauss.com/sustainability/). This groundbreaking approach combines sustainable design and environmental practices, with an emphasis on supporting the well-being of the employees involved in the garment manufacturing. The Dockers design team aims for novel design concepts, as well as a reduction of water and energy use in manufacturing processes, including garment-dyeing with cold-water pigment dyes and salt-free reactive dyes.

The Levi's Waste<Less collections feature aesthetic and durable denims made from recycled wastes—specifically, an average of eight recycled plastic bottles (12–20 oz.) per pair of jeans that are dyed using less water. In the year 2012 alone, the Levi's brand made 29 million Water<Less units, which translates to saving more than 360 million liters of water.

Levi's has developed a unique, long-staple yarn for its premium Wellthread. These extremely long staple cotton fibers are easily recycled and every garment has 100 % traceable components.

Levi's is also one of the six apparel companies working with the National Resources Defense Council on a pioneering initiative to reduce the environmental impact of textile mills in China. The company's other sustainable initiatives include The Future of Sustainable Fashion (trends that impact the fashion industry), A Care Tag for Our Planet (requesting that people act and drive change) and Lifecycle of a Jean (LCA and environmental impact over the lifespan of a pair of Levi's jeans and Dockers pants), which give a roadmap for reducing the carbon footprint. Levi's is also actively engaged in supporting the International Labor Organization's Better Work program, as well as the BSR Apparel Mills and Sundries Working Group, which aim at improving working conditions and the supply chain for textile mills and sundry/component parts suppliers. Levi's has a reputation for its social concerns, including Health Enables Returns (also known as the HER project), which coordinates general and reproductive health training for female factory workers in Pakistan and Egypt and combats HIV/AIDS in South Africa.

The LCA for Levi's 501 jeans and Dockers Original Khakis gives an in-depth understanding of the climate change, water usage, and energy impacts of these products, revealing that 58 % of the energy and 45 % of the water used during the lifetime of Levi's jeans occurs during the consumer use phase. Keeping this in mind, company has initiated a global dialogue with consumers, Care for Our Planet, to educate how caring for clothes affects the environment. Through this initiative, Levi's encourages the consumers to wash less, wash in cold water, line dry when possible, and donate clothing to a charity when no longer needed. Levi's also launched a contest, Care to Air, to find a better way to air dry jeans, as well as every other article of clothing that typically ends up in the dryer. Levi's has established a partnership with Goodwill in the United States to encourage consumers to increase the lifecycle of a pair of jeans by donating them, as well as piloting projects in which old jeans are reused as building insulation and other materials.

Levi Strauss launched the code of conduct—"the code that launched a thousand codes"—a pioneering concept to developing a comprehensive responsible global sourcing program. In 1991, Levi's created *Terms of Engagement* (now popularly known as the Sustainability Guidebook), which was a first for the apparel industry, outlining expectations from their business partners in practices pertaining to everything from worker rights to the environment. It is based on the United Nations Universal Declaration of Human Rights and International Labor Organization Core Conventions. Strict water quality standards were subsequently added, along with strengthening of the protection of workers' rights to form unions and conduct collective bargaining. Levi's is also a member of the Fair Factories Clearinghouse, which is dedicated to improving workplace conditions.

Levi's was one of the first apparel companies to release the names and locations of all of their active, approved owned-and-operated, contract, and licensee factories that manufacture and finish Levi's, Dockers, and Signature by Levi Strauss products. The Levi Strauss Foundation focuses on funding programs that strengthen worker rights and improve the working and living conditions for the people who make their products.

Levi's has been aggressively pursuing ways to reduce their carbon footprint by shifting from the most carbon-intensive modes of transport (air and trucking) to less intensive modes (rail and ships). In addition, the company also focuses on reducing energy use at their large-scale distribution centers by overhauling the lighting (installing efficient lighting systems that yield savings from 20 to 40 %), updating the maintenance programs to increase the efficiency of air-conditioning units, installing Forest Stewardship Council-certified wood flooring, and adding denim recycling stations. Levi's is reducing the number of hangtags on each garment from an average of three to two, and the company also began printing the size and care information directly onto garments.

2.6 Nike

A designer's knowledge of the Materials Sustainability Index and Higgs Index is an added advantage for designing sustainable products. The product creation teams at Nike use the Nike Materials Sustainability Index (Nike MSI) to select environmentally friendlier materials (http://www.nikeresponsibility.com/report/content/chapter/our-sustainability-strategy#sthash.m4MQWpf7.dpuf). Each material's impacts are assessed in four areas: energy, chemistry, water, and waste. The weighting of these environmental factors gives the MSI value: the higher the value, the better it is in terms of sustainability.

Being a company that is committed to sustainability, Nike has released an updated version of the MAKING app, adding new features and a roster of additional materials commonly used in footwear and apparel to help designers make sustainable design decisions from head to toe. MAKING is powered by data from the Nike MSI, a database built on materials research and analysis. Additional features of MAKING include the following:

(i) Inclusion of 20 materials commonly used in footwear, including rubber, ethylene-vinyl acetate foam, and zinc
(ii) Deeper insights on the materials, including insulation, waterproof, and absorbance
(iii) Tips for improving the environmental impact of designs
(iv) A comparison tool to measure the sustainability attributes between materials
(v) The ability to select/filter materials for apparel, footwear, and all materials categories.

These data have been made public with the goal of helping to lead industry sustainability efforts and provide designers and product creators with guidance in selecting materials with lower environmental impacts.

Nike has created the awareness on sustainability across the globe in a positive manner (http://www.nikeresponsibility.com/report/content/chapter/our-sustainability-strategy), such as with its sports jerseys for the 2010 FIFA World Cup that were made from recycled plastic bottles and Flyknit, an innovative manufacturing process

that reduces wastes in knitted fabrics used in the upper parts (shoe uppers) of the shoes. Other sustainable efforts from Nike include the exploration of new materials and manufacturing processes through their Sustainable Business and Innovation Lab, toward a leaner and greener supply chain.

Nike has been using an innovative technology, ColorDry, which replaces water with recyclable CO_2, thus reducing energy use and eliminating the need for auxiliaries in the process. Compared to the traditional dyeing methods, the ColorDry process reduces dyeing time by 40 %, energy use by $\sim$60 %, and the factory's carbon footprint by 25 %.

2.7 Patagonia

Patagonia was one of the first apparel manufacturing companies to initiate sustainable efforts, during the early 1990s. Patagonia's mission is to "inspire and implement solutions to the environmental crisis." The company hopes that these solutions will inspire others to follow their lead (http://www.patagonia.com/). Patagonia has been a pioneer on numerous environmental and social fronts since its inception, including the following:

- Using only organic cotton in cotton products since 1996
- Redefining corporate transparency through its Footprint Chronicles
- Launching the Common Threads Partnership to invite customers to take mutual responsibility for the entire lifecycle of the company's products through the *5Rs* (reduce, repair, reuse, recycle, and reimagine)
- The first brand member of the Bluesign system
- One of the first California companies to switch to wind energy and on-site solar energy systems
- Launching $20 Million and Change, a fund to help like-minded responsible start-up companies
- One of the first U.S. outdoor apparel companies to introduce Fair Trade Certified garments
- The first outdoor clothing manufacturer to manufacture fleece made from postconsumer recycled plastic soda bottles
- One of the first companies to use hemp, recycled nylon, recycled polyester, and Tencel

Patagonia's most recent initiative is working with The Nature Conservancy and Ovis XXI, representing fifth-generation ranchers, to regenerate overgrazed grasslands in Argentina, where it sources its merino wool. The company also takes responsibility for every garment at the end of its life by taking it back for recycling or repurposing. Patagonia co-founded 1 % for the Planet, Freedom to Roam, The Conservation Alliance, and the SAC, the company is a founding member of the Fair Labor Association.

Fig. 1 Patagonia's *Don't Buy This Jacket* Campaign (http://www.treehugger.com/corporate-responsibility/patagonia-dont-buy-our-jackets.html)

Patagonia's other sustainable campaigns, such as *Buy Less* and *Don't Buy This Jacket* have positive impacts on customers' awareness of sustainability. The campaign was inspired by the enormous response to its provocative *Don't Buy This Jacket* (http://www.treehugger.com/corporate-responsibility/patagonia-dont-buy-our-jackets.html) promotional advertisement, which asked customers to think twice about whether they needed a new jacket (Fig. 1). The *Better Than New* advertisement celebrated the resale of well-used, long-surviving Patagonia clothing. Patagonia's *Buy Less* campaign aimed at asking the customer whether they really need that several-hundred-dollar new parka. Indirectly, the message suggests that a customer could repair and keep using the $700 Patagonia parka he or she already has instead of buying a new one. The company also has produced a series of videos to show customers how to fix things themselves. Patagonia's new campaign, *The Responsible Economy,* asks consumers and businesses alike to rethink disposability for more effective resource allocation.

2.8 Puma

Puma, another sportswear manufacturer, is committed to working in ways that contribute to the world by supporting creativity, sustainability, and peace. The company aims to stay true to the values of being fair, honest, positive, and creative in decisions and actions taken (http://about.puma.com/sustainability/). PUMAVision lays the foundation for all the activities, a concept that guides with its three core programs of PUMA.Creative, PUMA.Safe, and PUMA.Peace. PUMA.Safe comprises initiatives and commitment for environmental protection and improved working conditions, with a focus on implementing cleaner, safer, and more sustainable systems and processes within the supply chain. PUMA.Peace supports the global day of ceasefire on September 21 every year through its initiative One Day One Goal, which aims at bringing people together to play football, with an idea that

the power of sports could unite people in peace. PUMA.Creative emphasizes creativity as the core competence of the brand, aiming to bring together artists and different organizations for mutual creative exchange and offering them an international platform.

Puma's Bring Me Back program has played a significant role in the recycling process. Puma's InCycle is a sustainable collection that includes shoes, apparels, accessories, and home insulation materials made up of either biodegradable polymers or recycled polyester and organic cotton. Puma also introduced a successful program called Cradle-to-Cradle, certified collections of lifestyle sneakers (biodegradable; a blend of organic cotton and linen with the biodegradable plastic APINAT Bio sole), the legendary Puma Track Jacket (recyclable; made up of 98 % recycled polyester and 2 % elastane), shirts (biodegradable), and backpacks (recyclable; polypropylene), with facilities to collect them back from the general public. Puma's Re-suede uses 100 % recycled materials and an outsole of rice-husk fillers instead of rubber components.

Many retailers take measures to follow these sustainable options by modifying retail outlets. The Puma stores feature a range of products made from organic cotton as well as Puma's Wilderness Collection, which is primarily sourced and produced in Africa using sustainable materials. The sustainability measures implemented in the Puma's Sustainable Store in Bangalore include constructing the building with recycled steel from old DVD players, bicycles, and tiffin boxes; using porotherm blocks in the shell of the building, which were made of silt; using furniture and fixtures made of recycled wood and low-volatile organic compound paint; reducing artificial lights by supplementing with access to natural lighting in the interior; installing a foam roof on the building for insulation; cooling the retail showroom without air-conditioning (natural cooling) by underfloor air distribution systems combined with air passing through an underground tunnel; generating energy by the pedal powers of customers entering the store; and using 100 % solar-powered energy and occupancy sensors.

3 Sustainable Measures Taken by Retailers

3.1 C&A

Sustainability is one of the underlying principles behind the C&A business model, which is coordinated by Sustainable Business Development (http://www.c-and-a.com/uk/en/corporate/company/our-responsibility/). C&A is committed in their responsibilities towards employees, customers, and the people who are involved in the entire supply chain by dealing with important matters concerning the environment, product safety, and employment conditions. A few of the sustainable measures taken by C&A include the following:

- Supporting the fight against Sumangali schemes (a form of bonded labor in India)
- Not accepting cotton originating from Uzbekistan
- Ceasing the purchase of sandblasted jeans
- Using products that only contain down feathers from birds primarily raised for meat production
- Using leather and skins from animals that are primarily raised for meat production
- Having zero tolerance of child labor
- Assisting the investigation by EEB commissions on the fire at Tazreen Fashion in Bangladesh
- Signing the Accord on Fire and Building Safety for implementation
- Following ILO standards on minimum wage
- Donating during natural calamities, such as earthquakes
- Operating training centers for youths on reading, writing, mathematics, and various trades.

The C&A Code of Conduct was developed in the year 1995, specifying both social and ecological standards in the supply chain. It also addresses issues such as waste avoidance, recycling, and energy saving. The Code of Conduct is monitored by the Service Organisation for Compliance Audit Management and an independent organization. C&A's environment protection strategy pursues two main objectives: reduction of total energy consumption in all relevant areas and meeting remaining energy needs from renewable resources with low CO_2 emissions. The European Crisis Management Team assists in the management of an unforeseen crisis, such as the spread of H1N1 virus and protection of workers in production facilities performing sandblasting operations.

Organic cotton plays a key role in C&A's sustainability strategy, such as the initiative in its new Bio Cotton range. C&A is one of the global market leaders for organic cotton, selling 110 million garments a year—nearly 38 % of total cotton sales in the year 2013. Farmers are trained in collaboration with organizations such as Textile Exchange and CottonConnect to cultivate the use of natural pesticides and fertilizers, reduce health risks, and protect the soils, fresh water, and revenue streams. Water Footprint Network demonstrated that organic cotton creates five times less gray water pollution from pesticide run-off than conventional cotton farming.

C&A is known for its sustainable supply chain. The company monitors and collaborates closely with suppliers in an effort to both validate and significantly advance social and environmental performance throughout the supply chain. C&A neither accepts nor sells products made of real fur, Angora rabbit fibers, or wool fibers from sources where mulesing practices are applied. C&A requires that all of its products and their manufacturing, use, and disposal/recycling processes are in full compliance with all the applicable legislation, as well as the latest version of the C&A Restricted Substance List policy.

3.2 Gap

Gap Inc. has been recognized by the Ethisphere Institute, an American management consulting firm, as one of the world's most ethical companies for 8 years in a row, reflecting that the company lives up to its promise "to do more than sell clothes" (http://www.gapinc.com/content/csr/html.html). Gap's sustainable initiatives include the following:

- The human resources strategy is based on UN Guiding Principles on Business and Human Rights.
- Gap is the first American retailer to set minimum and standard hourly rate (wage) for US employees.
- Gap currently employs 70 % female workers in its retail and corporate offices. The PACE program, which has been operational since 2007, provides female garment workers with technical skills to move up in the workplace and better their own lives, the lives of others, and the community in terms of communication, management of finances, problem solving, nutrition, and hygiene.
- Gap also works with local organizations and development experts to address the root cause of child labor in a regional education initiative that helps raise awareness on how to avoid traffickers.
- Gap was among the first US companies (along with Walmart and Children's Place) to contribute US$40 million to the victims of the Rana Plaza factory collapse in Bangladesh in April 2013.
- Gap stores and distribution centers incorporate the use of renewable energy, energy saving, and waste reduction.
- Human rights strategies focus on two key areas: vendor engagement and fire and building safety, as per the Human Rights Policy and Code of Vendor Conduct.
- The company is one of the founding members of the ILO's Better Work Program and is now a member of its Advisory Council.
- Gap has been transparent in reports of social and environmental impacts since 2003.
- The company reports to the Carbon Disclosure Project, and their score has been increasing every year.

Gap has "greened" its largest San Francisco building through a series of measures, including the way the employees sort and dispose of waste. Gap also developed a sustainable fiber toolkit for designers and merchants across their brands to highlight the environmental and social impacts of natural, manufactured, and alternative fibers. Another sustainable avenue is Gap brand's Wise Wash denim (www.gapinc.com), which was launched in the year 2012. Wise Wash (Fig. 2) is a manufacturing process that uses low-impact manufacturing techniques, consuming less energy and water than conventional wet processing.

Fig. 2 *Wise wash* of Gap [http://www.gapinc.com/content/csr/html/environment/product.html]

3.3 H&M

H&M has been designing collections made out of the sustainable materials since 2007. H&M's continuous commitment to more sustainable fashion was reinforced by two collections, Conscious and Conscious Exclusive, launched in 2014. Using two new sustainable materials, organic leather, from the Swedish leather supplier Tärnsjö, and organic silk, the collections exhibit the range of possibilities of the sustainable fashion (http://about.hm.com/en/About/sustainability.html).

H&M, the world's second largest clothing retailer, introduced a garment collecting initiative in 1,500 stores. The remaining 1,300 shops are expected to follow the practice to change the mindset of the customers, so that they can see their old clothes as a resource rather than throwing them into the garbage or letting them pile up at the back of their closet. Customers can go to any participating H&M store with their old clothes and hand them over at the cash desk, in exchange for redemption vouchers for a new purchase. H&M sells the donated clothes to I:CO. Clothes that are in poor condition are either converted for other uses, such as cleaning cloths, or recycled into textile fibers. H&M is well known for its sustainability, as demonstrated by the following initiatives:

3.3.1 Providing Fashion for Conscious Customers

- Using only more sustainable cotton—the largest user of recycled cotton, organic cotton, and BCI cotton
- Supporting innovation in sustainable fibers—Tencel, recycled wool, organic linen and hemp, recycled polyethylene terephthalate
- Promoting more sustainable leather—leather shoes are made from LWG-certified leather and water-based adhesives
- Inspiring customers to join conscious actions—HIV/AIDS awareness, H&M for Water, supporting children's rights with UNICEF in India and Bangladesh, reuse and recycle initiatives, climate and water-conscious garment care
- Introducing Conscious wash and care instructions—Ginetex Clevercare label

- Setting industry standards for measuring product sustainability
- Collaborating with the French government in product LCA
- Providing sustainability training for buyers and designers
- Increasing knowledge among sales advisors about the sustainability works
- Translating the new sustainability website into multiple languages.

3.3.2 Choosing and Rewarding Responsible Partners

- Implementing a supplier relationship program—survey on the relationship with H&M
- Choosing responsible partners—order placement only occurs after an initial audit and the order is subjected to the full audit program
- Analyzing of supplier management systems
- Measuring sustainability performance
- Rewarding good sustainability performers with better business
- Increasing workers' awareness of their rights
- Promoting higher wages for garment workers across the country
- Teaming up with the best partners and creating model factories
- Ensuring freedom of association and promoting social dialogue
- Reducing overtime in supplier factories
- Supporting better health for factory workers in Cambodia
- Continuing to promote improved fire safety in Bangladesh
- Continuing to promote an end to the Sumangali schemes in India
- Requesting a ban on Uzbek cotton.

3.3.3 Being Ethical

- Ensuring awareness and understanding of the code of conduct
- Launching a human rights policy based on United Nations guiding principles
- Promoting diversity and ensuring equality amongst colleagues
- Ensuring good workplace relationships and dialogue with colleagues in all markets
- Attracting and retaining talent
- Developing and implementing a new global training system
- Introducing an updated global leadership program
- Reaching over 90 % compliance with the company's safety standards
- Communicating business ideas through responsible advertising.

3.3.4 Being Climate Smart

- Reducing the operation's total greenhouse gas emissions
- Reducing electricity use in stores by 20 % per square meter

- Sourcing 100 % electricity from renewable sources
- Choosing and promoting environmentally conscious transportation
- Promoting energy efficiency among suppliers
- Using natural resources responsibly
- Strengthening the communities.

3.4 JCPenney

JCPenney's sustainability activities can be summarized by the following categories (http://ir.jcpenney.com):

- **Stores and operations**: JCPenney is committed to increasing operational efficiency, utilizing programs to manage energy consumption, reducing waste, and encouraging recycling across all the stores and logistics facilities. JCPenney has received ENERGY STAR certification for more than 500 locations and earned the ENERGY STAR Sustained Excellence Award for five consecutive years as an acknowledgement.
- **Supplier social and environmental standards**: JCPenney focuses on responsible sourcing and improving social and environmental supply chain standards in collaboration with Bureau Veritas (BV) in performing compliance audits.
- **Product safety**: The company has partnered with the BV's Consumer Products Services to analyze product performance and spot the potential issues and concerns.
- **Ethics**: The company publishes a statement of business ethics.
- **Employment**: JCPenney continually celebrates and enriches its diverse and skilled workforce through business resource teams and continuing education.
- **Community**: JCPenney is known for its grants and sponsorships, disaster relief, in-kind donations, and community engagement.

3.5 Target

Target's most important sustainable effort is the development of the Target Sustainable Product Standard, which was developed in partnership with industry experts, vendors, and nongovernmental organizations toward establishing a common language, definition, and process for qualifying products as more sustainable (https://corporate.target.com). Target collects the information from vendors and evaluates a product's qualities against set criteria using GoodGuide's UL Transparency Platform. The standard was first rolled out in three categories: household cleaners, personal care, and beauty and baby care. This tool helps to showcase the authenticity of products while pushing for industry-wide clarity around what really

Fig. 3 Target product sustainability standard (https://corporate.target.com)

makes a product sustainable. As the product standard rolls out and matures, it is expected to form the basis for Target's merchandising and product-placement decisions. The Target Sustainable Product Standard (https://corporate.target.com/discover/article/introducing-the-Target-Sustainable-Product-Standard) is just one example (Fig. 3) of how Target integrates sustainability in all areas of business, from the way stores are built to the products on their shelves. Using this standard and process, Target tries to incentivize innovation among the vendors and promote continuous improvement in the full assortment of their products.

Target takes its sustainability measures seriously and focuses on four commitments: sustainable living, sustainable products, smart development, and efficient operations. Target empowers both customers and employees to live more sustainably. Examples include the following:

- A reusable bag discount
- Recycling kiosks placed near the entrance of all stores, where guests can recycle bottles, cans, and small electronic devices
- Elimination of the potentially lethal sandblasting process for finishing apparel
- Assuring the ENERGY STAR label for Target stores
- LEED Gold rating for Target stores
- Use of low-wattage light fixtures and motions sensors in refrigerators
- Steps to protect and preserve water resources and the surrounding habitats
- Comprehensive storm water management to reduce and improve the quality of storm water run-off
- Efficient operations by using resources responsibly, eliminating waste, and minimizing carbon footprint
- New packaging designs using fewer components to minimize the volume of trash produced
- Disclosure of the company's carbon emissions each year through the Carbon Disclosure Project link
- Using energy-efficient store designs, new lighting technologies, and experiments with renewable energy
- Designing and building stores with plumbing fixtures that save up to 30 % more water.

Target's commitment to communities goes well beyond sustainability. The company has committed $1 billion to education by the end of 2015, in addition to the roughly $4 million a week to the communities to make them safer, happier, and healthier places to live.

3.6 Walmart

Walmart is reputed for its sustainable activities on the social, environmental, and economic fronts (http://corporate.walmart.com/global-responsibility/environmental-sustainability). Walmart has been continually focusing on supply chain capacity building, worker safety initiatives, women's empowerment initiatives, community investment programs (e.g. scholarships for migrant workers), anti-human trafficking, stakeholder engagement programs, a global social compliance program, retail market compliance, color-coded factory rating system (95 % green/yellow factories), worker helplines, orange school program (training to selected factories and suppliers, providing hands-on training to resolve high-risk social and environmental violations), violation correction training (in which the factories with higher-risk observations are requested to attend the training for a better understanding of the Walmart ethical practices), supplier development program, supplier roundtable, the Walmart zero-tolerance policy for unauthorized subcontracting, hunger-relief grants (at the local, state, and national levels), disaster relief, and emergency operation centers.

Sustainability 360 is a comprehensive view of the business that integrates the ideas, actions, and enthusiasm of all its suppliers, associates, and customers around the world. Walmart is taking numerous steps to reduce emissions, with technological advances in energy-efficient equipment, focused reduction efforts in refrigerant losses, reduced carbon intensity of utility power, and increased deployment and consumption of renewable energies. Since 2009, the Walmart has been committed to developing a Global Sustainability Index as the new retail standard for the twenty first century. This index is integrated along with the work of The Sustainability Consortium into the business and is tied to buyer incentives and performance evaluations. Sustainable agriculture is a new initiative of Walmart that supports farmers and the farming communities.

4 Sustainable Measures Taken by Manufacturers

4.1 DyStar

DyStar's sustainability strategy is twofold: reduce the company's own environmental impact and help customers to reduce their environmental impact (http://www.dystar.com/sustainability.cfm). The company has zeroed in energy,

greenhouse gas emissions, water, and waste as the main environmental impacts to address. DyStar has set an optimistic target of reducing environmental impacts in these four areas by 20 % by the year 2020, with a 2 % annual reduction of the impacts.

A compliance management system coordinates and supports employees to help in accordance with the company's core values and Code of Conduct and Social Accountability. DyStar has implemented a companywide sustainability initiative, the Caring for the Future program. Sustainability councils have been formed as part of these initiatives to identify opportunities for reductions and to enhance sustainability performance with local, regional, and international expertise. DyStar has released an annual sustainability report since 2010 in compliance with the Global Reporting Initiative Guidelines. DyStar also has published a carbon footprint report annually since 2011, in accordance with the Greenhouse Gas Protocol.

DyStar manufactures dyes and chemicals that are engineered to meet legislation such as REACH, voluntary regulations such as Oeko-Tex, or any of the Restricted Substances List of well-known brands and retailers. DyStar is committed to manufacturing products with an eco-clean profile, which shortens production time, decreases the use of water and energy, and provides improved color consistency with a right-the-first-time approach.

DyStar Textile Services supports the brands, retailers, and their industry partners with fast and innovative global solutions to create sustainable fashion. Color Solutions International (CSI) brings the most environmentally friendly and cost-effective solutions into the market and facilitates sustainable fashion. The CSI program includes ColorWall products, approximately 4,000 readymade colors that are updated regularly with the inspirations to provide trend-aligned colors. They are used from design to development and production, thus eliminating costlier and wasteful processes of laboratory trials and color approvals.

Some of the sustainable products in the DyStar line are Levafix, a reactive dye with high fixation levels for cotton textiles; Remazol Ultra RGB reactive dyes (low-impact dyes) for deep shades on cotton; Dianix green range, dispersed dyed polyester textiles that meet the stringent requirements of brands and retailers; Sera Zyme C-PE, which substitutes the conventional scouring with a bio-scouring process, thus providing less process time (7.3 %), less water usage (15.9 %), less electricity consumption (11.3 %), and less steam consumption (19.6 %); Sera Gal G-RFX and Remazol Ultra RGB, which allow the scouring and dyeing processes to be combined, with 38 % less processing time, 24 % less water, 28 % less electricity, and 38 % less steam.

DyStar's Sustainable Textile Solutions (STS) is a team of experts that guides the textile manufacturing units to optimize production, water and energy, and use of chemicals, while reducing the cost and delivering a similar or better quality of goods, as required through consultancy, auditing, and capacity building. The STS team also supports the brands and retailers in their efforts to develop, implement, and communicate Restricted Substances Lists to assure the safety of the consumer, have a minimum impact on the environment, and popularize their efforts. STS provides integrated advice on ZDHC compliance and third-party testing results to

further improve compliance systems, assess the supplier and its full chemical inventory, and provide advice accordingly. STS has been instrumental in the Discharge Data Report, which was recently launched by C&A, H&M, and G-Star Raw. It is a joint roadmap from a group of major apparel and footwear brands and retailers to help the industry towards ZDHC by the year 2020 based on the 11 priority chemical groups detected in wastewater discharge from textile manufacturing processes.

DyStar's Ecology Solutions Team supports textile mills, dyes houses, and laundries with ways to meet the demand for responsible and sustainable production, on issues relating to ecology and chemical legislation, and with recommendations for suitable products to meet the ecological specifications of the Ecoconfidence program.

4.2 Lenzing

The Lenzing Group has published a sustainability report entitled "Focus Sustainability—Taking Responsibility for Our Business" according to the Global Reporting Initiative (http://www.lenzing.com/en/fibers/botanic/sustainability.html). Lenzing is committed to sustainability through manufacturing environmentally friendly fibers, such as Tencel, Eurocel, and Modal as alternatives to viscose rayon, whose production involves highly corrosive and toxic chemicals.

For example, the mindset of consumers is to dispose of wipes in the toilet, regardless of whether they are "flushable" or not, which often leads to problems with blockages in public sewage systems. By using Tencel as a short-cut type, biodegradable, strong, and smooth surface, wipes are ideal for skin, prevent skin irritation, and have "flushable" characteristics. Environmental certificates, such as the EU Ecolabel, Nordic Swan, and OK biodegradable from Viocotte or Ecocert, demonstrate the environmentally responsible production of Tencel.

Eurocel is a new cellulosic fiber combined with a European footprint, made in Austria (Sandler AG) in an environmentally responsible process. Production in the Europe translates into shorter delivery distances, which means reduced carbon dioxide emissions during transportation and thus a lower carbon footprint—an approach toward near-sourcing. Additional advantages include improved product properties, such as improved volume, higher tear resistance, and reduced elongation. Eurocel is certified through Oeko-Tex Standard 100, European Ecolabel, Compostable, Vinçotte OK Compost Home, Vinçotte OK Compost, Vinçotte OK Biodegradable Soil, Medically Tested/ITV Denkendorf, US BPI compostable certificate, and Food Contact Compliance Certification to demonstrate its sustainable nature.

Lenzing Modal is produced from indigenous beech wood (100 % natural). Both the pulp and fiber production employ the principles of sustainability and processes are optimized for byproduct recovery. Eucalyptus, primarily used to produce the Tencel fiber, is an interesting raw material because it grows quickly and does not

require any artificial irrigation or genetic manipulation. A comparison of Tencel with conventional cotton revealed surprising results: The use of water and pesticides plays no role in the cultivation of eucalyptus trees and eucalyptus can be planted even in the marginal lands that are not used for the cultivation of the food products. An important asset is that the fiber yield with Tencel is 10 times higher than that of conventional cotton.

4.3 MAS Holdings

In 2006, MAS Holdings launched "MAS Eco Go Beyond," a community outreach initiative, together with the support of the Ministry of Education of Sri Lanka to create awareness of sustainability among the future generations of the country. MAS Holdings incorporated the concepts from the United Nations Environment Programme Youth Exchange Programme, the Consumer Citizenship Network, and the Looking for Likely Alternative toolkit to develop a sustainability curriculum in Sri Lankan schools. In 2008, the United Nations Educational, Scientific and Cultural Organization used the outlines of the Eco Go Beyond program to develop the Education for Sustainable Development (ESD) Toolkit for the Asia-Pacific region, and recognized MAS Holdings as the best partnership with the private sector for ESD in the year 2009.

MAS Holdings has been working aggressively to identify and minimize the environmental impact of their operations and products (http://www.masholdings.com/responsibility/environmental_sustainability.php). All MAS Holdings facilities are retrofitted for lower carbon, energy, and water footprints. A substantial change has been brought in their products and operations through the strong commitment to certifying all the facilities in Sri Lanka under ISO 14001 by the end of 2012. This led to key achievements, including a reduction of the energy intensity of production facilities by 8 % through intense focus on energy efficiency and establishing energy security using biomass boilers in larger steam-consuming factories. The company's commitment to 'build green' has resulted in all new buildings being designed as green facilities—and thus, MAS Holdings being the first LEED Platinum apparel manufacturer in the world. MAS Holdings has also focused on sustainable products, launching eco-elastics, and carbon-neutral products. The company works with customers to promote organic cotton, BCI cotton, recycled nylon, and recycled polyester to bring more environmentally sustainable products to the market.

MAS Holdings is committed to gender equality and became a signatory to the UN Global Compact Women's Empowerment Principles, ensuring that workplace policies and practices are free from gender-based discrimination, as well as ensuring the health, safety, and well-being of all female and male workers. MAS Holdings has established a zero-tolerance policy towards all forms of violence at work, including verbal and physical abuse, and sexual harassment. The company promotes education, training, and professional development for women; conducts training programs that include basic computer skills, English-language skills,

leadership skills, team building, financial management, and sign language training; and creates awareness among all employees on HIV/AIDS. Another important program, Getting More Out of Life, includes a series of programs that aim to improve workers' knowledge of sexual and reproductive health, to achieve the desired behavioral change with regard to reproductive and general health, and to face life events more competently and effectively.

4.4 Novozymes

Novozymes is one of the leading manufacturers of industrial enzymes as an alternative to harsh and toxic chemicals (http://www.novozymes.com/en/sustainability/Pages/default.aspx). The company's Sustainability Board determines sustainability targets, which are then broken down into four different levels:

(i) Across the supply chain to ensure the suppliers meet the company's standards
(ii) Within the company's own operations (energy, water, etc.)
(iii) The environmental footprint of the customers through the use of eco-friendly products
(iv) Society-level impacts.

An interesting practice of Novozymes' sustainability targets is the linking of annual employee bonuses to meeting the sustainability targets. If sustainability goals are not met, employees are paid less. Novozymes has framed many concepts to achieve sustainability, including *rethink tomorrow*. *Driving the world towards sustainability* is the specific mission of the company, which includes the aims to become *a voice on the world stage*, *to drive new business from sustainability,* and *to build sustainability capabilities.*

Novozymes is committed to reducing CO_2 emissions across the world. The company started the production of biogas from wastewater treatment in China, generated energy from windmills corresponding to electricity consumption in Denmark, and implemented many water-efficient practices for the reduction of water usage. Novozymes supports international human rights principles and labor standards and contributes to the local communities by enhancing their competency levels in science, environmental responsibility, and innovations.

Novozymes uses LCA to assess the environmental impact of the solutions covering the entire lifecycle from cradle to grave. Novozymes has topped the Dow Jones Sustainability Index in the biotechnology sector for 11 years. Novozymes provides cost-competitive biorefining to produce biofuels and biochemicals, providing a viable, renewable feedstock alternative. The company's bioagricultural products improve crop yields while reducing the environmental impact. Novozymes Taegro is a good example of a bacterial-based biofungicide/bactericide used for suppressing selected soil-borne and foliar diseases on fruit and leafy vegetables.

Table 4 SWOT analysis of various sustainability measures practiced by brands, retailers, and manufacturers

Sustainble measure/ initiative	Strength	Weakness	Opportunity	Threat
Supplier rating	Evaluates supplier's sustainable practices	Frequency of surprise visits by the auditing team to be further increased	Training and capacity-building of the suppliers	Huge competition with many suppliers/ brands on the market
	Supplier's ability to deliver fair, healthy, and environmentally-sound workplace conditions		Targets can be increased every year	
	Transparency by the supplier and the auditing agency	All units including outsourcing to be fully audited	Incentives for performing suppliers	
Sustainable materials	Use of organic cotton, better cotton, recycled polyester, and recycled nylon	High cost of organic and better cotton	Increased customer awareness	Voluntary regulations
	Lifecycle-based assessment		Incentives for the use of sustainable materials	Growing demand for government rules and regulations
Design tools	List of sustainable materials and processes available for the designer	Lack of designer knowledge on sustainability and sustainable materials and processes	Training programs for designers on sustainability practices	Growing understanding of sustainable materials
	Computer-aided design tools that include three-dimensional tools		Virtual technology for sample development, modifications, and approvals	Mass market and production
			Fast fashion.	
Virtual technology	Minimization of physical samples	Customers' mindset	Surge of e-commerce encourages the use of virtual technology	Growing security concerns regarding designs/ideas
	Reduce energy, materials, and waste generation		Reduction of color pallets	
	Web-based catalog for specific collections		Can be used during sampling, production, approvals, and sales	
	Ease of storage, retrieval, and modification			

(continued)

Table 4 (continued)

Sustainble measure/ initiative	Strength	Weakness	Opportunity	Threat
Code of conduct or ethical trading policy	Norms a supplier has to meet	Frequency of surprise visits by auditing team to be further increased	Training programs on code of conduct	Huge competition with many suppliers/ brands in the market
	Social compliance, such as fair trade practices	All units, including outsourcing, to be fully audited	Incentives for performing suppliers	Cost-cutting measures
Sustainable collection	Highlights the sustainability commitment	Higher price tag	Global Recycle Standard certification	Demand for low-cost, high-quality, and durable clothing
		Less customer awareness		
Digital and print campaigns focused on sustainability	Highlights the sustainability commitment	Cost of promotion	Global awareness on sustainability	Campaigns must meet the demands of the target audience
	Effective impact on the customers	Translation of awareness to purchase depends on the price factor also	Widespread use of internet	
			Use of celebrities	
Carbon footprint disclosure	Transparency and commitment to sustainability	Use of proper methodology/calculations is essential	Voluntary practices.	Cost-cutting measures
	Assists in baseline status and targets to be achieved		Trading based on carbon credit	
			Incentives for carbon-neutral products/companies	
Energy-efficient practices	Energy efficiency across the processes	Energy efficiency is initially expensive	Growing demand for Energy Star certifications	Cost-cutting measures
	Use of renewable resources			

5 SWOT Analysis of Various Sustainability Measures Practiced by Brands, Retailers, and Manufacturers

The sustainability measures practiced by brands, retailers, and manufactures can be best understood by analyzing the strengths, weaknesses, opportunities, and threats (SWOT) of an organization, company, industry, technique, practice, or measure. Table 4 shows the SWOT analysis of some sustainability measures discussed in this chapter.

SWOT analysis indicates that the use of sustainable materials and sustainable collections are bound to increase in the future. Digital and print campaigns focused on sustainability inform the customer about the initiatives and lay down the foundation for customers to make sustainable choices. A special mention has to be given for the use of virtual technology because of the prospects and benefits it will have on the sustainability front. Sustainable design tools can be a boon to the LCA initiative because product-making begins at the design stage. A supplier's rating, along with its code of conduct or ethical trading policy, must be made more transparent and has to be incentivized sufficiently. Energy-efficient practices assist in lessening the carbon footprint, which can be seen from the carbon footprint disclosure. In nutshell, all sustainability measures are going to have increased opportunities in the future and can only become more and more transparent.

6 Summary

Sustainable measures practiced by brands, retailers and manufacturers have been on the rise and can only improve in the future. All of these stakeholders often take collective measures to ensure sustainability in the entire value chain, making the system a robust one. The interesting features of such collective measures impose more restrictions and pressure on manufacturers operating in developing countries, which often suffer due to the problems associated with economic and political instabilities, in turn hindering the implementation of sustainable measures with the necessary supports.

Development of Eco-labels for Sustainable Textiles

A.K. Roy Choudhury

Abstract The main purpose of the eco-label is to stimulate consumers to buy environmentally-sound products and, in turn, to stimulate producers to produce in an environmentally friendly manner. Labels allow consumers to make comparisons among products. Consumers are also provided with the ability to reduce the environmental impacts of their daily activities by purchasing environmentally preferable and healthy products and by minimizing adverse consequences during use and disposal. Eco-labeling has emerged globally as a differentiating factor in retail markets for textile and apparel purchases. It is a primary tool for marketing to well-informed and 'green' customer; thus, eco-labeling has become very important to the development of a sustainable and credible textile industry. The Ecolabel Index currently contains brief details about 449 eco-labels in 197 countries and 25 industry sectors.

Keywords Ecology · Eco-label · Restricted substances lists (RSLs) · Organic cotton

1 Introduction

Ecology is the scientific study of interactions among organisms and their environment, such as the interactions organisms have with each other and with their abiotic (nonliving) environment. Ecosystems are composed of dynamically interacting parts, including organisms, the communities they make up, and the nonliving components of their environment. Ecosystem processes, such as primary production, pedogenesis (soil formation), nutrient cycling (the movement and exchange of organic and inorganic matter back into the production of living matter), and various

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niche construction activities, regulate the flux of energy and matter through an environment. These processes are sustained by organisms with specific life history traits, and the variety of organisms is called biodiversity. Biodiversity—which refers to the varieties of species, genes, and ecosystems—enhances certain ecosystem services.

Ecology is an interdisciplinary field that includes biology and earth science. The word *ecology* ("Ökologie") was coined in 1866 by the German scientist Ernst Haeckel (1834–1919). Ancient Greek philosophers, such as Hippocrates and Aristotle, laid the foundations of ecology in their studies on natural history. Modern ecology transformed into a more rigorous science in the late 19th century. Evolutionary concepts on adaptation and natural selection became cornerstones of modern ecological theory. Ecology is not synonymous with the environment, environmentalism, natural history, or environmental science. An understanding of how biodiversity affects ecological function is an important focus area in ecological studies. Ecologists seek to explain:

- Life processes, interactions, and adaptations
- The movement of materials and energy through living communities
- The successional development of ecosystems
- The abundance and distribution of organisms and biodiversity in the context of the environment.

Ecology is a human science as well. There are many practical applications of ecology in conservation biology, wetland management, natural resource management, city planning (urban ecology), community health, economics, basic and applied science, and human social interaction (human ecology). Organisms and resources compose ecosystems, which, in turn, maintain biophysical feedback mechanisms that moderate processes acting on living (biotic) and nonliving (abiotic) components of the planet. Ecosystems sustain life-supporting functions and produce natural capital, such as biomass production (food, fuel, fiber, and medicine), the regulation of climate, global biogeochemical cycles, water filtration, soil formation, erosion control, flood protection, and many other natural features of scientific, historical, economic, or intrinsic value (Odum and Barrett 2005).

This chapter discusses the use of various nonsustainable materials in the textile industry, the development of a large number of eco-labels to assure the nonuse of such substances, and confirmation of the sustainability of textile processes and products.

2 Textile and Ecology

Since prehistoric times, textiles have been produced by human beings. Textile manufacturing developed empirically based on previous experiences and randomly acquired knowledge; many professionals kept their manufacturing experiences secret. Technology stagnated, while the rate of developments and improvements in

manufacture was extremely slow. For a long time, there was no scientific approach to textile manufacture. Significant developments in the textile industry started by the end of the 18th century. Increased demand for textiles initiated investigations into ways to improve production. A series of inventions followed in the field of textile machinery and textile chemistry, as well as the introduction of new machines for manufacturing. These machines marked the beginnings of the Industrial Revolution. By the middle of the 19th century, artificial dyestuffs and the mercerization process were invented, which paved the way for a more scientific approach to textile finishing and dyeing. At the end of the 19th and beginning of the 20th centuries, these fields were marked by full industrial development. Environment pollution by this type of manufacturing presented no serious threat because textile manufacture at the time was much smaller, as was the population that used its products. Additionally, the chemicals used were mostly of natural origin (e.g. soaps, starches, vegetable oils), which were all easily biodegradable. Chemicals in wastewater and the air were mostly degraded and neutralized by natural processes. However, increased population and higher consumption of textiles per capita led to increased production and care, which resulted in a serious hazard to the environment.

During the last century, numerous new dyestuffs and auxiliaries were synthesized and gradually accumulated in the environment. Because of increased environment consciousness and enhanced knowledge, people began to realize that numerous chemicals previously considered to be safe and harmless were in fact carcinogenic, potentially carcinogenic, or toxic; consequently, legal regulation to ban these products or to limit their use resulted (Sivaramakrishnan 2009a, b).

According to these regulations, designers and manufacturers of textile products are supposed to pay special attention to meeting contemporary ecological requirements. For a product to be "green", it should be environmentally friendly throughout its production cycle, during use and care, as well as after its useful life has been terminated. Product design must not consider only the requirements of the economy but also those of ecology (Thiry 2009). In constructing a product, the designer should analyze the production process, together with the product's end use, everyday use, and care for the product designed.

Special certificates are awarded by independent institutions to the products that are environmentally friendly and do not represent health hazards. Ecological acceptability can be influenced by the raw material selection. Textiles that can be recycled should not be mixed with those that are not acceptable for recycling. Individual garment parts, such as some coatings, fibers, and zippers, may not be ecologically friendly. Although their substitution may be quite expensive, a producer aiming for ecological production will consider substituting such parts with ecologically acceptable and environmentally friendly products.

Designers should keep in mind that the responsibility for the product does not end with its manufacture; it lasts at least as long as the lifecycle of the product in question. It is extremely important for textile products not to emit volatile organic compounds or some other harmful substances (e.g., heavy metals) during their use and care. Textile care exhibits more profound and more serious impacts on the

environment than the manufacture itself. Excessive quantities of water are generally used for the repeated washing of used textile materials. This is the reason why textile products should be designed to have as little need as possible for washing and dry cleaning. For example, a proper and environmentally friendly oil-proof finish, if also soil-resistant, can considerably reduce the number of necessary washing and dry cleaning cycles, which obviously saves water and energy in the lifecycle of the product being treated. Washing at lower temperatures offers a method of savings as well.

Another approach to the problem is to extend the lifecycle of the product as much as possible because costs will be reduced in this manner for raw materials, manufacture, and finishing. The product should be manufactured to soil as little as possible, while the colors should not fade until the end of the product's useful life. Another important factor is the elimination of unpleasant odors that could develop in wear and general use. The useful life of the product can be additionally extended in this way.

The last factor is of special importance for sports articles. Antimicrobial treatment is necessary for these products because microorganisms degrade human sweat, and the products of this degradation often develop unpleasant odors. Antimicrobial treatment is even more important in finishing rugs, carpets, and other decorative textiles. Various bacteria and molds often develop on such products, especially under wet conditions, and they can easily damage the texture, cause color changes, or create stains that are extremely hard to remove (Bešensky and Soljacic 1983).

Some experts think that textile designers and manufacturers should be obligated to care for the final disposal of textiles, after their lifecycle is complete. The worst solution is to consider putting such products in landfills. At minimum, a product could be burned, producing some energy in the process. The best solution is to recycle textiles and reuse them as fillers for other textile articles or remanufacture them into new products. Obviously, the advantage is to have textiles designed from a single type of fiber, or fibers of similar properties, so as to make recycling easier (Thiry 2009).

The growing population and increased per capita consumption of textiles result in higher loads on the environment, both by effluent water and exhaust air. The literature confirms that water consumption has double the growth rate of population. Population has tripled in the past 100 years, whereas water consumption increased sevenfold. A serious shortage of potable water is expected in the near future (Strohle and Böttger 2008). There is also a real danger of permanently damaging and polluting the environment. Considerable and harmful consequences could be expected, which will be detrimental to human health and nature, particularly aquatic animal life.

Textile industry is considered to be the most hazardous environmental issue globally (Oecotextiles 2012). Primary sources of ecological problems in the textile industry are the finishing processes, from initial scouring and bleaching, through mercerization and dyeing, to final finishing processes and coatings applied to textiles. Therefore, it is of crucial importance to monitor and control wastewater pollution and exhaust air pollution in order to reduce the harmful effects of the

above-mentioned processes. Additionally, textiles produced in conventional processes sometimes contain dyestuffs and residual chemicals, which can evaporate or penetrate through the skin. Some of them are carcinogenic or can cause allergic reactions (Sivaramakrishnan 2009a, b).

To prevent these harmful effects, but also thanks to new knowledge and higher levels of ecological awareness, more and more restrictions and bans have been imposed or proposed, concerning on the use of particular chemicals and dyestuffs. In some instances, their use is limited by the regulations dealing with maximum allowed concentration for a particular chemical compound that can be used in treating a textile or that is allowed to remain on a particular textile substrate (Soljacic and Pušic 2005). This problem has been recognized since the 1960s, although some protective measures were taken even earlier. The measures aimed at protecting the environment and workers' health are becoming stricter. Currently, the following measures and procedures are most often implemented:

- Complete elimination of all the carcinogenic or potentially carcinogenic chemicals and dyes
- Substitution of aggressive chemicals with biodegradable materials
- Elimination of active chlorine and other active halogen compounds or, at minimum, a reduction in their use
- Recycling, purifying, and reusing chemicals (e.g., caustic soda from mercerization)
- Substitution of formaldehyde compounds with those that contain no formaldehyde or, when necessary, with compounds that contain reduced amounts of formaldehyde
- Elimination of dyestuffs containing heavy metal ions
- Use of dyestuffs with maximum exhaustion (if possible, above 90 %) so that wastewater pollution is reduced
- Reduction of the dye-to-liquor ratio, as well as the reduction of water, energy, chemical, and dyestuff consumption
- Reuse of heat and water (using them repeatedly in treatment processes) by which considerable savings in energy and water can be realized while reducing the level of environment pollution

Textile care consumes more water, chemicals, and energy than textile production (dyeing, finishing). Additionally, textiles are not washed only in large laundries, but primarily in numerous households, which multiplies the effect. Generally, the same principles of environment protection are implemented in textile care and production as well. Maximum energy, water, and chemical savings are the aim, while toxic and hazardous chemicals are supplemented by ecologically more favorable products that have less harmful impacts on both the environment and human health.

Special attention in laundering is given to compounds that are not fully biodegradable, primarily surfactants, which should be eliminated; biodegradable compounds should be used instead. Textile products that come to a shop should be marked with hanging tags or in-sewn labels—or often, both. Care instructions should contain the information on how and under which conditions a particular

textile product should be washed or dry cleaned to remain functional and keep its appearance for as long as possible.

Ecology has been, for some time, one of the key factors in selecting and managing textile finishing and care processes. Proper selection of dyestuffs, detergents, and chemicals, together with optimal process control, can result in serious savings of natural resources, water, and especially energy, as well as in considerable reduction of environment pollution.

2.1 Textile Ecology

The term *textile ecology* is easier to comprehend if it is explained in three parts: production ecology, human ecology, and disposal ecology (Moore and Wentz 2009).

Production ecology refers to the process of production and manufacture of fibers, textiles, and garments. Sustainable textiles should be environmentally friendly and should satisfy the rational conditions to respect social and environmental quality by pollution prevention or by installing pollution control technologies. Third-party certification bodies and governments have issued Restricted Substances Lists (RSLs) that link production ecology to human ecology. Such lists provide stimuli to promote the use of safer chemical inputs and provide targets for the verification of cleaner production of textile products.

Human ecology focuses on the effects of textiles on the users and their near environment or surroundings. According to the present methodology, concentrations of substances that could induce dangerous effects on humans during normal use must be understood, modeled, and managed. Consumers are concerned with this aspect of textile human ecology. Risks have been addressed through the development of RSLs by governments, retail organizations, producers, and nongovernmental organizations. RSLs must be analyzable for the final textile products used by people, and they must be reviewed regularly as living documents.

Product analyses to detect and quantify RSL substances should be performed by accredited independent laboratories. Consensus-based test methods must be used to verify the absence or concentrations of harmful chemicals. The diverse and complex nature of global textile production requires analytical verification of the absence or concentration of restricted substances by accredited international laboratories. The modular concept of the Oeko-Tex Standard 100 certification at every stage of production has the advantage that intermediate textile components can be certified for eco-labeling. It prevents costly supply rejections at every step of the textile chain and supplements conventional quality assurance testing. The development of updated RSLs and the corresponding development of international third-party laboratory networks to verify RSL compliance is becoming an important tool for human ecology product assurance. This concept of disposal ecology is based on what happens at the end of the ‘first use’ of textile products. Disposal ecology addresses the recycling, reuse, energy, disposal, and/or decomposition of textile

products without release of harmful substances or thermal elimination without endangering air purity.

Ecology for textiles, and by inference eco-labels for textiles, may address production, human, and disposal ecologies. Because the textile industry is truly global in scope, products are made and sold throughout the world. Therefore, compliance with various companies' individual requirements can be a challenge. Some trade regulations have produced unified information label requirements that describe the country of origin and fiber content. Eco-labels are now attempting to inform consumers additionally of the 'textile ecology' of the products they are buying.

For modern production technologies, analytical laboratories (after rapid information dissemination) can produce eco-certifications and labeling schemes that are transparent, accurate, and cost-effective. Until recently, textile labels that addressed composition, care, and origin were considered adequate. Human ecology, production ecology, and lifecycle information are now demanded by major international retailers. The eco-labels of the future will provide a myriad of information that encompasses the social and environmental aspects of a product.

3 Sustainability

Sustain means "to maintain" or "to uphold." With regards to industrial processes, *sustainability* means establishing principles and practices that help to maintain the equilibrium of nature—or, in other words, to avoid damage to the earth's natural sources. A greater degree of sustainability in industrial processes and systems requires a better balance between the social, economic, and environmental aspects of textile production. A sustainable product is one that is manufactured in the following ways:

(1) It respects the social elements of fair trade and the human rights of the people involved in the whole of the manufacturing chain.
(2) It has the lowest possible adverse effect on the environment with the most efficient use of water and energy, recycling of raw materials and water, and recovery of heat from wastewater.
(3) It should not be an uneconomic choice versus less sustainable products and the economic returns should be fairly distributed along the supply chain.

Various fashion brands and retailers are considering the options available to make their products "green." To achieving more ethical or sustainable clothing, one should start at the design stage, such as the use of more sustainable textile fibers and low-impact dyes and chemicals. Eco-friendly fibers may be natural or synthetic, but they must have reduced environmental impact in their production and processing compared to conventional fibers. Exclusion or reduction in the use of pesticides and synthetic fertilizers during their production results in less hazards for human beings, especially for farmers. Some of these fibers have been used in the textile and apparel industries for a long time but became more important in recent years due to

Table 1 Classification of eco-friendly textile fibers

Class	Eco-friendly fibers
Organic	Organic cotton, organic wool, organic silk
Man-made	Corn/soya bean, lyocell, pineapple, milk weed
Recycled	Recycled cotton, recycled polyester
Natural	Naturally colored cotton

their environmental benefits, such as organic fibers (cotton, wool, silk), recycled cotton, naturally colored cotton, lyocell, corn, soya bean, recycled polyester, and some others, as listed in Table 1 (Jain and Easter 2010).

With the increase in consumer interest and the establishment of third-party certification systems, the textile industry has emphasized the production of sustainable fibers and the search for newer alternatives. Some successful examples are Tencel, recycled polyester, recycled and organic cotton, and bamboo. However, the sustainability and eco-friendliness depend critically on how the fiber is subsequently processed.

The careful selection of dyes and chemicals through accurate and reliable information provided by reputed suppliers enables processors to match a customer's RSL criteria. Because of a lack of clear information and the absence of an internationally agreed-upon standard for a definition of eco-friendly dyes, various myths and misinformation have emerged around dyestuffs.

In summary, a sustainable approach covers the following points:

- Minimum use of resources (water and energy)
- Minimum chemical consumption
- Minimum pollution load
- Elimination of toxic chemicals from the supply chain.

Therefore, sustainable textiles or apparels are,

- Safe for humans and the physical environment
- Made from renewable materials
- Produced while making the most efficient use of resources, such as water and energy
- Manufactured by people employed in decent working environments
- Capable of being washed at low temperatures using environmentally friendly laundering agents
- Capable of being returned safely to the environment at the end of their useful life (Performance Apparel Markets 2009).

In terms of life cycle assessment, sustainable textiles are manufactured and used in sustainable ways without using restricted substances and can be disposed of sustainably after use.

To minimize the usage, it is important to measure the inputs. To eliminate the most harmful chemicals, it is important to know and understand what is being used.

Uncontrolled or unknown inputs lead to the unmanaged use of resources and uncontrolled outputs. The measurement and control of these inputs and outputs can lead to the following:

- Improved resource productivity
- Improved eco-efficiency
- Improved cost efficiency
- Improved customer satisfaction
- Improved brand reputation

4 Restricted Substances

The relocation of production due to globalization has created additional levels of complexity for sustainable textile production because different nations have different environmental laws—or even none at all. To secure a clean production by manufacturers, trade and brands around the world refer to the RSL. The number of demanding and critical consumers requesting transparent value chains and high-quality, harmless, and environmentally safe products is constantly growing. This is a challenge that future-driven businesses have to accept. The textile industry is a major manufacturing industry and will continue to be so in the foreseeable future. It is no longer adequate to have a finished product be safe only to human beings—the product has to be environmentally safe during its entire lifecycle, and even beyond. Environmental technology (or green technology, clean technology) is the application of the environmental science and green chemistry to conserve the natural environment and resources and to curb the negative impacts of human involvement.

RSLs can be very extensive. These lists differ from country to country and from industry to industry. Not surprisingly, governments and industries focus on the dangerous substances that are important to them, in the sense that they cause severe health or environmental problems. Nevertheless, some substances are commonly found in RSLs.

Textile industries are using a large number of chemicals, which include toxic and harmful substances used during various processes; a few are listed here (Roy Choudhury 2011):

(a) Cotton growing—banned pesticides such as DDT, Dieldrin, Aldrin, etc.
(b) Sizing—pentachlorophenol as a preservative
(c) Scouring—chlorinated products
(d) Bleaching—sodium and calcium hypochlorite
(e) Dyeing and printing—azo dyes containing/releasing banned amines, dyes containing traces of heavy metals (e.g. arsenic, lead, cadmium, mercury, nickel, copper, chromium, cobalt and zinc), formaldehyde-based auxiliaries
(f) Finishing—formaldehyde-based finishes, stain removers containing chlorinated products
(g) Packing—wooden boxes treated with insecticides

4.1 Azo Dyes

The use of azo dyes is one of the hottest issues that the textile/garment and apparel industries have had to face. These dyes have outstanding fastness properties and have been widely used in the industry, accounting for about 60–70 % of the dyes used. However, certain azo dyes may, under suitable conditions, undergo in vivo reductive cleavage of the azo bond to form harmful aromatic amines. Some of these aromatic amines are either proven or suspected carcinogens. At present, 22 amines are classified by the European Union or the MAK Commission as human carcinogens. The use of dyes that may cleave to any of those 22 amines has been restricted.

Before 1970, bladder cancer was common among workers engaged in handling benzidine in the production of benzidine dyes. In 1971, the major German colorant manufacturers voluntarily agreed to cease production and marketing of such azo dyes.

At the beginning of the 1990s, the German Senate Commission for testing for harmful substances recommended that azo dyes should be treated in the same way as the amines on which they are based, because the azo dyes can be split under certain physiological conditions to form carcinogenic amines. In a second amendment in 1994 to the Ordinance on Materials and Articles, the use of certain azo dyes is prohibited in the manufacture of materials and articles that are designed for more than temporary contact with the human body. The specific azo dyestuffs include those that are known to be toxic or are suspected to release harmful aromatic amines.

Two German laws have been amended that apply specifically to textile processing activities: the Fourth Federal Emission Protection Ordinance and the ordinance on materials and articles. The German Legislation came in force from 30th June 1996. The German ordinance on materials and articles has received worldwide attention because of its fundamental importance for the textile supply chain. It is probably the most widely discussed law in the textile sectors in the last few years. Twenty aromatic amines are banned, which are listed below (source: Eco-Tex Consortium, Germany).

Amines definitely carcinogenic in nature:

(1) Benzidine
(2) 4-chloro-o-toluidine
(3) 2-naphthylamine
(4) 4-aminodiphenyl

Amines reasonably suspected to be carcinogenic:

(5) o-toluidine (3,3′ dimethyl benzidine)
(6) o-dianisidine (3,3′ dimethoxy benzidine)
(7) p-chloro-aniline
(8) 4-chloro-o-toluidine
(9) 3,3′-dichloro-benzidine
(10) o-amino-azotoluene

(11) 2-amino-4-nitrotoluene
(12) 2,4-toluylendiamine(4-methyl 1-1,3 phenylenediamine)
Other prohibited amines:
(13) 2,4-diaminoanisole (4-methoxy-m-phenylenediamine)
(14) 4,4′-diaminodiphenylmethane
(15) 3,3′-dimethyl-4-4′-diaminodiphenylmethane
(16) p-kresidine (2-methoxy 5-methylaniline)
(17) 4,4′-methylene–bis-(2-chloroaniline)
(18) 4,4′-oxydianiline
(19) 2,4,5-trimethylaniline
(20) 4,4′-thiodianiline
Dyes releasing following amines on decomposition that are to be phased out:
(21) p-amino-azobenzene
(22) 2-methoxyaniline

Approximately 70 % of all dyes (belonging to various dye classes) used in the textile industries are azo dyes. Due to their toxic nature or amine-releasing properties, approximately 25 % of the azo dyes are already prohibited in manufacture and use.

According to DIN 55493, pigments are colorants that are not bioavailable because they are not soluble in the application medium. The Fifth Amendment (November 1996) excludes poorly soluble pigments with a molecular weight of more than 700. The decision on whether a pigment is prohibited is based on the official test method.

The forbidden dyes belonging to various dye classes are listed below (without any guarantee of completeness).

Direct dyes (amine releasing, 82 dyes):
C.I. Direct Yellows 1 (22250), 24 (22010), 48 (23660).
C.I. Direct Oranges 1 (22370), 6 (23375), 7 (23380), 8 (22130), 10 (23370), 108 (29173).
C.I. Direct Reds 1 (22310), 2 (23500), 7 (24100), 10 (22145), 13 (22155), 17 (22150), 21 (23560), 22 (23565), 24 (29185), 26 (29190), 28 (22120), 37 (22240), 39 (23630), 44 (22500), 46 (23050), 62 (29175), 67 (23505), 72 (29200).
C.I. Direct Violets 1 (22570), 12 (22550), 21 (23520), 22 (22480).
C.I. Direct Blues 1 (24410), 2 (22590), 3 (23705), 6 (22610), 8 (24140), 9 (24155), 10 (24340), 14 (23850), 15 (24400), 22 (24280), 25 (23790), 35 (24145), 53 (23860), 64 (22595), 75 (24411), 76 (24411), 151 (24175), 160 (-), 173 (-), 192 (-). 201 (-), 215 (24115), 295 (23820).
C.I. Direct Greens 1 (30280), 6 (30295), 8 (30315), 8:1 (-), 85 (30387).
C.I. Direct Browns 1 (30045), 1:2 (30110), 2 (22311), 6 (30140), 25 (36030), 27 (31725), 31 (35660), 33 (35520), 51 (31710), 59 (22345), 79 (30056), 95 (30145), 101 (31740), 154 (30120), 222 (30368).
C.I. Direct Blacks 4 (30245), 29 (22580), 38 (30235), 86 (24115), 91 (30400), 154 (-).

Direct dyes (without C.I. No.) - (23820), - (30230).

Acid dyes (amine releasing, 24 dyes):

C.I. Acid Orange 45 (22195).
C.I. Acid Reds 4 (14710), 5 (14905), 24 (16140), 73 (27290), 85 (22245), 114 (23635), 115 (27200), 116 (26660), 128 (24125), 148 (26665), 150 (27190), 158 (20530), 167 (-), 264 (18133), 265 (18129), 420 (-).
C.I. Acid Violet 12 (18075), Brown 415 (-).
C.I. Acid Blacks 29 (-), 94 (30336), 131 (-), 132 (-), 209 (-).

Acid dyes (poisonous, 2 dyes):

C.I. Acid Oranges 156 (26501), 165 (28682)

Acid dyes (carcinogenic, 4 dyes):

C.I. Acid Red 26 (16150), Violets 17 (42650), 49 (42640), (without C.I. No.) - (16155).

Basic dyes (carcinogenic, 8 dyes):

C.I. Basic Yellows 2 (41000), 21 (48060).
C.I. Basic Reds 9 (-), 12 (48070).
C.I. Basic Violet 16 (48013).
C.I. Basic Blues 3 (51004), 7 (42595), 81 (-).

Basic dyes (amine releasing, 3 dyes):

C.I. Basic Reds 42 (-), 111 (-).
C.I. Basic Brown 4 (21010).

Azoic colors (poisonous, 3 components):

C.I. Azoic Diazo Components 20 (37175, Blue BB), 24 (37155, Blue RR), 41 (37165, Violet B).

Azoic colors (amine releasing Components, 8 Nos.):

C.I. Azoic Blue 37.
C.I. Azoic Diazo Components 11 (37085, Red TR), 12 (37105, Scarlet G), 17 (37270, Orange R), 29 (37255, Red GTR), 48 (37235, Blue B), 112 (37225, Corinth B), 113 (37230, Dark Blue R).

Disperse dyes (carcinogenic, 1 dye):

C.I. Disperse Blue 1 (64500).

Disperse dyes (allergenic, 26 dyes):

C.I. Disperse Yellows 1 (10345), 3 (11855), 7 (26090), 9 (10375), 23 (26070), 39 (-), 49 (-), 54 (47020), 56 (-), 64 (47023).
C.I. Disperse Oranges 1 (11080), 3 (11005), 76 (-), 149 (-).
C.I. Disperse Reds 1 (11110), 11 (62015), 15 (60710), 17 (11210), 151 (-).
C.I. Disperse Blues 3 (61505), 7 (62500), 26 (63305), 35 (-), 102 (-), 106 (-), 124 (-).

Others:

C.I. Developer 14 (76035, Developer B)
C.I. Ingrain Blue 2/2(74160, Phthalogen Brill. Blue IF3G, Brill. Blue 3G)

4.2 Chlorinated Phenols

Chlorinated phenols (e.g., pentachlorophenol [PCP] and tetrachlorophenol [TeCP]) have been used as wood preservatives, as an impregnation agent for textiles, as a bactericide in tanning, and in the paper and pulp industries. They are very hazardous to both humans and the environment.

4.3 Formaldehyde

Formaldehyde, with its pungent smell, can be used as a cross-linking. anti-greasing, and anti-shrinking agents; it is also used as a preservative. Formaldehyde is a suspected carcinogen and is irritating to the eyes, nose, and other tissues.

4.4 Brominated Flame Retardants

Brominated flame retardants are also on RSLs. These substances persist once they enter the environment and the food chain and are likely to accumulate in biological tissues, implicating them as being dangerous to wildlife. The European Parliament has banned the application of pentabromodiphenyl ether (pentaPBDE) and octabromodiphenyi ether (octaPBDE), while risk assessments of decabromodiphenyl ether (decaPBDB) are in progress.

4.5 Organotin Compounds

Organotin compounds are commonly used as plastic stabilizers, catalytic agents, industrial biocides, and antifouling paints. They are environmental pollutants and are particularly harmful to the aquatic environment. Organotins are very toxic to marine and freshwater organisms, even at very low levels.

4.6 Other Substances

Some RSLs have been extended to include other substances causing health concerns. Chemicals such as disperse dyes for polyesters and nickel released from metal parts

may cause skin sensitization when the articles are in direct contact with skin. Heavy metals with different health hazards may be present as impurities in dyes or catalytic agents. Pesticides and biocides raise serious health concerns because of their particularly toxic nature. Other substances such as some organic solvents, chlorinated organic carriers, nitrosamines, and nonylphenol may also be listed.

5 Organic Fiber Production

Organic vegetable fiber is produced from plants that are not genetically modified and are certified to be grown without the use of any synthetic agricultural chemicals, such as fertilizers, pesticides, or defoliants. They are produced according to the internationally recognized organic farming standards of EU regulation 834/2007, the US National Organic Program, the Indian National Programme for Organic Production, or the Japanese Agricultural Standard. Organic fiber production is more environmentally friendly and better for the health of the community (Global Organic Cotton Community Platform 2012).

Organic cotton production does not simply mean replacing synthetic fertilizers and pesticides with organic types. Rather, it is a systemic approach that aims to establish a diverse and balanced farming ecosystem, ideally including all types of crops and farm activities. Farms typically need to complete a two-year conversion period to change their production system from conventional to organic. An essential element of organic cotton production is the careful selection of varieties adapted to local conditions in terms of climate, soil, and resistance to pests and diseases. Soil fertility management and crop nutrition are based on crop diversification and organic inputs, such as compost, mulch, and manures. Pest management focuses on pest prevention and the stimulation of a balanced agro-ecosystem through crop rotation, mixed cultivation, trap crops, and the use of natural pesticides when pest infestation rises above the economic threshold. The beneficiaries of organic cotton are farmers, traders/retailers, and consumers. The benefits gained include the following (OTA 2013):

(1) A balanced ecosystem and enhanced health
(2) Improved economic situation and food security
(3) Improved access to markets
(4) Training and education

The benefit for the traders and retailers include the following:

(1) Participation in a dynamic market
(2) Traceability, risk management, and quality management
(3) Contribution to ecological and social sustainability
(4) Credibility and a good image

Benefits for consumers include the following:

(1) Buying a healthy product
(2) Traceability, clear standards, and labels
(3) Environmental friendliness
(4) A positive impact on producers' livelihoods

5.1 Organic Cotton

For a given weight of cotton harvested, a farmer uses one-third of that weight in chemical fertilizers. Cotton plants are highly susceptible to pests, especially in humid areas (Grose 2009). Clay (2004) reported that whilst cotton production is restricted to 2.4 % of the cultivatable land globally, an estimated 25 % of insecticide and 11 % of global pesticide production is consumed in cotton cultivation. A report (Bĺecourt 2010) claimed that the global insecticide share used on cotton had declined from 19 % in 2000 to 15.7 % in 2008. Also in 2008, cotton's pesticide consumption was claimed to be 6.8 % of global use. This thirsty crop also requires 7,000–29,000 L of water to produce 1 kg of cotton fiber (ISIS 2007).

Historically, cotton was planted at low densities and rotated with other crops to ensure the optimum health of the soil. Pest cycles were taken into consideration before planting and harvesting. Significant amounts of pesticides began to be applied from the mid-twentieth century. The advent of dichlorodiphenyltrichloroethane and other neurotoxins were considered to be cheaper ways of controlling pests compared with strategic crop management and the efforts of agricultural laborers (Haenow.com 2012). Today, however, there are increasing concerns that the pesticides used in 'conventional' (versus 'organic') cotton farming increasingly threaten people, wildlife, and the environment; as insects gradually become resistant to pesticides, ever-increasing amounts of pesticides need to be applied to be effective, resulting in ecological damage and crop failures (ISAAA 2011).

In 2010, organic cotton represented 0.76 % of global cotton production. Organic cotton was grown in 22 countries worldwide, with the top ten producer countries led by India, followed by (in order of rank) Turkey, Syria, Tanzania, China, the United States, Uganda, Peru, Egypt and Burkina Faso. Approximately 220,000 farmers grew the organic fiber (Ferrigno 2012).

In the United States, it is required by law that any producer wanting to label and sell a product as "organic" must meet the standards established by the Organic Food Production Act of 1990, enforced by the state organic program. This act specifies the procedures and regulations for the production and handling of organic crops (US Department of Agriculture 2013). The Global Organic Textile Standard (GOTS) was developed in 2006 through a collaboration by leading standard setters. The aim of GOTS is to define requirements that are recognized worldwide and that ensure the organic status of textiles, from the harvesting of raw materials through environmentally and socially responsible manufacturing all the way to labeling, in

order to provide credible assurance to the consumer (Global Standard 2013). The preparatory processes required before dyeing and printing are similar for organic cotton and conventional cotton processing. However, some chemicals, such as substances with high adsorbable organic halogens (AOX) values, bluing agents, chelating agents, chlorine compounds, and formaldehyde, are prohibited for use on organic textiles. All dyestuffs should conform to ETAD (1997) restrictions regarding residual heavy metals and banned aromatic amines. The first choice for dyeing organic fabrics, where applicable, could be plant-based natural vegetable dyes; however, they have never been subjected to rigorous eco-toxicological testing, and their commercial availability is limited. The best choice may be low-impact dyes, such as fiber-reactive dyestuffs made from petrochemicals.

Permitted synthetic and non-synthetic chemicals are listed in eco-labels, such as the GOTS (www.global-standard.org). The use of synthetic flame-retardants and many functional finishes are prohibited. Mechanical finishing techniques must be explored instead of chemical finishes wherever possible (Wakelyn and Chaudhry 2009). Most of the top apparel brands and retailers in the world—such as Nike, Levi's, Walmart, Patagonia, Timberland, Orvis, Adidas, Marks and Spencer, Roots, Cotton Ginny, and Target—have already introduced organic cotton into their product range and are expecting increases in the demand for organic textiles in coming years, particularly in the health-conscious, high-end markets (Hanu 2010).

Besides helping the environment, there are other benefits from organic cotton products. Working environments are better for those on farms, and small-scale farmers save money by not having to buy large amount of pesticides. Consumers benefit, also. Some suggest that organic cotton products are softer and easier on the skin. Recent awareness of these benefits has increased demand for organic cotton and thus lowered its cost (Baldwin 2008).

Organic agriculture protects the health of people and the planet by reducing the overall exposure to toxic chemicals from synthetic pesticides that can end up in the ground, air, water, and food supply, and that are associated with health consequences from asthma to cancer. Because organic agriculture does not use toxic and persistent pesticides, choosing organic products is an easy way to help protect oneself (OTA 2011a).

5.2 Organic Flax

The flax plant (*Linum usitatissimum*) is one of the oldest fiber crops in the world and has been used in the production of linen for over 5,000 years. Organic linen refers to linen made from flax fibers grown without the use of toxic pesticides or chemical fertilizers. Although there are products on the market claiming to be "organic linen" or "eco-friendly linen," some of these products may be made from flax fibers, but many are made from other fibers.

Like all conventional crop farming, flax cultivation has environmental impacts (Duigou et al. 2013), which can be greatly reduced if a certified organic method of

crop production is used. Compared with other crops, flax performs poorly in soils with low fertility and can require significant use of fertilizers. However, by using crop rotation, multi-seeding methods, biological pest control, and green manure and compost, organic flax farming can produce the seeds with reduced environmental impact. Crop rotation is not only essential from an organic certification standpoint but also for maintaining soil quality (www.natural-environment.com 2008).

5.3 Organic Wool and Silk

Organic certification standards vary between countries. In some countries, the standards are set and overseen by the government, whereas in others, the standards are set by a non-profit organization or private company. The requirements for certification of organic wool by the Organic Trade Association (OTA) in North America are as follows (OTA 2011b).

- Livestock feed and fodder used from the last third of gestation must be certified organic.
- The use of synthetic hormones and genetic engineering is prohibited.
- The use of synthetic pesticides (internal, external, and on pastures) is prohibited.
- Producers must encourage livestock health through good cultural and management practices.

To be classified as organic, wool must have been sheared from sheep given organic feed and raised without the use of hormones or pesticides. Organic livestock management is different from nonorganic management in at least two major ways:

(1) Sheep cannot be dipped in parasiticides (insecticides) to control external parasites, such as ticks and lice.
(2) Organic livestock producers are required to ensure that they do not exceed the natural carrying capacity of the land on which their animals graze.

This poses problems in the prevention of blowflies (meat-seeking fly strikes) on sheep when the usual sheep dipping is not allowed. In many countries, sheep are dipped in organophosphate or synthetic pyrethroid types of pesticide. In the United Kingdom, between 1.25 and 30 ml of fully-active sheep dip is used per sheep year. Wool textiles as a whole constitute less than 2 % of total world textile fiber production; hence, the production of organic wool (and silk) is small.

Organic silk must not only be obtained by feeding the silkworms with leaves from mulberry bushes that have been grown organically, but in which no ‘cruelty’ has been employed (i.e. not by the conventional production method of placing the cocoons containing the live silk worms into boiling water) . Thus, in the so-called ‘peace’ or ‘vegetarian’ varieties, the silkworms are allowed to develop and emerge as moths. As a consequence, the silk is obtained in the form of a short staple instead of continuous filament, yielding a fabric with a different appearance and handle, but with a warmer handle.

6 Eco-certification

The objective of certification is to gain access to the market for environmentally sustainable products (Rundgren and Hagenfors 1999). The certification process should help because data collected in the process of certification can be very useful for market planning as well as for extension and research; moreover, it improves the image of product and increases its credibility and visibility. Auriol and Schilizzi's (2003) studies have shown that the costlier the certification process, the fewer the firms that are able to afford certification. That is, cost becomes a major factor in deciding market structure, potentially leading to monopoly and ultimately to no certification at all.

7 Eco-label

Eco-labels identify products, raw materials, or companies that meet a particular organization's or government agency's standards in terms of organic content, sustainability, or minimizing risks to humans, animals, or the environment. Eco-labels will certify the quality of a particular product and also provide information about the whole lifecycle. Eco-labeling is becoming a differentiating factor on a worldwide scale in retail markets for textile and apparel purchases. Consumers are becoming increasingly concerned with the adverse impacts of industrial pollution on the environment and their health, resulting in mounting pressure on the textile and fashion industries to adopt more eco-friendly chemicals and manufacturing processes. Environmental concerns raised by production systems have been recognized since the late 1960s. Attempts to move towards more sustainable and environmentally friendly approaches have been through a range of regulatory measures, from green taxes to strict bans.

One approach gaining increasing importance is that of environmental labeling or eco-labeling. According to Piotrowski and Kratz (2005), environmental labeling is broad, covering a range of labels and declarations of environmental performance, with a focus on consumption rather than the production of a given product (e.g. recyclable material). Eco-labels, on the other hand, are a subgroup of environmental labeling. They convey environmental information about a product to the consumer and communicate that the environmental impacts are reduced over the entire lifecycle of a product, without specifying the production practices. An eco-label provides brief information on environmentally related product qualities. It enables consumers to identify products that are environmentally safe, have been manufactured using eco-friendly materials, and do not contain chemicals that are harmful to the user. Certification, such as eco-labels, plays a major role in giving credible assurance to retailers and end consumers that products comply with standards based on social, ecological, and environmental standards.

The characteristics of an eco-label are as follows:

- It identifies the overall environmental preferences of a product.
- It carries information on environmentally related product qualities.
- It is a tool for consumers to identify environmentally safe products.
- It assures that a manufacturer has used eco-friendly raw materials and ingredients.
- It is an additional product quality that can be used as a marketing tool.
- It can be issued by a private or public body.
- It assures less stress on the environment.
- It increases the selling value of products.

The benefits of eco-labeling (Sivaramakrishnan 2012) include the following:

(1) Global marketing: Manufacturers and retailers of textile goods come under pressure to comply with the international eco-labels.
(2) Improved product quality: Eliminates substances in the fabric that may be harmful to the customer.
(3) Financial savings—Results in saving of water, chemicals, and energy through process optimization and improvements. Frequently, the processing time is reduced by adopting a "Right the First Time" approach. These benefits generally offset the incremental costs of using eco-friendly chemicals or of adopting a modified process.
(4) Improved environmental performance—Achieved through the phase-out of toxic and hazardous substances and conservation of water, energy, and raw material usage. This leads to a reduction in the quantities and pollution potential of various emissions. Elimination of hazardous chemicals from the textile manufacturing process is also beneficial for the environment. For example, a complete phase-out of sodium hypochlorite and the antichlor agent sodium bisulphite results in the elimination of halogenated organic compounds (AOX) and a reduction of total dissolved solids in the effluent. The removal of these hazardous chemicals results in safer and better working conditions in the workplace.

The Organic Exchange Fiber Report (2008/2009) estimated a 54 % increase in cultivation of organic cotton from the previous year, but production of organic cotton only 0.959 % of conventional cotton. That is, the growth in eco-labeled textiles is not reflected in consumer demand, raising questions about the impact of eco-labeled or 'sustainable' textiles. A number of issues may impede the spread of eco-labeled textiles through the supply chain: costs and time required to achieve, use and renewal, the eco-label, the recession, and the potential loss of competitive advantages.

The five factors for measuring the effectiveness of an eco-label (EPA 1994) are as follows:

(1) Consumer awareness of labels
(2) Consumer acceptance of labels (credibility and understanding)
(3) Changes in consumer behavior

(4) Changes in manufacturer behavior
(5) Net environmental gains.

The first four of the above items serve to support the last.

There are many challenges for eco-labeling, the most serious of which are misleading or fraudulent to uninformative claims, unfair competition and protectionism, and lack of stringency or standardization in the process or mechanisms of eco-labeling. Eco-labeling educates the consumer, differentiates the product and the targeted market, provides a sustainable connotation for the producer or seller, and develops a higher or different perception for the product in the eyes of the entire supply chain. However, eco-labels can be used as market-based trade barriers, and some research indicates that although a global, transparent eco-labeling system benefits markets, regional eco-labeling can limit market access and reduce global competition (Hyhyvarinen 2008).

Differences in testing and certification methods create difficulties in the application of an eco-label to a particular product category. A few questions are stated below:

- Should the assessment be the product's environmental burden over its entire lifecycle, or some subset of it?
- What techniques can be used to measure environmental impact?
- What specific environmental impacts are the most important?
- What criteria are appropriate in rating impacts?
- How can the consumer verify the claims made by the eco-label?

An analysis of the ecological labeling process by Lavallee and Plouffe (2004) concluded that a 'cradle-to-grave' analysis for eco-labelled products and services is not always respected. At the present time, eco-label delivery criteria are not sufficiently stringent or standardized, leading to confusion in the marketplace, making it difficult for companies to identify stakeholder preferences, and making it difficult for justified environmental claims to be considered credible (EPA 1998).

Types of labels include the following:

- Eco-labels
- Organic labels
- Fair-trade labels
- Health-related labels

Eco-labels may be voluntary or mandatory. Mandatory labeling is always third-party labeling (i.e. issued by an independent body). Voluntary programs may be established by firms or business associations, as well as third parties. Currently, there are no eco-labels in textiles and clothing enforced by mandatory rules. Eco-labels are normally issued either by government-supported or private enterprises once it has been proven that the product of the applicant has met the criteria (Hyvarinen 1999).

The following eco-labels are issued by the governments of various countries:

- Blue Angel (Germany)
- Eco Mark (Japan)
- Environmental Choice (Canada)
- White Swan (Nordic countries)
- Eco-Mark (India)
- Green Label (Singapore)

Some of the eco-labels issued by private agencies are as follows:

- Eco-tex
- Oeko-Tex (textiles and clothing) (Germany)
- Green Seal (United States)

The eco-label has a role in Integrated Product Policy, aiming for minimum environmental degradation caused by any of the phases of a product's lifecycle (European Commission, 2008). The criteria for granting eco-labels are mostly based on the "cradle-to-grave" approach—that is, the lifecycle analysis of the product and assessment of its impact on the environment from the processing of raw materials, production, distribution, consumption, maintenance, (i,e, washing, ironing, dry-cleaning), and finally disposal of the product. All participants—namely designers, industry, marketers, retailers, and consumers—are to be engaged. A 'cradle-to-cradle' certification program assesses the sustainability of product ingredients for human and environmental health, as well as their recyclability or compostability, making it easier at the design stage to create ecologically intelligent products by choosing materials that meet key sustainability criteria for material health and material reutilization (Braungart and McDonough 2008). Differences between various eco-labeling schemes confuse public understanding of eco-labels: some are based on detailed analysis of the environmental impacts, whereas others analyze only certain stages of the lifecycle. The International Standards Organization (ISO) has classified voluntary labels into three typologies: Type I, II, and III, according to the specification of preferential principles and procedures (Moore and Wentz 2009):

- Type I is voluntary, based on multiple criteria. It is issued by third-party programs that award a license, which authorizes the use of environmental labels on products indicating environmental preference within a category based on lifecycle considerations. Type I programs can also be categorized as 'multi-criteria practitioner programs.'
- The Type II labels are informative self-declarations of environmental claims *(de facto).* These are self-declarations based on common terms, definitions, and symbols.
- Type III labels are voluntary and provide quantifiable environmental data under preset categories, which are produced by a qualified third party and verified by that or another qualified third party. Such programs provide quantified product information report cards of performance in multiple areas of qualification, such as social responsibility, ecological performance, toxic residues, etc.

Many other prominent international trade and environmental organizations deal with issues related to eco-labeling, such as the United Nations, the World Trade Organization through its International Trade Centre and Committee on Trade and Environment, the US Environmental Protection Agency, and the Organisation for Economic Co-operation and Development.

The ISO labeling standards are principle-based. Requirements include the following (Moore and Wentz 2009):

- Accurate labeling that is verifiable, relevant, and nondeceptive
- Relevant information concerning attributes must be available and their derivation transparent to purchasers
- Labels must be based on scientific methods that are reproducible and based on agreed standards of practice,
- Transparency for information and methods should be ensured for all stakeholders and interested parties
- Labeling should include the lifecycle of the product or service
- Administration of the eco-labels should not be burdensome
- Labels should not create unfair trade restrictions
- Labels should not inhibit innovations that improve ecological performance
- Label criteria should be developed by consensus

Greenwashing (or green sheen) is a form of spin (i.e. propaganda) in which green marketing is deceptively used to promote the perception that an organization's products, aims, or policies are environmentally friendly. Evidence that an organization is greenwashing often comes from pointing out the spending differences—that is, when significantly more money or time has been spent advertising being "green" (i.e. operating with consideration for the environment) than is actually spent on environmentally sound practices (Greenpeace USA 2013). Greenwashing efforts can range from changing the name or label of a product that contains harmful chemicals to evoke the natural environment to multimillion dollar advertising campaigns portraying highly polluting energy companies as eco-friendly (Karliner 2007).

While greenwashing is not new, its use has increased over recent years to meet consumer demand for environmentally friendly goods and services. The problem is compounded by lax enforcement by regulatory agencies, such as the Federal Trade Commission in the United States, the Competition Bureau in Canada, and the Committee of Advertising Practice and the Broadcast Committee of Advertising Practice in the United Kingdom. Critics of the practice suggest that the rise of greenwashing, paired with ineffective regulation, contributes to consumer skepticism of all green claims and diminishes the power of the consumer in driving companies toward greener solutions for manufacturing processes and business operations (Dahl 2010).

8 Various Eco-labels

The Ecolabel Index is the largest global directory of ecolabels, currently tracking 449 eco-labels in 197 countries and 25 industry sectors (http://www.ecolabelindex.com, accessed on 20 April 2014). Within Europe, there are many textile eco-labels, such as Ecotex, Oekotex, GuT, Nordic Swan, Stitching Milieukeu, and Skal Organic. For EU eco-labels, a single set of criteria was agreed upon, which is intended to reduce key impacts, such as energy use, global warming, acid rain, and water pollution. The Nordic Swan label is the world's first multinational environment labeling scheme. The standard Eco-Mark scheme of different organizations in Germany is based on seven major eco-parameters: (a) formaldehyde (b) toxic pesticides (c) pentachlorophenol (d) heavy metal traces (e) azo dyes that release carcinogenic amines, (f) halogen carriers, and (g) chlorine bleaching.

Some of the eco-labels are discussed below:

8.1 Green Mark

Figure 1 is an example of a certification label issued for the production of textile materials. The label is a registered trademark of Green Mark (Taiwan).

Objectives include the following:

- To guide consumers in product purchasing
- To encourage manufacturers to design and supply

Product categories include cloth diapers and unbleached towels.

Criteria for cloth diapers are defined as follows:

The product shall not contain fluorescent whitener, formaldehyde, or other hazardous chemicals. The product shall last for at least 150 times of use to bear a label reading "reusable diaper". The diaper shall contain not less than 50 % cotton. The name and address of the Green Mark user must be clearly printed on the

Fig. 1 Green mark (Taiwan). Retrieved from, http://www.ecolabelindex.com/legal/

Fig. 2 Thai green label (Thailand). Retrieved from, http://www.ecolabelindex.com/legal/

product or on the packaging material. For nonmanufacturing logo users, the manufacturer's name and address shall also be shown.

Criteria for nonbleached towels are defined as follows:

There shall be no use of bleach of any kind fluorescent whitener and formaldehyde in the manufacturing process of the product. Any dyestuff used in the manufacturing process must not contain mercury, chromium (+6), cadmium, lead, copper, zinc, arsenic, or other heavy metals or their oxides. The product shall be made of 100 % natural fiber to bear a label reading "nonbleached." The packaging box used for the product is recommended to be made from recycled pulp with at least 80 % recycled paper.

8.2 Thai Green Label

Developed by Thailand Environment Institute in 1994, the Green Label (Fig. 2) uses lifecycle consideration and stresses certain high-priority national goals, such as waste reduction and energy and water conservation.

Product categories (made from cloth) include the following:

- Hats, bags
- Products made for babies
- Garments (i.e. shirts, trousers)
- Clothing accessories
- Home and household textile fabrics

8.3 Eco Mark

The Eco Mark (Fig. 3) Program was established in 1989 by the Japanese Environmental Association. Products must meet the following criteria:

- Impose less environmental load than similar products in their manufacture, use, and disposal
- Reduce the environmental load in other ways

Fig. 3 Eco mark (Japan). Retrieved from, http://www.ecolabelindex.com/legal/

Product categories include the following:

- Cloth diapers for infants (24 products, 9 companies)
- Unbleached clothes, bed linens, and towels (68 products, 55 companies)
- Cloth shopping bags (53 products, 27 companies)
- Textiles made of waste fibers (122 products, 91 companies)
- Clothing made of used polyethylene terephthalate resin.

8.4 Ecomark

The Government of India launched the Ecomark scheme (Fig. 4) in 1991. The label is awarded to consumer goods that meet the specified environmental criteria and the quality requirements of Indian standards. The logo is an earthen pot, which uses a renewable resource, does not produce hazardous waste, and consumes little energy in making.

Production categories include baby clothing and fabrics made by various textile fibers.

8.5 EcoMark (Africa)

The EcoMark Africa eco-label (EMA, Fig. 5) is currently in development. It will consist of threshold criteria and indicators suitable for the African continent. The standard will be designed in such a way that existing standard systems may be

Fig. 4 Eco mark (India). Retrieved from, http://www.ecolabelindex.com/legal/

Fig. 5 Eco mark (Afrika). Retrieved from, http://www.ecolabelindex.com/legal/

benchmarked against it and accredited certifiers may use it to certify companies against it. In both cases, operations that fulfil the requirements of the EMA standard may use the EMA eco-label.

With its certifiable standard, EMA will provide one continent-wide and cross-sectorial label to mark sustainably produced African products. EMA will encourage African producers to access the markets with sustainably produced goods and services. EMA will particularly support small- and medium-sized enterprises to get certified and gain access to niche markets.

8.6 Ecocert

Ecocert (France) (Fig. 6) is a certification body for sustainable development. It is an inspection and certification body established in France by agronomists aware of the need to develop environmentally friendly agriculture and of the importance of offering some form of recognition to those committed to this method of production. From its creation, Ecocert has specialized in the certification of organic agricultural products. Ecocert has contributed to the expansion of organic farming. Conformity with Ecocert's standard is verified by an independent organization (third party) following ISO 14001 and 9001.

Fig. 6 Ecocert (France) (Japan). Retrieved from, http://www.ecolabelindex.com/legal/

Fig. 7 Energy star (US). Retrieved from, http://www.ecolabelindex.com/legal/

8.7 Energy Star

ENERGY STAR (United States, Fig. 7) is a voluntary government-backed program dedicated to helping individuals protect the environment through energy efficiency. The ENERGY STAR mark is the national symbol for energy efficiency, making it easy for consumers and businesses to identify high-quality, energy-efficient products, homes, and commercial and industrial buildings. ENERGY STAR distinguishes what is efficient/better for the environment without sacrificing features or performance. Products that earn the ENERGY STAR mark prevent greenhouse gas emissions by meeting strict energy-efficiency guidelines set by the U.S. Environmental Protection Agency.

8.8 Environmental Choice

Environmental Choice (New Zealand) (Fig. 8) is a voluntary, multi-criteria environmental labeling program operating to international standards and principles. It originates from a New Zealand Government initiative and International Accreditation New Zealand manages it on behalf of the Minister for the Environment. The Australian scheme, Environmental Choice Australia, was trialed in Australia from 1991 to 1994 but it did not gain wide industry support.

Product categories include the following:

- Wool pile carpets
- Wool-rich pile carpets

Fig. 8 Environmental choice (New Zealand) (Japan). Retrieved from, http://www.ecolabelindex.com/legal/

Fig. 9 EU ecolabel (EU) (Japan). Retrieved from, http://www.ecolabelindex.com/legal/

8.9 EU Ecolabel

EU Ecolabel (EU) (Fig. 9) is a voluntary scheme designed to encourage businesses to market products and services that are kinder to the environment and to allow European consumers (including public and private purchasers) to easily identify them. Conformity with EU Ecolabel's standard is verified by an independent organization (third party) following ISO 17011.

8.10 Nordic Ecolabel

Nordic Ecolabel (Fig. 10) demonstrates that a product is a good environmental choice. The "Swan" symbol, as it is known in Nordic countries, is available for 65 product groups. The Swan checks that products fulfill certain criteria using methods such as samples from independent laboratories, certificates, and control visits.

Each Nordic country has local offices with the responsibility for criteria development, control visits, licensing, and marketing. In Denmark, the Nordic Ecolabel is administered by Ecolabeling Denmark at Danish Standards Foundation; in Sweden, by Ecolabeling Sweden AB; in Finland, by Finnish Standards; in Norway, by The Foundation for Ecolabeling; and in Iceland by the Environment Agency, which operates under the direction of the Ministry for the Environment. Conformity with Nordic Ecolabel or "Swan" standard is verified by an independent organization (third party) following ISO 17011 Accreditation, ISO 17021 Management system certification, and ISO 17025 Testing and Calibration Laboratories.

Fig. 10 Swan ecolabel (Nordic) (Japan). Retrieved from, http://www.ecolabelindex.com/legal/

Fig. 11 Austrian ecolabel (Austria). Retrieved from, http://www.ecolabelindex.com/legal/

8.11 Austrian Ecolabel

Österreichisches Umweltzeichen, the Austrian Ecolabel (Fig. 11), is primarily for consumers but also for manufacturers and public procurement. The eco-label provides consumers with guidance in order to choose products or services that are the least hazardous to the environment or health. The eco-label draws the consumer's attention to aspects of the environment, health, and quality (fitness for use).

8.12 Singapore Green Label Scheme (SGLS)

The Singapore Green Label Scheme (SGLS; Fig. 12) aims to help the public identify environmentally friendly products that meet certain eco-standards specified by the scheme. It seeks to encourage eco-consumerism in Singapore as well as to identify the growing demand for greener products in the market. The scheme hopes to encourage manufacturers to design and manufacture with the environment in mind. It was launched in May 1992 by the Ministry of the Environment. It was handed over to the Singapore Environment Council (SEC) on 5 June 1999 and is currently under the authority of the SEC.

Fig. 12 SGLS (Singapore). Retrieved from, http://www.ecolabelindex.com/legal/

Fig. 13 Milieukeur ecolabel (Dutch). Retrieved from, http://www.ecolabelindex.com/legal/

8.13 Milieukeur Label

Milieukeur is the Dutch environmental quality label (Fig. 13) for products and services. There are Milieukeur criteria for a wide variety of food products, consumer products and services, ranging from vegetables, potatoes, fruit, beer, pork, trees and plants to concrete products, fire extinguishers, florists, butchers, green electricity, and car washes.

The Milieukeur criteria relate to the entire lifecycle of the product or service and represent an integrated approach to sustainability. The Milieukeur certification schemes cover a diverse range of sustainability issues, including raw materials, energy and water consumption, noxious substances, packaging and waste, plant protection, fertilizers, animal welfare, nature management, food safety, and employee care. Milieukeur is supported by the Dutch government.

8.14 Oeko-Tex Standard 100

The Oeko-Tex Standard 100 (Fig. 14) is a globally uniform testing and certification system for textile raw materials, intermediate, and end products at all stages of production. The certification covers multiple human-ecological attributes, including harmful substances that are prohibited or regulated by law, chemicals that are known to be harmful to health but are not officially forbidden, and parameters that are included as a precautionary measure to safeguard health.

Textile products may be certified according to Oeko-Tex Standard 100 only if all components meet the required criteria without exception. A tested textile product is allocated to one of the four Oeko-Tex product classes based on its intended use. The more intensively a product comes into contact with the skin, the stricter the human

Fig. 14 Oeko-tex standard 100 (Austrian Textile Research Institute). Retrieved from, http://www.ecolabelindex.com/legal/

ecological requirements it must fulfill. Oeko-Tex Standard 100 is found on millions of products around the world in (almost) all retail segments (based on more than 65,000 certificates issued to date).

Probably the most widely used textile eco-label is the *Oeko-Tex Standard 100*, the label of the International Association for Research and Testing in the field of Textile Ecology founded by Austrian Textile Research Institute. The label or mark states that the textile product or accessory has been tested for harmful substances according to the conditions specified in this standard. The standard is applicable to textile and leather products. The objective is to market products that do not contain substances detrimental to health. The products have been classified into four groups according to their contact with human skin:

Class I: Products for babies up to the age of 2 years.

Class II: Products having direct contact with skin, such as blouses, shirts, and underwear.

Class III: Products not having direct skin contact, such as skirts, trousers, and jackets.

Class IV: Furnishing and decorating materials.

One of the main features of the scheme is the test procedure for chemicals associated with dyeing processes and for dyes themselves. Thus, for each product group, there are limiting values of extractable heavy metals (EHM). Limiting values and fastness properties in the Oeko-Tex Standard 100 are shown in Table 2.

8.15 Oeko-Tex Standard 1000

To achieve better environmental performance for a company, as well as verifying and communicating it to the public, the environmental auditing and certification scheme, Öko-Tex Standard 1000 (Fig. 15), has been developed. The aim of Standard 1000 is an evaluation of the environmental performance of textile sites and products. It also independently documents that certain environmental measures were undertaken and a certain level was achieved.

To complement the product-related Oeko-Tex Standard 100, the Oeko-Tex Standard 1000 is a testing, auditing, and certification system for environmentally friendly production sites throughout the textile processing chain. To qualify for certification according to the Oeko-Tex Standard 1000, companies must meet stipulated criteria in terms of their environmentally friendly manufacturing processes and provide evidence that at least 30 % of total production is already certified under Oeko-Tex Standard 100. In addition, companies must prove that the social standards demanded by Oeko-Tex 1000 are fulfilled.

Certification criteria include the avoiding the use of environmentally damaging chemicals, auxiliaries, and dyestuffs; compliance with standard values for wastewater and exhaust air; optimization of energy consumption; avoidance of noise and

Table 2 Oeko-tex standard 100 limits

Parameter/compound	Product class			
	I	II	III	IV
pH value	4–7.5	4–7.5	4–9	4–9
Formaldehyde	20	75	300	300
Antimony	5.0	10.0		
Arsenic	0.2	1.0		
Lead	0.2	1.0		
Cadmium	0.1	0.1		
Chromium	1.0	2.0		
Chromium (VI)	Under detection limit[a]			
Cobalt	1.0	4.0		
Copper	25.0	50.0		
Nickel	1.0	4.0		
Mercury	0.02	0.02		
Pesticides[b]	0.5	1.0		
PCP/TeCP	0.05	0.5		
Banned dyes[c]	Not used			
Chlorinated organic carriers	1.0			
Biocidic and flame-retardant finishes	None			
Color fastness (staining)				
Water		3		
Acidic perspiration		3–4		
Alkaline perspiration		3–4		
Rubbing, dry[d]	4	4	4	4
Rubbing, wet[d]	2–3	2–3	2–3	2–3
Emission of volatiles				
Aromatic hydrocarbons	0.3		0.3	
Organic volatiles	0.5		0.5	
Odor	No abnormal odor[e]			

Extractable quantities are in ppm; fastness is in grades

[a] Detection limits, 0.5 ppm for Cr (VI), 20 ppm for arylamines, 0.006 % for allergeneous dyes (using TLC techniques)

[b] Total pesticides incl. pentachlorophenol (PCP)/2,3,5,6 tetrachlorophenol (TeCP)

[c] Cancerogenes, allergenic dyes, and dyes with cleavable arylamines

[d] For pigment, vat, or sulfur dyes, rubbing fastness of 3 (dry) and 2 (wet) are acceptable

[e] No odor of mold, high-boiling fraction of petrol, fish, aromas, or perfumes

Fig. 15 Oeko-tex standard 1000 (Austrian Textile Research Institute). Retrieved from, http://www.ecolabelindex.com/legal/

dust pollution; compliance with defined measures to ensure safety at the workplace; no use of child labor; introduction of the basic elements of an environmental management system; and existence of a quality management system.

8.16 The Global Organic Textile Standard

The Global Organic Textile Standard 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 (Fig. 16) Version 4.0 was published on 1 March 2014, 3 years after Version 3.0 was introduced and 9 years after the launch of the first Version. The high ecological and social requirements as well as worldwide practicability and verifiability were considered in the revision work, in order to achieve a reliable and transparent set of criteria.

The aim of the standard is to define globally recognized requirements that ensure the organic status of textiles, from harvesting of the raw materials, through environmentally and socially responsible manufacturing, up to labeling, in order to provide a credible assurance to the end consumer. Textile processors and manufacturers are enabled to export their organic fabrics and garments with one certification accepted in all major markets.

The standard covers the processing, manufacturing, packaging, labeling, trading, and distribution of all textiles made from at least 70 % certified organic natural fibers. The final products may include, but are not limited to, fiber products, yarns, fabrics, clothes, and home textiles. The standard does not set criteria for leather products.

A textile product carrying the GOTS label grade of 'organic' must contain a minimum of 95 % certified organic fibers, whereas a product with the label grade 'made with organic' must contain a minimum of 70 % certified organic fibers

Environmental criteria include the following:

- At all processing stages, the organic fiber products must be separated from conventional fiber products and must to be clearly identified.
- All chemical inputs (e.g. dyes, auxiliaries, and process chemicals) must be evaluated and meet basic requirements on toxicity and biodegradability/eliminability.

Fig. 16 GOTS label. Retrieved from, http://www.ecolabelindex.com/legal/

- Critical inputs such as toxic heavy metals, formaldehyde, aromatic solvents, functional nanoparticles, genetically modified organisms, and their enzymes are prohibited.
- The use of synthetic sizing agents is restricted; knitting and weaving oils must not contain heavy metals.
- Bleaches must be based on oxygen (no chlorine bleaching).
- Azo dyes that release carcinogenic amine compounds are prohibited.
- Discharge printing methods using aromatic solvents and plastisol printing methods using phthalates and polyvinyl chloride (PVC) are prohibited.
- Restrictions for accessories must be followed (e.g. no PVC, nickel, or chrome permitted).
- All operators must have an environmental policy, including target goals and procedures to minimize waste and discharges.
- Wet processing units must keep full records of the use of chemicals, energy, water consumption, and wastewater treatment, including the disposal of sludge. The wastewater from all wet processing units must be treated in a functional wastewater treatment plant.
- Packaging material must not contain PVC. Paper or cardboard used in packaging material, hang tags, swing tags, etc. must be recycled or certified according to FSC or PEFC.

Technical quality and human toxicity criteria include the following:

- Technical quality parameters must be met (e.g. rubbing, perspiration, light and washing fastness, shrinkage values).
- Raw materials, intermediates, final textile products, and accessories must meet stringent limits regarding unwanted residues.

Minimum social criteria based on the key norms of the International Labour Organisation must be met by all processors and manufacturers. They must have a social compliance management with defined elements in place to ensure that the social criteria can be met (GOTS-IWG 2013).

9 Future Trends

A study by Sinha and Shah (2011) examined the issues within and across the textile supply chain that come to bear upon the growth of eco-labelled sustainable textiles products in particular and in developing a sustainable textile industry in general. All companies interviewed agreed that sustainable textiles products (STPs) are needed. They felt it was very important to note that all naturally grown products are not organic or sustainable. For example, not all naturally grown cotton is organic; it might be genetically modified cotton. Also, there is no assurance that the land does not have any traces of harmful fertilizer or pesticides.

A number of methods are available to enter the sustainability arena. There should be transparency and a clear statement about the extent to which the

companies have taken up eco-labeling. Third-party verification of environmental credentials can often bring legitimacy to sustainability. Many of the most successful eco-labels are those that have been backed by issues-led organizations, such as the GOTS certification for textile products made from organic cotton. Third-party verification can range in scope from qualitative assurance of general claims to detailed verification of all stages of a full lifecycle product assessment. Given the generally low levels of consumer trust in big business, some degree of external verification is an essential component of any credible environmental claim.

Educating, enabling, and encouraging people to act towards sustainability is key for the success of any eco-label and STP as consumers' usage and disposal patterns liberate CO_2, so there should be programs to educate them. Methods to do this range from using trustworthy eco-labels with required information, through various media, and through regulations. Once the consumers are educated, then they may be encouraged to prefer buying more sustainable products.

Enlisting employees to promote sustainability is another method because employees are the key players of any manufacturing facility. Investing in the skills of employees is part of a sustainable and responsible human resource management (Brito and Blanquart 2008).

To become sustainable, everyone from manufacturer to consumer should remember to "reduce, reuse, and recycle." Textile waste in landfills contributes to the formation of leachate as it decomposes (which has the potential to contaminate groundwater), methane gas (a major cause of greenhouse gases contributing to global warming), and ammonia (which is highly toxic for land, water and air) (Productivity Commission 2006).

Eco-labels are not simple to understand, so they may not be as appropriate marketing tools as suggested by the government policies. For example, GOTS and OE labeling guides are both standards that are applicable for products made from organic cotton, on which retailers and manufacturers can use their respective logos on the tags. Under both the standards, it is mandatory to mention the percentage of organic cotton on the label. If the product is made from 100 % organically cotton, the manufacturer or retailer can use the statements "Organic" and "Made with 100 % organically grown cotton," respectively.

10 Conclusions

Eco-labeling will continue to grow as a method of providing ecological and social information to consumers. A number of emerging information and labeling from other industries may influence textile eco-labeling. Eco-labels based on a third-party certification, a de jure standard, represent the most reliable and verifiable type of labeling scheme. However, transparency in the standards development process, auditing, and the verification of performance and conformity are extremely important.

Nonstandard testing methods and questionable certification processes may damage the credibility of eco-labeling. They diminish rather than increase the value

of 'eco' products. Eco-labeling must promote sustainability and responsible decisions by retailers and consumers. The best techniques and practices must be used to produce eco-certification and eco-labels to allow for continuous improvement. Eco-labels are very important to the development of a sustainable textile industry and a credible textile industry.

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Ecolabels and Organic Certification for Textile Products

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Abstract Consumers demand not only specific functionalities and quality levels for textile products but also safety and ecology. In response to this trend, the fashion supply chain places more and more importance on sustainability, forcing textile producers to respect high environmental and social standards in the entire textile-clothing chain, from raw materials to retail. In some cases, the consumer and postconsumer (reuse, recycle, disposal) phases are also considered. To answer the needs of consumers of eco-friendly products, several eco-labeling systems have been developed, which include specific requirements for "organic" textiles. This chapter presents an overview of the requirements of the major eco-labels that are used a, including the European Union Ecolabel (flower label), Oeko-Tex 100 (and the new certification scheme Sustainable Textile Production), Bluesign, organic certification systems (Global Organic Textile Standard and Organic Content Standard), Fairtrade, and labels from retailer chains (Clear to Wear and Ecosafe).

Keywords Textiles · Ecolabel · Organic certification · Sustainability · Health and safety · Social responsibility · Environmental protection

1 Introduction

When purchasing a garment or a home textile, consumers demand not only specific design, functionalities, and quality levels but also safety and ecology, with concern for the protection of the environment and producers in developing countries. Sustainability is becoming more of a marketing tool of the fashion supply chain, forcing textile producers to respect high environmental standards in their production methods (Caniato et al. 2012).

To answer the needs of consumers for eco-friendly products, several eco-labeling systems have been developed, especially since the 1990s (Moore and

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Wentz, 2009). Also within this trend for sustainability, an increased demand for organic products has emerged in the beginning of the 21st century.

Eco-labels in the textile products (either garments or home textiles) are a way to show to the consumer that the products are:

- Safe in terms of human health: this corresponds to the so-called human ecology and is a main requirement for consumers.
- Produced with environmentally friendly materials and technologies: this corresponds to the real ecology, which takes into account the rational use of resources (especially nonrenewable natural resources, water, and energy), air emissions, wastewater, solid waste, use of clean technologies, water and energy recovery, etc.
- Produced with regard to the health and safety of the workers: adequate measures should be used to prevent occupational accidents and protect the health of workers, including the use of collective and personal protective equipment, reducing dust and noise, preventing contact with dangerous and unhealthy chemicals, etc.
- Produced with respect to social criteria in terms of the human rights of workers, namely according to the International Labor Organization standards.

Eco-labeled products must also have certain performance quality levels. The different ecolabel systems impose criteria that affect the entire textile chain, with special emphasis on the dyeing, printing, and finishing processes.

An overview of the requirements of the major ecolabels that are used for textile products is presented in this chapter.

2 European Union Ecolabel

The EU Ecolabel, also called the "flower label" due to its logo, was launched in 1992, according to the Council Regulation (EEC) No 880/92 of 23 March 1992. At that time, apart from private labels, some Member States were launching national labels. The European Commission used this regulation to create conditions for ultimately establishing an effective single environmental label in the European Union. It was also a way to contribute to the consolidation of policies related to the environment, particularly at preventing, reducing, and eliminating as much pollution as possible (prioritizing the source); ensuring sound management of raw material resources; and highlighting the importance of developing a policy towards clean products. The EU Ecolabel system has been fully revised, according to the Regulation (EC) No 66/2010.

The EU Ecolabel identifies products and services that have a reduced impact on the environment throughout their lifecycle, from the extraction of raw material through production, use, and disposal (from cradle to grave) (Hale 1996). It is the only official ecological label within the European Union, as the corresponding regulations have been adopted as EU directives and published in the official journal. It is, of course, a voluntary label, although the competent body in each country is officially appointed by each European Union Member State to be responsible for

collecting the corresponding fees. The fees are normally calculated as a percentage (up to 0.15 %) of the annual sales value of ecolabeled products.

One of the basic principles of this label is to consider the environmental impact during the entire lifecycle of the product. There are several product groups, divided into the following major groups (in alphabetical order): beauty care, cleaning, clothing (including textiles and footwear), coverings (including textile floor coverings), do-it-yourself, electronic equipment, furniture, gardening, holiday accommodation, household appliances, lubricants, other household items (including bed mattresses), and paper products. Other product groups are being developed, in coordination with the European Joint Research Center and with the participation of different interested parties at European and national levels. Criteria are generally revised every 3 years.

Among the different product groups are textiles. The first version for textiles was published in 1995; at that time, it was only applicable to cotton and polyester-cotton T-shirts and bed linens, following a detailed cradle-to-grave study by Danish experts. The last revised version was published in 2009 (Commission Decision 2009/567/EC of 9 July 2009); it was valid until June 2014 and was still under revision at the time of writing. The revised criteria have been published on 13 June 2014 (Decision 2014/350/EU).

The criteria are divided into three main categories: textile fibers, processes and chemicals, and fitness for use.

The applicant must provide detailed information about the textile fibers and all the textile processes, from spinning to fabric finishing. This includes declarations and test reports, as mentioned in the Commission Decision.

(a) Textile fibers

Fiber-specific criteria are set for acrylic, cotton and other natural cellulosic seed fibers, elastane, flax and other bast fibers, greasy wool and other keratin fibers, manmade cellulose fibers, polyamide, polyester, and polypropylene. Other fibers for which no fiber specific criteria are set are also allowed, with the exception of inorganic fibers.

The criteria for a given fiber-type need not be met if that fiber contributes to less than 5 % of the total weight of the textile fibers in the product. Similarly, they need not be met if the fibers are of recycled origin. In this context, recycled fibers are defined as fibers originating only from cuttings from textile and clothing manufacturers or from postconsumer waste (textile or otherwise). Nevertheless, at least 85 % (by weight) of all fibers in the product must be either in compliance with the corresponding fiber-specific criteria, if any, or of recycled origin.

For each fiber, the criteria have been chosen by taking into account the major impacts to the environment.

For cotton, there is a list of restricted pesticides. There are special conditions if the cotton is organically grown. In this case, "organic cotton" can be added to the label if at least 95 % of the cotton is organic. If 70–95 % of the cotton in one product is organic, it may be labeled as "made with X % organic cotton."

For flax, there are restrictions concerning water retting. Wool has restrictions in terms of pesticides and for the treatment of the wool scouring effluent.

For manmade fibers, the ecolabel legislation established specific criteria, either in terms of monomer or polymer production (e.g. emissions to air of acrylonitrile in acrylic fibers) or in terms of toxic substances in the fiber (e.g. adsorbable organohalogens [AOX] in cellulosic fibers or antimony in polyester).

(b) Processes and chemicals

In terms of chemicals, there is an increased concern about Registration, Evaluation, Authorisation and Restriction of Chemical substances (REACH) regulation.

There are restrictions concerning the biodegradability of auxiliaries, finishing agents for fibers and yarns, and detergents and softeners.

Chlorine agents are excluded for bleaching yarns, fabrics, and end products.

In terms of dyeing and printing, levels of ionic impurities in dyes and pigments are established. Dyes that are carcinogenic, mutagenic, or toxic to reproduction or potentially sensitizing dyes are banned. Also, azo dyes that can cleave into a list of aromatic amines are banned (according to EU regulations). Chrome mordant dyeing is not allowed, and there are restrictions for metal complex dyes based on copper, chromium, or nickel. Halogenated carriers shall not be used. Printing pastes cannot contain more than 5 % volatile organic compounds. Plastisol-based printing is not allowed.

The word *finishes* covers all physical or chemical treatments for a textile fabric's specific properties. No use is allowed of finishing substances or finishing preparations containing more than 0.1 % by weight of substances that are assigned or may be assigned at the time of application any of the following risk categories (or combinations thereof), as defined by Directive 67/548/EEC:

- R40 (limited evidence of a carcinogenic effect)
- R45 (may cause cancer)
- R46 (may cause heritable genetic damage)
- R49 (may cause cancer by inhalation)
- R50 (very toxic to aquatic organisms)
- R51 (toxic to aquatic organisms)
- R52 (harmful to aquatic organisms)
- R53 (may cause long-term adverse effects in the aquatic environment)
- R60 (may impair fertility)
- R61 (may cause harm to the unborn child)
- R62 (possible risk of impaired fertility)
- R63 (possible risk of harm to the unborn child)
- R68 (possible risk of irreversible effects)

Alternatively, classification may be considered according to Regulation (EC) No 1272/2008 (Classification, Labeling and Packaging (CLP) Regulation). In this case, no substances or preparations may be added to the raw materials that are assigned, or may be assigned at the time of application, with any of the following hazard statements (or combinations thereof): H351, H350, H340, H350i, H400, H410,

H411, H412, H413, H360F, H360D, H361f, H361d H360FD, H361fd, H360Fd, H360Df, or H341.

An applicant to the EU Ecolabel must either provide a declaration that finishes have not been used, or indicate which finishes have been used and provide documentation (e.g. safety data sheets) and/or declarations indicating that those finishes comply with this criterion.

Regarding biocidal or biostatic products, chlorophenols (their salts and esters), Polychlorinated Biphenyl (PCB), and organotin compounds cannot be used during transportation or storage of products and semi-manufactured products.

Only flame retardants that are chemically bound into the polymer fiber or onto the fiber surface (reactive flame retardants) may be used in the product. If the flame retardants used have any of the R-phrases listed above, these reactive flame retardants should, on application, change their chemical nature to no longer warrant classification under any of these R-phrases (less than 0.1 % of the flame retardant on the treated yarn or fabric may remain in the form as before application). Flame retardants that are only physically mixed into the polymer fiber or into a textile coating are excluded (additive flame retardants).

Regarding anti-felting finishes, halogenated substances or preparations shall only be applied to wool slivers and loose scoured wool.

Formaldehyde is traditionally present in crosslinking agents used in textile finishing. The amount of free and partly hydrolysable formaldehyde in the final fabric shall not exceed 20 ppm (or mg/kg) in products for babies and young children under 3 years old, 30 ppm for products that come into direct contact with the skin, and 75 ppm for all other products.

In terms of water and energy use, although there are no restrictions, the applicant shall provide data on water and energy use for the manufacturing sites involved in wet processing.

(c) Fitness for use

Although the EU Ecolabel is not a quality label, minimum quality performance levels are established in terms of dimensional changes during washing and drying, color fastness to perspiration (acid and alkaline), color fastness to rubbing (dry and wet), and color fastness to light.

The following information should appear on the Ecolabel: “encouraging the use of sustainable fibers,” “durable and high quality,” and “hazardous substances restricted.”

The proposed revision of the EU Ecolabel criteria for textiles gives further indications concerning the substances that are used in textile finishing and which may appear on the final product, taking into account the listed hazard classes or risk phrases in accordance with Regulation (EC) No 1272/2008 (the CLP Regulation mentioned previously). The textile hazard class restrictions will be split into textile hazard categories A and B. The following restrictions will in principle apply:

- Substances classified with textile category A hazard classes should not be used in dyeing, printing, and finishing processes and should not be present on the final product.
- Substances classified with textile category B hazard classes should only be used in dyeing, printing, and finishing processes where they have been specifically designated for use and according to associated designated conditions. For these substances, concentration limits must be respected.

In the revision, concentration limits (with respect to the weight of the fiber) for different kinds of finishes will be introduced (e.g. 20 % for flame retardants, 0.3 % for water and stain repellents) and a certain durability of the effect will be required.

New criteria concerning restriction of aerial emissions from finishing processes, namely in terms of organic substances, are also expected in the future.

3 Oeko-Tex 100

Oeko-Tex Standard 100 was developed in 1990 by a group of European research and testing textile institutes, in response to the needs of the general public for textiles that pose no risk to health. The label simply assures that the textile does not contain chemicals that are potentially harmful to the human health (or the so-called human ecology) (Zippel 1999).

The basic elements of the Oeko-Tex® system are as follows:

- Globally uniform and scientifically based (textile and human ecologically relevant) test criteria
- Annual re-evaluation and development of the stipulated limit values and criteria (every year the Oeko-Tex Standard 100 is revised)
- Testing and certification of the textile products through independent test institutes
- Testing of textile raw materials, intermediate, and end products at all stages of processing (modular system)
- Product conformity through internal quality management within the companies
- Company audits to ensure the best possible certification process and targeted support for operational quality assurance
- Product monitoring by means of regular control tests in the market and site inspections by independent auditors from the Oeko-Tex Association

Oeko-Tex tests are based on the three different methods of chemical absorption by the body:

- Cutaneous absorption. Using an artificial sweat solution, the amount of the substance that detaches from the existing fabric due to perspiration is determined.
- Ingestion. Ingestion of harmful chemicals plays an important role, especially in the case of baby items. This aspect is examined with tests using artificial saliva.

- Inhalation of harmful substances. The possibility of inhaling any harmful substances in air is determined by laboratories using olfactometry and emission analysis.

The standard is applicable for all textile and leather products in all levels of production, including nontextile accessories. It is also applicable to mattresses, feathers and downs, foams, upholstery and other materials with similar characteristics. It is not applicable for chemicals, auxiliaries, and dyes, although often the dye and chemical auxiliary manufacturers claim that their products compile with Oeko-Tex 100.

Limit values are established for four different product classes:

1. Products for babies (including children up to 36 months old)
2. Products in direct contact with the skin
3. Products not in direct contact with the skin
4. Decorative materials

Oeko-Tex certification also covers all textile-relevant substances of very high concern on the European Chemical Agency (ECHA) candidate list. The yearly updates of Oeko-Tex Standard 100 take into account the evolution of the list published by ECHA.

The main criteria (according to the 2014 version of the standard) are as follows:

- pH value (4.0–7.5 for classes 1 and 2 and 4.0–9.0 for classes 3 and 4)
- Formaldehyde (not detectable for class 1, up to 75 mg/kg for class 2, and up to 300 mg/kg for classes 3 and 4)
- Extractable heavy metals (restrictions for antimony, arsenic, lead, cadmium, chromium, cobalt, copper, nickel, and mercury; limit values are lower for class 1)
- Heavy metals in digested samples (restrictions for lead and for cadmium)
- Pesticides
- Chlorinated phenols, chlorinated benzenes, and toluenes
- Phthalates (special restrictions for baby articles)
- Organic tin compounds
- Other chemical residues (arylamines, o-phenylphenol, short-chained chlorinated parafines, tris(2-chlorethyl)phosphate, and dymethylfumarate)
- Dyestuffs (cleavable arylamines, carcinogens, allergens, etc.)
- Polycyclic aromatic hydrocarbons
- Biologically active products and flame retardants (not to be used except those in the positive list agreed upon by the Oeko-Tex Association)
- Solvent residues (1-methyl-2-pyrrolidone, N,N-dimethylacetamide, and dimethylformamide)
- Surfactant and wetting agent residues (nonylphenol, octylphenol, nonylphenolethoxylates, and octylphenolethoxylates)
- Perfluorinated compounds (perfluoroctane sulfonates, perfluoroctanic acid, henicosafluoroundecanoic acid, tricosafluorododecanoic acid, pentacosafluorotridecanoic acid, heptacosafluorotetradecanoic acid)

- Color fastness (water, perspiration, dry rubbing, saliva/perspiration)
- Emission of volatiles (formaldehyde, toluene, styrene, vinylcyclohexene, 4-phenylcyclohexene, butadiene, vinylchloride, aromatic hydrocarbons, organic volatiles)
- Determination of odors
- Asbestos is banned.

In addition to the written documents and laboratory testing of the submitted test samples, the certification process involves a company audit at the site of the applicant where the certified items are produced. In general, company visits are carried out every 3 years. A prerequisite for awarding of the certificate is successful evidence of a quality assurance system that guarantees the processing techniques, dyestuffs and auxiliaries, recipes, and material compositions stipulated in the application for certification on an ongoing basis.

Oeko-Tex certificates are issued by one of the participating institutes (there are delegations all over the world) and are valid for 1 year. The association also spot-tests labeled products in the retail market.

Products can be marked with the Oeko-Tex label, providing an effective way of drawing more attention to the products. The association creates its own advertising campaigns. Oeko-Tex 100 is the most widely used textile ecolabel in the market.

4 STeP (Sustainable Textile Production)

The same group of research and testing institutes involved in Oeko-Tex 100 later developed the Oeko-Tex Standard 1000—a testing, auditing, and certification system for environmentally friendly production sites throughout the textile processing chain. To have this certification, at least 30 % of the total production must be certified according to Oeko-Tex Standard 100.

The Oeko-Tex Standard 100 plus is a product label that provides textile highlights to the consumers—not only regarding the human ecology of the products but also environmentally friendly production. It focuses on the effects of transformation processes on humans and the environment, taking into account the hazards of textiles and chemicals on health and well-being, as well as the production ecology. All of the production sites involved in the manufacturing of a specific product need to comply with the requirements of the Oeko-Tex Standard 1000, without exception. This label was discontinued in June 2014. The new certification system STeP (Sustainable Textile Production) has replaced the Oeko-Tex Standard 1000.

The Oeko-Tex Association launched the new STeP system certification system, which offers production facilities the possibility of a modular analysis of all relevant company areas, such as quality management, use of chemicals, environmental protection, environmental management, social responsibility, and health and safety. Because the certification tool is specifically tailored to the situations in the individual processing stages of the textile and clothing industry, it can provide

interested companies with targeted support for continuous improvement of their production conditions. Like the Oeko-Tex Standard 1000, STeP is not itself a product ecolabel.

STeP is a certification system for brands, retail companies, and manufacturers from the textile chain who want to communicate their achievements regarding sustainable production to the public in a transparent, credible, and clear manner. Certification is possible for production facilities of all processing stages from fiber production, spinning mills, weaving mills, and knitting mills to finishing facilities and manufacturers of ready-made textile items. STeP certification involves the permanent implementation of environmentally friendly production processes, optimum health and safety, and socially acceptable working conditions. Like the previous Oeko-Tex Standard 1000, STeP establishes performance levels in terms of the sustainability of production beyond legislative regulations, independently of the country of production.

STeP allows comprehensive analysis and evaluation with regard to sustainable production conditions. In addition to this, the requirements and criteria of STeP certification are specifically adapted to the situation in the textile and clothing industry.

Through modular analysis of all relevant company areas, such as the management of chemicals, environmental protection, environmental management, health and safety, social responsibility, and quality management, the STeP certification allows a comprehensive and reliable analysis of the extent of sustainable management provided by a production facility.

STeP Involves the following issues:

(a) Management of chemicals

- Compliance with the guidelines of a restricted substances list (RSL)
- Introduction of suitable harmful substances management
- Compliance with the principles of 'green chemicals'
- Periodic training and further education regarding the handling of the chemicals used
- Obligation for appropriate communication regarding the chemicals used and their risks
- Monitoring the use of chemicals

(b) Environmental performance

- Compliance with the stipulated limit values
- Use of best available production technologies
- Optimization of production processes
- Efficient use of resources
- Responsible handling of waste, waste water, emissions etc.
- Reduction of the carbon footprint

(c) Environmental management

- Proof of a suitable environmental management system for targeted coordination and systematic implementation of all environmental protection measures
- Commitment to environmental targets
- Periodic creation of environmental reports
- Appointment of an environmental representative
- Periodic training regarding the implementation of environmental targets and measures
- Implementation of existing environmental protection systems (e.g. ISO 14001)

(d) Social Responsibility

- Ensuring socially acceptable working conditions according to United Nations and International Labour Organization conventions
- Execution of performance appraisals for employees
- Implementation of existing social standards (e.g. SA 8000)
- Guaranteed training for employees regarding the social issues of an operation

(e) Quality management

- Implementation of a suitable quality management system (e.g. in line with ISO 9001 or operational approaches)
- Guaranteed traceability, responsibility, and appropriate documentation regarding the flow of goods and manufactured products
- Advanced management aspects, such as risk management or corporate governance

(f) Health and safety

- Proof of suitable measures to ensure the required health and safety in the workplace (e.g. filter systems, ear protection)
- Guaranteed safety of buildings and production plants (e.g. through constructive measures, escape plans, separation of production areas)
- Risk prevention
- Implementation of existing safety standards (e.g. OHSAS 18001).

STeP certification considers three different levels describing the extent to which the company has achieved sustainable production and working conditions:

- Level 1 = Entry level
- Level 2 = Good implementation with further optimization potential
- Level 3 = Exemplary implementation in the sense of a best-practice example

The STeP scoring system is an important tool for continuous improvement.

5 Bluesign

The Bluesign system was also designed to be a solution for a sustainable textile production. It eliminates harmful substances right from the beginning of the manufacturing process and sets and controls standards for an environmentally friendly and safe production. This not only ensures that the final textile product meets very stringent consumer safety requirements worldwide, but it also provides confidence to consumers that they are acquiring a sustainable product.

The idea of the Bluesign system arose from practical experience, in a joint effort from a textile company (Schoeller Textil), a retailer company (Nike), and a chemical company (Huntsman). It was an effort to develop a textile product with the least possible impact on the environment coupled with resource-conserving production and safety for workers and consumers. Bluesign developed from a project initiative in 1997, in order to guarantee that the system is independent and therefore implementable for the greatest possible number of companies. The company Bluesign Technologies AG was founded in 2000, with headquarters in Switzerland.

The label Bluesign claims to be "the independent industry textile standard" because it was developed from the industry and retailers and not by official authorities (like EU Ecolabel) or testing laboratories (like Oeko-Tex 100 or STeP).

Bluesign is based on five principles:

- Resource productivity
  Resource productivity refers to the sustainable use of raw materials and energy. The aim is to produce textiles of maximum quality and added value by minimizing the consumption of resources as well as reducing the environmental impact. Using as few resources as possible during the complete process automatically involves cost efficiency. The environmental impact decreases while the added value of the products increases. Finally, the textile companies reduce their ecological footprint, consisting of energy and material input per kilogram of manufactured textile products.
- Consumer safety
  Consumers are sensitive not only to the safety of the textile products they buy but also to the conditions under which a product has been manufactured. Therefore, consumer safety has to include both the promise of high-quality textile products without health risks, as well as assurance that sustainability was implemented in each step of the production process. Bluesign promotes "proactive manufacturers" that are able to meet the requirements of their customers for sustainable and reliable products—even before legal obligations force them to act.
- Water emission
  Water emission control includes returning purified water into the water cycle and reducing the aquatic environment impact to a minimum. Effective ways include the use of sustainable components, the optimization of production, and the use of wastewater treatment technology. An intelligent selection of process components helps to minimize the amount of harmful substances in wastewater.

As a consequence, the basic contamination of sewage can be reduced. Manufacturers are also requested to install well-functioning wastewater treatment.

- Air emission
  Each process step of textile production causes air emissions. The Bluesign system effects all areas and process steps by directly targeting the basis: the selection of raw materials and chemical products. It specifies strict selection criteria for substances and components having an emission impact. The aim is to reduce CO_2 emissions within the company's sphere of influence as well as during the subsequent process steps. Exhaust air has to be cleaned and recycled by adequate environmental technology. This is the essential condition in order to reduce greenhouse gas emissions and to make an active contribution to climate protection.
- Occupational Health and Safety
  The health and safety of employees in the textile industry have to be safeguarded by strict guidelines. Localized problems have to be detected. Safety measures, according to the risk potential of deployed chemical substances, are mandatory. Occupational health and safety also includes protection against environmental pollution, such as dust and noise.

In fact, the basic principle of the Bluesign system is to eliminate harmful substances from the very beginning, guaranteeing the application of sustainable ingredients in a clean process, at which end stands a safely manufactured product, irrespective of the number of process steps or manufacturers involved. The producers must take into account the positive list of accepted chemical inputs.

Bluesign has a rating system for each applied chemical component based on the criteria described above. Chemicals are categorized as follows:

"Blue" category	components meet all of the Bluesign criteria and requirements.
"Grey" category	components can only be used under certain appropriate conditions.
"Black" category	components do not meet the Bluesign criteria.

Web applications are available, for chemicals, manufacturers, and brands/retailers.

6 Organic Certification

The trend for buying organic products is mainly related to food. Organic certification is a certification process for producers of organic food and other organic agricultural products based on several requirements—the most important of which are related to avoiding synthetic chemical inputs, such as fertilizers, pesticides, antibiotics, and food additives. Genetically modified organisms (GMOs),

irradiation, and the use of sewage sludge are also forbidden. This trend has also emerged in textile fibers.

People from around the world are becoming more and more aware of issues such as global warming, pollution, protection of the environment, and social responsibility. The use of organic fibers, especially organic cotton, is one of the answers to this trend. There is a growing interest in exploring this niche market, which is attracting more and more consumers. Organic cotton is produced in a sustainable way through the management and protection of natural resources, without the use of agricultural chemicals (pesticides and chemical fertilizers) or other products that are harmful to humans, animals, and the environment, while maintaining and restoring the fertility of the soil and assuring biodiversity. It also is softer and less likely to cause allergic skin reactions.

The year 2007 marked a real "boom" in terms of the growth rate of organic cotton: 152 % compared to 2006. Although this rate of increase is now much lower, the fact that 2009 was declared by the United Nations to be the "Year of Natural Fibers" also lead to a large number of initiatives promoting natural fibers, particularly organic cotton.

Conventionally grown cotton consumes more than 10 % of the pesticides used in the world. Organic cotton cultivation is being promoted by several NGOs as a way to have a better environment, higher income for farmers, and better working conditions for laborers (Wakelyn and Chaudhry 2009).

At present, the European Commission is in the final stages of a review of the current EU organic legislation. It has decided that the legal basis of its organic regulation should not be extended to cover textiles (or cosmetics) because the regulation only concerns farming and organic food. Nevertheless, the principles of organic farming can be applied to natural textile fibers, both vegetable (cotton and flax) and animal (wool and silk).

The first European legislation was published in 1992 (Council regulation EEC 2092/91). The present legislation is Regulation EC 834/2007, which is used by certifying bodies for organic certification. Worldwide, the National Organic Program of the US Department of Agriculture is also used.

There are presently many textile consumer products marketed as "organic" (in most of the cases, made with "organic cotton"). Market estimation of organic textiles in the European Union in 2011 was about 1 billion Euro (Matrix Insight Ltd 2012). According to this study, organic is responsible for more than 90 % of this figure, although that represents only approximately 0.7 % of the total cotton world production.

Because the European regulation is not clearly applicable to textiles, there is no official system to avoid misleading claims.

6.1 Global Organic Textile Standard

The major certifying system for organic textiles is the Global Organic Textile Standard (GOTS). This standard was developed following an initiative in 2002. A working group formed in 2004 involves the following four organizations that certify and promote organic textiles:

- International Association Natural Textile Industry, Germany
- Soil Association, England
- Organic Trade Association, USA
- Japan Organic Cotton Association, Japan.

The first edition of GOTS was launched in 2006. The most recent version of GOTS (version 4.0) has been valid since March 2014.

The aim of GOTS is to define globally recognized requirements that ensure the organic status of textiles, from the harvesting of the raw materials, through environmentally and socially responsible manufacturing up to labeling, in order to provide credible assurance to the consumer.

Although this label is based on certified organic fibers, GOTS has very strict demands, not only in terms of the use of cotton fibers (or other natural fibers) produced according to organic agriculture rules, but also for the rules concerning all stages of textile and clothing production, from the fiber to the final product.

If the product is marketed as "organic" or "organic—in conversion," at least 95 % of the fiber content of the products (excluding accessories) must be of certified organic origin or from "in conversion." If the product is marketed as "made with X % organic materials" or "made with X % organic—in conversion materials," then 70 % of the fiber content of the products (excluding accessories) must be of certified organic origin or from "in conversion."

There are several requirements for chemical inputs in all processing stages, banning several inputs, including the following:

- Aromatic and/or halogenated solvents
- Brominated and chlorinated flame retardants
- Chlorinated benzenes
- Chlorophenols (including their salts and esters)
- Complexing agents and surfactants (prohibited are all APs and APEOs (i.e. NP, OP, NPEO, OPEO, APEOs terminated with functional groups, APEO-polymers, EDTA, DTPA, NTA, LAS, α-MES)
- Endocrine disruptors
- Inputs that contain or generate formaldehyde and other short-chain aldehydes
- GMOs and their derivatives (including enzymes derived from GMOs) or made from GMO raw materials (e.g. starch, surfactants, or oils from genetically modified plants)
- Heavy metals (all inputs must be 'heavy metal free,' although certain limits are allowed for impurities)

- Inputs (e.g. azo dyes and pigments) releasing carcinogenic arylamine compounds (MAK III, categories 1–4)
- Inputs containing functional nanoparticles (including all nanofinishes, namely nanosilver, structured nanosurfaces, nano-TiO_2, etc.)
- Inputs with halogen-containing compounds (if they contain >1 % permanent AOX)
- Organotin compounds
- Plasticizers (polycyclic aromatic hydrocarbons, phthalates, bisphenol A, and all other plasticizers with endocrine-disrupting potential)
- Per- and polyfluorinated compounds, such as perfluorinated carboxylic acid (including perfluorooctanoic acid), perfluorooctane sulfonate (including perfluorosulfonic acid) and fluorotelomer alcohol
- Quaternary ammonium compounds (DTDMAC, DSDMAC and DHTDMAC)
- Short-chain chlorinated paraffins (SCCPs, $C_{10–13}$)
- Substances and preparations that are prohibited for application in textiles with a recognized internationally or a nationally valid legal character
- Substances and preparations having restrictions in usage for application in textiles with a recognized internationally or a nationally valid legal character. This concerns substances that are in the list or candidate list of substances of very high concern for authorization (REACH Regulation EC 1907/2006 and further amendments)
- In general, all Inputs that are classified with specific hazard statements (risk phrases) related to a list of health hazards and environmental hazards
- Inputs that are bioaccumulative and not rapidly degradable
- All preparations applied must further comply with requirements concerning oral toxicity, aquatic toxicity, and the relationship of biodegradability/eliminability.

Although all the above inputs are forbidden, certain amounts of residues are accepted (e.g. due to unavoidable contamination).

All chemical inputs intended to be used to process GOTS goods are subject to approval by a GOTS-approved certifier prior to their usage. Preparations must have been evaluated and their trade names registered on approved lists prior to their usage. GOTS issues a positive list of textile auxiliary agents (chemical inputs) containing the trade names of applied preparations that have been found to be compliant with the criteria of this standard.

For all chemical inputs (substances and preparations), a Material Safety Data Sheet (MSDS) prepared according to an applicable recognized norm or directive must be available. All stages through the supply chain (from spinning to retail) must be established so as to ensure that organic and conventional fibers are not commingled and that organic fibers and GOTS goods are not contaminated by contact with prohibited substances.

GOTS has restrictions concerning all textile processes. This includes oils in spinning, weaving and knitting, and sizing agents. The most demanding restrictions concern the wet processing stages. In terms of pretreatment, apart from the use of allowed chemical auxiliaries, only oxygen-based bleaches are allowed and

mercerization is only accepted if alkali baths are recycled. Ammonia treatment and chlorination of wool are prohibited. For dyeing and printing, there are many restrictions on dyes and pigments, as well as printing processes.

For finishing, apart from all the restrictions mentioned above, prohibited in general is the use of synthetic inputs for antimicrobial finishing (including biocides), coating, filling and stiffening, lustering and matting, as well as weighting. Garment finishing methods that are considered to be harmful to the workers (e.g. sandblasting of denim) are prohibited.

GOTS includes specific requirements for additional fiber materials and accessories present in the final product. GOTS also established additional specific requirements for textile personal care products.

Although GOTS does not specifically require that the companies have an environmental management certified system, a written environmental policy is required, as well all procedures and data, especially in terms of wet processing units. Full records must be kept on the use of chemicals, energy, water consumption, and wastewater treatment, including the disposal of sludge. In particular, companies must continuously measure and monitor wastewater temperature, wastewater pH, and sediment quantities. There are specific requirements concerning water discharges (chemical oxygen demand, pH, and temperature). There are also requirements for storage, packaging, and transport, namely in terms of the prevention of contamination and restrictions concerning packaging materials.

One of the main requirements that are taken into account by GOTS auditors are recordkeeping and internal quality assurance. Companies must have effective documented control systems and records that enable the following to be traced:

- The origin, nature, and quantities of organic and additional (raw) materials, accessories, and inputs that have been delivered to the unit, including transaction certificates for organic fibers
- The flow of goods within the unit (processing/manufacturing steps performed, recipes used, and stock quantities)
- The composition of manufactured products
- The nature, quantities, and consignees of GOTS goods that have left the unit
- Any other information that may be required for the purposes of proper inspection of the operation

Records relevant to the inspection must be kept for at least 5 years.
GOTS also includes some technical quality parameters, such as the following:

- Color fastness: rubbing (dry ad wet), perspiration (alkaline and acid), light, washing (in general at 60 °C, at 30 °C for animal fibers) and saliva (for baby and children's clothing)
- Dimensional changes after washing (in general at 60 °C, at 30 °C for animal fibers)

Social criteria are also very important for GOTS. These criteria are nearly as strict as those in the SA 8000 standard. They must be respected in the entire textile supply chain.

In terms of a quality assurance system, processors, manufacturers, and traders of GOTS goods must participate in the GOTS certification procedure, which is based on an on-site annual inspection cycle (including possible additional unannounced inspections based on a risk assessment of the operations). They must hold a valid certificate of compliance listing the certified products/product categories and the processing, manufacturing, and trading activities that are qualified under the scope of certification (including the names of subcontractors assigned and their relevant processing and manufacturing steps).

The companies must perform a risk assessment, and the quantity of residues and technical quality parameters must be tested. The testing frequency, type, and number of samples are to be established according to the risk assessment. Samples for residue testing may also be taken by the inspector during the required on-site inspection, either as a back-up to the inspection process or for suspicion of contamination or noncompliance. Additional samples of goods may be taken from the supply chain at any time without advance notice. Tests must be conducted in laboratories that are accredited according to ISO/IEC 17025 and that have appropriate experience in residue testing for textiles.

GOTS-certifying organizations must be accredited by the GOTS International Working Group, in accordance with the document 'Approval Procedure and Requirements for Certification Bodies.' According to a survey of Portuguese textile companies, GOTS is considered to be the most demanding certification scheme (Almeida and Tristram 2012).

6.2 Organic Content Standard

In 2007, the international organization Organic Exchange (OE) developed the OE 100 and OE Blended standards, to verify the organic cotton content claims on products. The standards established a system for tracking and documenting the purchase, handling, and use of certified organic cotton fiber.

Since then, there has been a need for a broader organic standard that would support content claims for all organic inputs, not just cotton. To meet this need, Textile Exchange (the new name of the Organic Exchange) developed the Organic Content Standard (OCS), based on the generic chain-of-custody requirements of the Content Claim Standard.

The first version of the OCS Standard was published in 2013. OCS applies to any nonfood product containing from 5 to 100 % organic material. It verifies the presence and amount of organic material in a final product. It tracks 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. It also can be used as a business-to-business tool to give companies the means to ensure that they are getting what they are paying for and selling.

The OCS standard is still mainly used to certify textile consumer products made with organic cotton. Unlike GOTS, the only requirements relate to the organic origin of the material and can be applied to a product containing just 5 % organic material.

7 Fairtrade

Fairtrade is an alternative approach to conventional trade that is based on a partnership between producers and consumers. Fairtrade offers producers a better deal and improved terms of trade. This allows them the opportunity to improve their lives and plan for their future. For consumers, Fairtrade offers a powerful way to reduce poverty through their everyday shopping.

When a product carries the Fairtrade mark, it means that the producers and traders have met Fairtrade standards. The standards are designed to address the imbalance of power in trading relationships, unstable markets, and the injustices of conventional trade.

Fairtrade, unlike other labels mentioned in the previous sections, is not in itself an eco-label, but it is committed to protecting small producers in major markets. Indeed, it helps them escape poverty and improve their living conditions, while transmitting social, environmental, and management knowledge. Fairtrade and organic products are often associated with each other (Bassett 2010).

The Fairtrade minimum price is the minimum price that a buyer of Fairtrade products has to pay to a Producer Organization for their product. It is not a fixed price. It is set at a level to ensure that Producer Organizations receive a price that covers the cost of sustainable production for their product and permits them to develop the social criteria in their organization. However, when the market price is higher than the Fairtrade minimum, the buyer has to pay the market price. Producers and traders can also negotiate a higher price—for instance, depending on quality of products.

Fairtrade publishes a series of standards that are designed to tackle poverty and empower producers in the poorest countries in the world. The standards apply to both producers and traders. There are standards for small producer organizations, hired labor, contract production, and trade standards. One of the standards relates to fiber crops—namely, to cotton seeds.

Fairtrade certified cotton was launched in 2004. At present, some retailers are asking to their suppliers to implement the requirements of Fairtrade, namely by using certified cotton along the textile chain.

Fairtrade has also launched a project that aims to develop a specific textile standard. The Fairtrade Textile Standard will set the requirements for operators at different levels of the textile supply chain processing Fairtrade certified cotton, with the intent of leading to greater worker empowerment, ensuring decent working conditions and wages, improved livelihoods for workers, increased market access for Fairtrade cotton producers, and more sustainable supply chains for all operators. The textile standard will be guided by the Fairtrade Hired Labor Strategy and other

leading social standards and approaches in the textile industry. The target is to publish the standard in 2016.

8 Labels from Retailer Chains

Many retailers have developed their own labels to demonstrate to buyers that textiles are sustainable, but with special emphasis on the safety of the consumers. These labels or certifying schemes impose very strict requirements on the suppliers.

These labels have recently become stricter in terms of product safety, due partly to the action of the nongovernmental environmental organization Greenpeace International. The campaign DETOX (toxic-free fashion), directed to major fashion leader retailers, and a study about the presence of toxic substances in children's clothing induced a reaction in retailers, which was passed on to their suppliers.

8.1 Clear to Wear

Clear to Wear is a product health standard developed by Inditex group, in collaboration with the University of Santiago de Compostela (Spain), in conformity with the most stringent legislation on product health and safety. Clear to Wear is of general application and obligatory for all the clothing products, footwear, accessories, and/or textiles supplied to Inditex.

In addition to composition, pH, and color fastness, this standard regulates "substances whose use is legally limited" that, if present in the product above certain levels, could be hazardous for human health, including Formaldehyde, arylamines, phenols Pentachlorophenol (PCP) and Tetrachlorophenol (TeCP), cadmium, lead, mercury, chromium, chromium (VI), nickel, phthalates, polybrominated flame retardants, pesticides, short chain chlorinated paraffins, perfluorooctane sulfonates, dimethyl fumarate, organotin compounds, and allergenic dyes. Additionally, Clear to Wear sets limits to the use of two parameters not contemplated by the legislation in effect: organochlorinated compounds and isocyanates.

Clear to Wear includes REACH as the EU regulation of mandatory compliance for all Inditex suppliers. This standard is of general and mandatory application for all clothing products, footwear, accessories, and/or fabrics supplied to Inditex.

The supplier is the only party responsible for the compliance of the products supplied to Inditex with Clear to Wear. Regardless of the commitment accepted by the supplier to control the parameters regulated in Clear to Wear, Inditex will verify its correct implementation at any phase of the manufacturing process of those products that are manufactured, commercialized, and/or distributed by it by carrying out routine and random sample analyses on determined models/quality at any point of their production cycle. The corresponding costs are to be supported by the suppliers.

Clear to Wear defines 10 families of products, according to article type, degree of contact with the skin, and age of the end user:

- Products for users younger than 3 years old (babies)
- Clothing in direct and prolonged contact with the skin
- Clothing not directly in contact with the skin
- Parts of footwear in direct and prolonged contact with the skin
- Parts of footwear not directly in contact with the skin
- Accessories in direct and prolonged contact with the skin
- Accessories not directly in contact with the skin
- Metallic-only accessories
- Home textiles in direct and prolonged contact with the skin
- Home textiles not directly in contact with the skin.

For each product family, Clear to Wear defines limit values to be respected. These limit values are similar to those specified by the label Oeko-Tex 100.

The Clear to Wear reference manual published by Inditex presents detailed information for each substance of limited use. This information includes where the substance can be found, the international or different national regulations, the test methods, acceptable or detection limits, and the ways to avoid or limit the presence of the harmful substance.

9 Eco Safe

Eco Safe is a mark of the ICQ group (based in Italy) to be used by companies who believe in adherence to increasingly higher standards of quality and safety. This label is mainly used by the Benetton Group.

The Italian ICQ group, founded in 1982, works at international level as a certification institute for quality and safety of consumer products. The textile division was founded in 1995. ICQ is now part of Underwriter Laboratories, a global independent safety science company with more than a century of expertise innovating safety solutions.

The Eco Safe mark is applied to all products in the children's range (United Colors of Benetton, Undercolors of Benetton, Sisley Young). The presence of the brand Eco Safe mark on the garment indicates that the products have been designed in compliance with chemical and mechanical safety standards, including the following:

- *Small parts* Small parts, such as buttons, zipper pulls, studs and eyelets, present a potential hazard to children if they are not well secured to the garment (choking hazard).
- *Dangerous strings and drawstrings* Often clothes have cords and drawstrings that can have either a functional or a purely decorative purpose. On children's clothing, they can become potentially dangerous, causing serious accidents

(strangulation hazard). Cords and drawstrings are restricted in Europe by the standard EN 14682 (clothing for children up to 14 years old).
- Carcinogenic dyestuffs (damage to health, including carcinogenic effects).
- Allergenic dyestuff (possible sensitization, possible dermatitis, itching, redness of skin).
- Phthalates (possible allergic reactions and/or irritation in case of skin contact, possible harmful effects on the reproductive system, liver or kidney damage or damage to the nervous system). The problems are greater for children, especially younger ones, who have a habit of putting objects in their mouths.
- Formaldehyde (possible allergic reactions and/or irritation in case of skin contact; potentially carcinogenic).
- Heavy metals (possible allergic reactions and/or irritation in case of skin contact, possible nerve damage, possibly carcinogenic).

Benetton's entire network of suppliers is involved in achieving the goal of final consumer safety. Materials, semi-finished products, and production phases are subjected to strict controls and screening through comprehensive statistical sampling.

Benetton and Inditex are just two examples of the efforts made by major retailers and brands to demonstrate to their customers that their products are safe and eco-friendly.

For instance, in 2013, Marks & Spencer reported that significant progress had been made in increasing the amount of sustainable cotton; in fact, the company claimed that nearly 11 % of their cotton products were Fairtrade, recycled, organic, or sourced from the Better Cotton Initiative, compared with 3.8 % in 2011–12.

The Swedish fashion retailer H&M, according to Textile Exchange, leads the list of the biggest users of certified organic cotton in the world. H&M claims that its plans are to source 100 percent of its cotton from "more sustainable" sources by 2020.

The Dutch chain C&A also has a strategy of increasing organic cotton, as a key role for sustainability. In 2013, organic cotton represented 38 % of its total cotton sales. The retailer also publishes an updated list of restricted substances, very similar to the Oeko-Tex 100 limits.

Many other major retailers have also defined their sustainability strategies, which often include commitments related to the restrictions imposed by major ecolabels.

10 Other Labels and Certification Systems

Many other labels can be applied to textile products to demonstrate ecological aspects. In fact, worldwide there are about 450 ecolabels, of which more than 100 can be applied to textiles, according to the Ecolabel Index (see http://www.ecolabelindex.com).

It is not possible to provide a complete review of all these labels here. Nevertheless, it is worth mentioning some of them (in alphabetical order):

Blue Angel, Carbon Free, Cradle to Cradle, Global Recycling Standard, Gemeinschaft Umweltfreundlicher Teppichboden (Society for environmentally friendly carpets) (GUT) (carpets), Medically Tested (skin-tolerant textiles), Natur Textile, the Nordic Swan, and SKAL.

11 Conclusion

Sustainable textile production is now an important marketing tool to address the awareness of more demanding consumers. Ecolabeling systems are a good tool for this purpose. In this chapter, an overview of the major ecolabeling schemes specific to textiles was presented.

In general, it is normally expected that—independent of the country where textiles are produced—ecolabeled products should respect restrictions that go beyond the legislation in more developed countries.

The trend for "organic textiles" corresponds with this tendency. Specific labels have been developed to answer the demands of the market, imposing severe restrictions throughout the textile chain.

The large retailer chains are more and more forced on offering their customers "sustainable textiles." These companies often prefer to not use any of the existing ecolabels but instead are developing their own sustainability policies, imposing strict demands on their suppliers to assure that the textile products they sell are safe for the consumer, use environmentally friendly techniques, and consider social responsibility.

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