

**UN/CEFACT Conference on “Ethical and informed choices for sustainable clothing – Tracking and tracing textile supply chains” , 03 October 2017, Rome**

**Draft Background Research Paper for Comments (unedited)**

## **Transparency in textile value chains in relation to the environmental, social and human health impacts of parts, components and production processes**

*18 September 2017*

### **Abstract**

Clothing is one of the largest industries in the world economy, generating annual revenues of around US\$ 3 trillion, producing 80 billion garments, and employing 60 to 75 million people with direct jobs worldwide. The industry is a global one, with its supply chains spreading across all countries, driven mostly by big retailers and traders that determine where to produce, what to produce, and at which prices to sell. The negative social and environmental impacts of the fashion industry have been well documented over the past few decades, demonstrating that these impacts mostly occur within the upstream portion of the supply chain.

This background paper discusses the importance of addressing information asymmetries in the clothing sector with regard to negative environmental, social and health impacts caused by products/production methods in textile value chains. The lack of complete and transparent information about where and by whom materials are sourced, transformed and assembled, the lack of transparency as to the effects on the environment and human health of practices and processes, along with the lack of transparency on working conditions across the supply chain are key gaps. Improving traceability has therefore become a priority for the industry, in order to increase its ability to manage its supply chains both more efficiently and sustainably.

This paper identifies basic principles, possible solutions and provide recommendations for an international framework initiative on transparency and traceability for sustainability patterns in the clothing sector, in support of Sustainable Development Goal 12 on responsible production and consumption.

## Table of Contents

<b>Introduction .....</b>	<b>2</b>
<b>I. Textile value chains: environmental, social, and health impacts .....</b>	<b>3</b>
<b>A. Overview of the environmental impacts of the textile industry .....</b>	<b>3</b>
<b>B. Health risks, social risks, and consumers' approaches towards sustainability .....</b>	<b>4</b>
i. Health risks.....	4
ii. Social Risks .....	5
iii. Notes on consumers' behaviour towards sustainability.....	5
<b>C. Transparency in textile value chains.....</b>	<b>6</b>
i. General considerations .....	6
ii. Transparency through traceability, supply-chain mapping and sustainable sourcing.....	7
iii. IT solutions to communicate information on environmental performance .....	8
<b>II. The business perspective on enhancing transparency in textile supply chains.....</b>	<b>10</b>
<b>A. Opportunities.....</b>	<b>10</b>
<b>B. Challenges.....</b>	<b>11</b>
<b>Concluding remarks on the need for a new UNECE recommendation .....</b>	<b>12</b>
<b>List of references .....</b>	<b>14</b>

I

## Introduction

What is, in the ECE region, the incidence of purchases of textile and apparel that may incorporate parts and components coming from environmentally harmful production processes, with or without health consequences for workers and consumers? How does the textile industry relate to the concepts of transparency, traceability, supply-chain mapping and sustainable sourcing? Are there economic gains to reap for businesses going green? Are there innovative IT solutions to facilitate textile value chains' transparency through traceability? Lastly, is there scope for recommending regulatory action on both the public and private sectors' side?

In an attempt to provide a starting point to answer these questions, this paper surveys academic and policy-oriented literature on the relationship between the environmental and human health impacts of textile production and processing, on the one hand, and the extent to which information about such impacts reaches the final consumer.

More specifically, the paper is sub-divided into two main sections. Section I tries to depict the landscape of environment-related practices in the textile industry. It briefly reviews stylized facts about environmental and health impacts in the textile sector; explains how the concept of transparency in supply chain management translates into practical interventions such as traceability schemes and relevant tools; and provides notes on consumers' perspectives and IT innovative solutions to communicate information on environmental performance along textile value chains. Section II summarizes case studies and theoretical analyses on opportunities and challenges linked to the decision, on the business side, to enhance transparency in their supply chains. The paper concludes with some considerations as to the opportunity and desirability of investing in a new UNECE recommendation on traceability for communicating environmental and health risks along textile value chains and down to the final consumer.

### I. Textile value chains: environmental, social, and health impacts

#### A. Overview of the environmental impacts of the textile industry

Two major categories of environmental impacts of textile production and processing are: discharge of pollutants; and consumption of water and energy (UNEP 2014).

With regard to the discharge of pollutants, these can result in air, water and land pollution, and are mostly linked to the use of chemicals. However, while air emissions are a minor but not negligible source of pollution, most of the chemicals and auxiliaries are released to waste water. Concerning the organic load, 20 – 100 g organic carbon/kg processed textiles are emitted, which is 15-250 times higher than emissions to air. Thus, emissions to water are predominant (OECD 2004). The case of cotton is particularly telling. Cotton comprises 45 per cent of all fibres used within the global textile industry and there are health and environmental risks involved in farming and manufacturing practices (Kaye 2013). The majority of growing operations use high levels of pesticides, which can settle into the soil and the water supply (Kemi 2014).

With regard to energy consumption, it is widely recognized that the textile business plays a role in climate change by virtue of its considerable energy consumption. To meet its energy demand, the sector resorts to two distinct types of energy sources: indirect emission sources (electricity) and direct emission sources (natural gas, cogeneration and diesel fuel). Reduction in greenhouse gas emissions associated with energy consumption can be achieved by various means, the main ones being energy efficiency, the rational use of energy consumption, and cogeneration (MED-CLEAN 27).

As discussed later in this paper, it is interesting to note that most of the interventions to enhance sustainability in textile production practices can bring economic benefits to business. The discharge of pollutants and wastes, for instance, represents an additional economic cost to the company. Indeed, inefficient processes lead to loss of expensive chemicals, wastage of water and energy, while also giving rise to undesirable quality variations in industrial output (UNEP 1994).

Another important field of investigation to reduce environmental chemical impact concerns the raw materials tier. Improving partnerships between buyers, farms and SMEs in order to introduce innovative land and water management practices, could reduce chemical and energy usage and enhance production quality and health for workers and livestock. Also in this case, there is a need to track and trace data regarding consumption and performance improvement. This should involve the use software and tools for the physical tracking and mapping of animals and the harvest involved in sustainable and ethical practices.

Moreover, a carbon capture good practice, with large extension of tree plantation can constitute a CSR action for large enterprises, while helping farmers improving land management and reducing ground erosion, which impacts on the quality of production. Also, large companies and governments (coordinated actions and research programs) could help SMEs and farms to experiment using new technology and tracing methods to reduce chemicals in the supply chain.

## B. Health risks, social risks, and consumers' approaches towards sustainability

### i. Health risks

A number of studies and research initiatives undertaken by both institutional and academic stakeholders support the view that, besides the obvious potential to create occupational illnesses due to direct contact during handling of chemicals, certain chemicals incorporated in garments have direct negative consequences for their final users (UNEP 2014). In 2014, for instance, a report by the Swedish Chemical Agency revealed that 10 per cent of textile-related substances are of potential concern to human health (Kemi 2014).

Approximately 25 per cent of chemicals manufactured globally are applied in the textile industry. For example China's textile industry, which represents over 40 per cent of global manufacturing, reportedly uses about 42 per cent of the world's textile chemicals (Greenpeace 2013).

Workers in the textile industry are exposed to chemicals that are linked to several kinds of cancers, including brain cancer, lung cancer and stomach cancer. Chemical contact to skin and inhalation can lead to other serious health effects, while exposure to noise also represents a serious risk to workers (Oecotextiles, 2013).

The *Associazione Tessile e Salute* (Textile and Health Association), based in Italy, reported in 2014 that harmful substances, such as carcinogenic aromatic amines and heavy metals, were present in garments put on the market in Italy in the same year. Contextually, Italian surveyed hospitals and clinics reported that 7 to 8 per cent of dermatological diseases were caused by textiles and footwear (Associazione Tessile e Salute, 2014 <http://tessileesalute.it/en/about-us/studies-and-tools/>). This Association, established with the contribution of Universities and the Italian Medical Dermatological Association (SIDAPA), and with support of the Health Ministry, represents a good practice helping industries to adopt standards and international rules for a sustainable chemistry in textile. Its research activities have been fundamental to compile the guidelines "Eco-toxicological requirements for clothing, leather goods, footwear and accessories" ([http://www.cameramoda.it/media/pdf/linee\\_guida\\_en.pdf](http://www.cameramoda.it/media/pdf/linee_guida_en.pdf)), developed in collaboration with the

Italian Chamber of Fashion, and now representing the main reference for major brands and Italian SMEs to track chemical impact and engage suppliers towards impact reduction.

## ii. Social Risks

The production of garments often outsourced to developing countries is subject to less stringent labor laws. This allows companies to benefit from cost efficiencies by taking advantage of workers, and avoiding paying them their country's minimum wage, let alone a fair living wage (Global Fashion Agenda & The Boston Consulting Group, 2017). The issue is not only limited to achieving a minimum wage, but also to gender equality issues, where women are paid less than men. Workers are forced to labor relentlessly under improper conditions, with negative health effects. A mother is working long hours at the factory, and she often has no choice but to bring her children to work, where they can suffer from developmental issues. Additionally, the lack of access to education in countries where such factories are located, has facilitated the employment of children within the textile industry.

Several initiatives have been established to address such issues. Better Work, a program developed by the International Labour Organization (ILO) and the International Finance Corporation (IFC), works directly with factories to implement sound solutions and provides support through guidance on minimum wages and financial incentives to encourage factories to create better working conditions (Better Work, 2017).

Another example is the establishment of self-assessment tools such as the Higg Index, developed by the Sustainable Apparel Coalition, which enables corporations to assess their performance against a set of established standards. The Higg Index evaluates social and labour impacts, waste levels and waste management systems, emission levels, chemical use within factories, and information to inform upper management on ways to develop products more sustainably (Higg Index, 2017).

Partnership and collaboration among all actors involved is an important approach to address social risks, as it can help ensuring benefits to both the business and society. Rather than a CSR department simply providing a donation in the form of philanthropy, where the company has little to no involvement in the distribution of the funds, a partnership allows there to be a sharing of value where tangible changes can be made (Keys., Malnight., & van der Graaf, 2009).

## iii. Notes on consumers' behaviour towards sustainability

Reviewed literature suggests that consumers, in the majority of cases, are not aware of the potentially negative environmental and social impacts of their purchasing decisions. Against this general assumption, the factors shaping consumers' behavior and attitudes towards sustainability appear to have a direct relationship with issues related to enhancing transparency in textile supply chains. Such factors can become drivers of policy decisions from both the public and private sectors, particularly in relation to strategic decisions to invest in supply chain transparency.

In 2011, the Organization for Economic Cooperation and Development (OECD) carried out a survey on consumers' environmental behaviour. Information was collected from more than 12,000 households in Australia, Canada, Chile, France, Israel, Japan, Korea, the Netherlands, Spain, Sweden and Switzerland, and revealed that environmental attitudes matter and governments can have a role in forging them. Accordingly, a complex set of factors underpin people's decisions and habits, including knowledge, the availability of information, trust, the concerns of neighbours, levels of environmental activism, as well as education, income, and ownership status. Several findings of this study suggest that well-designed information campaigns and educational programmes can change behaviours. Moreover, while the survey confirmed that prices and costs can be hugely influential in household decisions, it also revealed an overall willingness to be green and to pay more for environmentally-friendly choices (OECD 2014).

More selective studies demonstrate that some corporate social responsibility (CSR) initiatives, such as companies' environmental commitments, along with some corporate abilities (CA), such as product quality, significantly explain a trade-off effect on consumers' willingness to pay for a product (Feldmand and Vasquez-Parraga 2014).

Research on consumer awareness trends confirmed that while some consumers are informed and aware of environmental and social issues connected to their purchases, others show little interest in sustainability aspects of fashion. Industry research indicated the potential for promoting sustainability in the fashion supply chain, but found that little communication had been made to consumers (Saicheua et al. 2011).

A 2014 study on US consumers revealed that, in the U.S. market, consumers' knowledge of environmental issues in the apparel industry, moral norms, expectations of ethical behavior, and attitudes towards patronizing apparel retail brands engaged in CSR were all important predictors of U.S. consumers' intentions to patronize socially responsible apparel retail brands. Knowledge of environmental issues in the apparel industry and universalism values were found to influence consumers' expectations of retail brands ethical behavior (Diddi 2014).

Clothing consumer behaviour appears to be particularly complex and influenced by many different factors. Hiller Connell and Kozar (2014) report that in recent research on consumers' environmentally sustainable clothing behavior, the emphasis has been on the knowledge and attitudinal variables in encouraging the consumption of environmentally sustainable clothing. Recently large brand's retailing network are looking at potential impacts on the conversion rate, by piloting temporary shops or green corners in stores networks and on e-commerce platforms.

## C. Transparency in textile value chains

### i. General considerations

Global Value Chains (GVCs) are the main feature of international trade. GVCs rely on well-functioning transport, logistics, finance, communication and other professional business services in order to operate smoothly. Many goods and services are now from "everywhere" rather than "somewhere." It is thus vital for the future development of GVCs to have complementary trade policies consisting of a holistic approach to trade regulation, to facilitate and adjust to a world of GVCs (OECD 2013).

Approximately 80 per cent of textiles consumed in the EU, for instance, are imported from non-EU countries. It also appears that important information related to production methods and materials is not being carried along well enough from producer to consumer (Kemi 2014).

Textile GVCs are particularly complex. As Lam and Postle (2006) put in, the typical problems facing with textile and apparel supply chain are short product cycle for fashion articles, long production lead-time and forecasting errors for fashion items. These authors further report on the case of the Hong Kong textile and apparel supply chain, which faces additional problems of distance from customers in the U.S. and European markets, long production lead-times and minimum batch sizes for production, all of which force supply chain managers to improve efficiency and enhance competitiveness.

It should also be kept in mind that the textile sector represents the first stage of value added manufacturing for low-income countries (OECD, WTO and IDE-JETRO 2013).

## ii. Transparency through traceability, supply-chain mapping and sustainable sourcing

As suggested by Linich (2014), “*transparency goes beyond gaining visibility into the extended supply chain. It is the process by which a company takes action on the insights gained through greater visibility in order to manage risks more effectively*”.

Traceability schemes or initiatives appear to be important tools to move towards more transparency in the management of GVCs, as well as to facilitate the flow of information. Traceability in supply chains can be defined as the ability to identify and track the path of a product or material component from raw material to finished good. This is a useful tool to understand and relay information about the transformation of products, parts, and materials throughout the value chain.

Traceability fits into a certification scheme by serving as a link between production and consumption in the market place. “A Guide to Traceability” was developed in 2014 in collaboration between the UN Global Compact (UNGC) and The Business of a Better World. The Guide provides an overview of the importance of traceability for sustainability objectives across various industries. Accordingly, two models were identified that define the process of traceability in the textile industry: product segregation and mass balance.

Product segregation implies that certified materials and components are physically separated from non-certified materials and components at each stage through the supply chain.

Mass balance allows certified and non-certified materials to be mixed. The identified volume of certified material entering the value chain must be monitored and controlled and the same volume of certified product leaving the value chain can be sold as certified (UNGC 2014).

Supply-chain maps are geographical representations of the network of suppliers of a given firm. These maps mostly rely on innovative IT solutions to graphically represent the movement of parts and components along value chains, and can be a helpful tool to enhance transparency in supply chain management (Zeeb 2013).

Finally sustainable sourcing, for which transparency in supply chain management is a necessary pre-condition, mostly relates to the procurement policies put in place by firms in the selection of their suppliers (SAI 2013). Arguably, these policies depend on the availability of reliable information on the health and environmental impacts of inputs, processes and production methods along value chains.

These and other initiatives to enhance transparency in textile value chains can bring several economic, social and environmental benefits. However, implementation efforts are often very demanding in terms of economic investments and technical knowledge needed to put them in place. Innovative IT solutions can help overcome these barriers towards effective implementation.

The implementation of free trade agreements across a greater number of countries can help to further protect the rights of workers. This can help to ensure that member countries adhere to a strict set of labor standards that are outlined in the legislation (ILO, 2017). A strict set of labor standards is also necessary to reduce the promotion of illegal practices by workers (i.e. the unauthorized capturing of animals).

Respecting ethical protocols is not only limited to human rights, but to those of animals as well. Live-plucking and force-feeding of geese for the use of down is a controversial issue in that performing such a task is still legal in several countries. The increase of regulations within the 2006 Animal Welfare Act, which outlines the promotion of welfare and the avoidance of harm towards animals, can serve to prohibit the performance of such processes on animals. Companies can also make use of third parties whose purpose is to provide the tracking and tracing of animal treatment within the supply chain, and who can maintain accuracy of the results provided. The International Down and Feather

League Laboratory and Institute (IDFL) tests garments that are filled with both synthetic and natural materials, as well as those that are filled with down and feathers. IDFL provides audits and inspection services that provide clients with the information needed to trace the credibility of the source from which the textile filling has originated (IDFL, 2017). The Textile Exchange is an organization that works directly with the textile value chain to ensure a sustainable process from start to finish, and they have introduced numerous standards to which companies can adhere to, including The Responsible Down Standard (Textile Exchange, 2017).

Recycling, re-using and upcycling policies belong to the general framework and are necessary to improve the collection system, transparency and safety on all final phases of products. That is for customer protection and to ensure truly recycled product (i.e. green labels coming from a traced and audited system of remnants and unsold items). We have also health implications and transparency aspects about the source of materials. Also for the second-hand market we need to trace the origin and treatments of the sold product. Labels should not be accepted without evidences of traceability notes and/or certification. QR and bar-code, GPS tools could help to inform and trace the collected and recycled products. An important social aspect of traceability impact is to consider ongoing technologies to combat criminal organizations that collect discarded garments and re-sell without respect for hygienic practices, thus avoiding the progression to less well-off people.

Transparency and safety concern also recycling, re-using and upcycling practices, at the heart of circular economy approaches for the clothing sector. For the second-hand market, for instance, there is a need to trace the origin and treatments of products on sale. QR and bar-codes, GPS tools can help tracking and tracing the collected and recycled products. An important social aspect to consider in this case is the combat of criminal organizations that collect discarded garments and re-sell them without respecting fundamental hygienic practices.

### iii. IT solutions to communicate information on environmental and ethical performances.

The extent and complexity of textile supply chains makes it very hard for companies to collect accurate information about sources and relevant environmental/health risks and impacts. As a consequence, in recent years there have been a number of technological advancements that helped cut costs and improve the quality and reliability of data. Linich (2014) reports the following examples of key technological advancements in this field, within and beyond the textile sector:

- **Assessment tools for use across the supply chain.** *Rather than conducting on-site or third-party audits, companies can now track compliance or employment data using mobile technology. LaborLink, LaborVoices, and other service providers offer confidential surveys for factory, farm, and other supplier-level employees to voice concerns via SMS technology. Compared to traditional third-party audit services, SMS-based surveys offer the advantages of real-time data, confidentiality, and reduced costs. Muddy Boots Software, for instance, recently introduced its new Greenlight Assessments app, for use on Apple iPad® mobile devices with Muddy Boots's Quickfire self-assessment system, as a portable data-collection and data-sharing tool. Unilever uses the technology to track, in real time, how effectively its agricultural suppliers are complying with the company's Sustainable Agriculture Code.*
- **Managing internal key performance indicators (KPIs) with external supplier data.** *In response to the US Foreign Corrupt Practices Act (FCPA), Dodd-Frank Act, and UK Bribery Act, multinational businesses are required to collect information about relationships with suppliers in a global effort to thwart fraud and corruption. Many companies subscribe to due diligence services through companies like Dun & Bradstreet, MapleCroft, or LexisNexis, which provide access to databases containing information about businesses and individuals. New tools from companies like Aravo, Hiperos, and SourceMap go a step further by integrating those external information sources with internal KPIs or risk indicators. Some tools even integrate social,*

environmental, and other compliance metrics, helping companies visualize, anticipate, and preempt supplier-level risks.

- **Tracing individual products.** Some industries are beginning to track products from the manufacturer to the end consumer to help confirm quality and prevent fraud. For example, in anticipation of proposed federal and state “track-and-trace” legislation, 16 some pharmaceuticals companies are employing new approaches pioneered by technology start-ups, such as printing each pill with a code that can be texted to a central telephone number to verify the product’s integrity. Other companies have developed technologies for embedding near-infrared spectral fingerprints or tags containing inactive ingredients into pills. These technologies are helping pharmaceutical companies respond to product safety regulations, limit costly counterfeits, and provide customers with a greater sense of security.
- **Transparency to inform and engage end users.** Some companies voluntarily and publicly offer consumers visibility into their supply chains. A clothing maker, IceBreaker, provides a “baacode” with each product, which allows customers to use the company’s website to trace the merino wool in the garment all the way back to the source—the sheep farm where the wool was produced
- **Blockchain as a means of transforming the supply chain.** Big IT companies, such IBM have recently been working with multinational companies to trace where a given food has originated from, through the use of a blockchain. This shared ledger can help to identify all points along the supply chain (IBM, 2017). Similar to how blockchain is being used to enhance transparency in the food industry, the use of this technology can be applied to the garment industry to help track the origins of products, access real-time inventory levels, access where raw materials are sourced from, and provide operational efficiencies. The use of this technology is not only limited to products and services, but can also be used as a means of tracking staff along the supply chain through their qualifications (Casey & Wong, 2017). By having real-time data about employees, it facilitates the ability for companies to identify what and where are the pain points, thereby facilitating their ability to resolve them. If there is a work accident, the safety features, the operator, as well as his credibility can be quickly determined. The creation of a custom SKU Metadata Format (SMF) specific to the textile industry can be introduced as a means of retaining product information, product origins, product modifications, pricing variations, sizing codes, and any other additional information that may be needed to trace garments within the industry (Beckwith, 2017).

Other studies have tried to investigate the existence of causality between certain firm characteristics and their use of traceability-related technology. For instance, Jin and Kang (2013) have found that the greater the firm’s global awareness and the greater the firm size, the higher the global sourcing involvement. Also, the greater the top management commitment to global sourcing and the greater the firm size, the higher the IT implementation. While global sourcing involvement increased all three levels of firm performance, IT implementation led only to higher operational performance.

Kubler et al. (2014) analyse as follows potential solutions to the issue of determining what information should be communicated in product lifecycle management (PLM). They propose a data dissemination process called fuzzy AHP to select context sensitive information in order to store or replicate on a product. In their own words: “This process combines analytic hierarchy process (AHP) used to solve multi criteria decision making (MCDM) with the fuzzy logic which allows collective points of view from different stakeholders. The process is used on a case study “communicating textiles” to determine context sensitive information and lists data to be stored on the product ranked in order of highest relevance and importance”.

Mapping and tracing system is therefore important for CSR policies to create global supply chains with components coming from certified/traced ethical production. So we can track a lot of data regarding local producers (i.e. from Africa villages), using clean and natural processes, measuring also social impact. Systems and technological tools can help to improve animal safety (theft, predator attack, contamination/ infection). Some government agencies (i.e. Australian and New Zealand) have already introduced good practices for animal mapping and care on the territory. New technologies are also emerging for fire safety and to monitor seasonal chemical usage in the ground.

An important step towards a sustainable program for the clothing sector is to create a rating system with specific KPIs for companies that have started the traceability for environmental accountability processes, including adopting human rights and animal welfare good practices. The Life Cycle assessment is an advisable tool to initiate internal rating systems, but maybe the companies and brands need a universally recognized system of account, rules and KPIs. This aspect concerning the rating systems, has also financial implications considering the interest of banking and financial institutions to rate ethical and green companies. Recently some banks have decided to fund and give incentives to SMEs supporting sustainable investment and certification programs for the textile and clothing supply chain. (i.e. Unicredit & CNMI sustainable funds/loans).

## **II. The business perspective on enhancing transparency in textile supply chains**

### **A. Opportunities**

As a general rule, investments aimed at improving sustainability of business operations allow companies to use fewer resources for a greater output. For instance, manufacturers that have been early adopters on carbon efficiency, water conservation, and energy savings, have not only added to their bottom line but also gained an opportunity to differentiate their products with the buyers in the short term (cKinetics 2010). This sub-section summarizes case studies on “greening” initiatives that brought economic gains to businesses in the textile sector in both developed and developing countries.

The case of Nudie jeans Co., a medium sized Swedish clothing company, suggests that supply chain transparency is a useful corporate tool. Consumers exposed to traceable supply chains were more willing to buy, while at the same time they were not interacting more or differently with Nudie representatives. The author argues that transparency improves comprehensibility and comparability; however it is far from certain if in practice this is enough to empower consumers to pressure the disclosing firm (Egels-Zandén and Hansson 2015).

In 2005, Nike and Levi-Strauss published lists of their suppliers. Steps taken in this connection included developing new information systems to enable the two companies to better track information about labour practices and introducing code monitoring systems, using both internal and external auditors (Doorey 2011).

The Cleaner Production Regional Activity Centre (CPRAC) reports about several successful firm-level initiatives, of which two examples are set forth below:

1) First Textile, a company based in Turkey and engaged in the production of knitted textile, yarn, fabric-dyed textile and printed textile, realized the following gains from implementing cleaner production processes:

Environmental Benefits	Cost (Investment+Operational)	Annual saving	Payback period
• Reduction of water, energy and chemical consumption	USD0	USD58,340-32,370	immediate
• Reduction of water and salt consumption	USD20,000	USD57,680	3 months
• Reduction of steam and energy consumption • Air pollution control	USD328,820	USD513,000	1 year

2) A large public-sector textile factory in Egypt, producing 8,000 tonnes of raw fabric a year, realized the following gains:

#### COST - BENEFIT RELATIONSHIP

Factory Department	Action	Capital & operation costs (€)	Yearly savings (€)	Payback period (months)
Measures already implemented				
All	Steam condensate recovery	13,203.0	39,638.3	< 4
	Upgrade insulation of steam and hot water networks	14,083.2	39,646.0	< 5
	Improve storage facilities	0	6,689.5	Immediate
	Optimise chemical usage	0	10,269.0	Immediate
Fabric	Counter current flow in Kyoto range	12,909.6	65,064.4	< 3
Pre-treatment				
<b>Subtotal</b>		40,195.8	161,307.2	< 3
Additional measures to be implemented				
Fabric	Install automatic shut-off valves, Gaston County range	10,709.1	13,159.0	< 10
	Recycling final wash water	8,802.0	41,442.8	< 3
Yarn Dyeing	Heat recovery from hot liquors	23,472.0	31,443.7	< 9
<b>Subtotal</b>		42,983.1	86,045.4	< 6
<b>OVERALL COST - BENEFIT RELATIONSHIP</b>		83,178.9	247,352.6	4

As can be seen in these two examples, savings from optimization of water consumption appear to be predominant.

In sum, the existence of clear economic gains and the fact that consumers in key export markets react to GVC transparency initiatives fully support the preliminary conclusion that, on the side of the firm, it would be economically meaningful to convey information about improvements in environmental performance to both intermediaries and final customers.

## B. Challenges

Conveying complex information along complex supply chains can be expensive and can imply investments in infrastructure, human capital and technological knowledge. In addition, abiding by new firm-level standards in the context of a traceability scheme can be particularly burdensome on the side of smaller suppliers. However, the present paper is limited to considerations related to

transparency in supply chain management, hence abstracting from the typical challenges related to compliance with the substantive requirements of private and “public” standards as such (ITC 2011), for instance on environmental performance.

The WTO and the OECD (2013) provide an analysis of ways forward to overcome broader supply chain costs in the textile sector in the context of Aid for Trade initiative. Their study identifies four drivers for aid-for trade assistance: encouraging overall development of the textile sector, promoting preferential utilization, supporting social upgrading in the global supply chain and supporting vertical integration between apparel and textile sectors.

Finally, while technology can help cut the costs involved in enhancing supply chain transparency, some authors contend that the expectations associated with transparency policies are often unrealistically high. Accordingly, transparency schemes can help to cope but not solve social and environmental problems that are associated with production and consumption trends of advanced industrial societies (Dingwerth and Eichinger 2010).

### Concluding remarks on the need for a new international framework initiative

The literature reviewed in this paper fully supports the case for an international framework initiative (e.g. a policy recommendation or a framework agreement) on enhancing transparency in textile value chains. An international framework initiative of general application would be more appropriate than a standard due to the high concentration of patent-protected new technologies in relation to the various GVC transparency tools reviewed in this paper. A standard would require disclosure of patent protected information and would probably become too rigid an instrument to spread a message that should reach out to the maximum number of private and public stakeholders.

Indeed, both governments and companies, can play a crucial role in raising awareness and enhance supply chain transparency.

As to the role of governments, it appears that they can for instance support the reinforcement of environmental attitudes in consumers and business. For as much as variables such as trust and education matter in forging such attitudes, governments can invest in education programmes and awareness-raising campaigns. As confirmed by the OECD (2014), such initiatives lead to measurable impacts in the attitudes of consumers and enterprises towards sustainable sourcing and other environmental and health issues.

For companies, the existence of economic gains arising from the implementation of cleaner and healthier production practices, coupled with consumers’ positive reactions to being informed about environmental and health impacts, supports the view that enhancing supply chain transparency can be a win-win situation.

Against these general considerations, however, development-related concerns should not be left behind, and due assistance should be provided to suppliers who lack the financial and human means to better communicate information on their environmental performance. An international framework initiative should explicitly mention these concerns, and propose solutions to overcome the relevant challenges.

Further, as recalled by UNEP (2014), companies and governments should act in concert to enhance supply chain transparency and the overall environmental performance of the textile sector through research, training, information exchange and communication. Whereas at the firm level the use of industry guidelines and self-regulatory procedures can have significant impacts, at the government

level policy formulation should be consistent and oriented towards a preventive cleaner production approach, and also consider incorporate monitoring and reporting requirements as part of such policy framework.

A harmonized and internationally consistent approach to public regulation in this sector would thus be highly desirable. An international framework initiative reaching out far beyond the UNECE Region and conveying key stakeholders around the same table, could perfectly serve that purpose, and help countries draw together their initiatives and approached to enhance transparency in textile GVCs.

An international framework initiative could foster innovation, improvements and price reductions in the IT tools used for supply chain mapping, traceability and sustainable sourcing. It would create momentum for new investments in these technologies, while at the same time avoiding the risk to create a rigid framework for stakeholders to adopt one or another of those technologies. However, such an initiative should encourage interoperability in relation to such new technologies with a view to avoiding inefficiencies, overlaps and losses.

A new framework initiative of a general nature would also serve the objective of fostering the international debate on the necessity to tackle negative health, social and environmental impacts of textile-related operations. In this connection, efforts to improve transparency in textile supply chains would also be of utmost relevance in the framework of the definition of the new Sustainable Development Goals (SDGs). It would in particular make a significant contribution to draft-Goal 8, which calls for decent work conditions for all, as well as draft-Goal 12, which calls for sustainable consumption and production patterns.

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