IOP Conf. Series: Materials Science and Engineering **254** (2017) 192006 doi:10.1088/1757-899X/254/19/192006

Textile sustainability: reuse of clean waste from the textile and apparel industry

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Abstract. Today societies are already experiencing changes in their production systems and even consumption in order to guarantee the survival and well-being of future generations. This fact emerges from the need to adopt a more sustainable posture in both people's daily lives and productive systems. Within this context, textile sustainability emerges as the object of study of this work whose aim is to analyse which sustainability dimensions are being prioritized by the clean waste management systems of the textile and garment industries. This article aims to analyse solutions that are being proposed by sustainable creative business models in the reuse of discarded fabrics by the textile industry. Search also through a qualitative research by a case study (the Reuse Fabric Bank) understand the benefits generated by the re-use in environmental, economic, social and ways to add value.

1. Introduction

The exaggerated consumption and incorrect waste disposal have generated increasing and alarming environmental, social and economic problems. Data from the UN (2015) show that carbon dioxide emissions have increased almost 50 % since 1990 and 40 % of the oceans are impacted by the waste pollution with reduced fishing and loss of coastal habitats. While 1.3 billion tons of food is wasted daily, the vast majority of the world's people starve in developing countries, where 12.9 % of the population is starving. UN projections for 2050 come up with a population of 9.6 million people, requiring 3 planets to provide natural resources to support current lifestyles [1].

Given this context, sustainability presents itself as a way to minimize environmental and social crises in view of the maintenance and perpetuation of resources for future generations. However, there is a strong awareness of society when it comes to rethinking their consumption habits and promoting radical changes in the way they produce, consume and their lifestyles [2].

In this context of transition to sustainability, we can observe the mobilization of some sectors, namely the fashion industry, which begins to point out some proposals for changes in their production systems. In face of the textile and clothing industry's negative impact in the environmental and social spheres, innovative initiatives are emerging, which seek solutions through systems development built under the pillars of sustainability.

This article presents the main objective of analysing the sustainable dimensions that are being prioritized by organizations related to the textile industry in Brazil, which carry out changes through innovative systems for sustainability. In order to carry out the present study, textile and clothing were delimited, selecting sustainable projects in Brazilian institutions that perform the clean waste management service of the textile and clothing industry for new products development with added

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value. The Reuse Fabric Bank of São Paulo was used as a case study and analysed its systemic structure. The tool SDO-Sustainability Design Orientation Toolkit was applied in order to map thru radars the sustainability dimensions, which are being prioritized by the Reuse Fabric Bank, but also applied as systemic innovation strategies.

2. State of Art

2.1 Sustainable Fashion

The fashion industry products have an ephemeral life cycle, as they are mostly designed by trends that stimulate consumers to renew their goods every season and, thus, strengthen the capitalist system structure. In search of systems construction, which oppose the dictates of the fast fashion model, understood as a practice of fashion companies and distribution networks, which focus on the strategy of constantly design updating of their products combined with low production costs, fast flow and low sales prices [4]; also the ones that think more ethically about fashion and generate positive impacts in the environmental, social and cultural spheres with economic equilibrium. Thus, there is an increasing number of initiatives that reflect the sustainable fashion concept. The sustainability process drives changes in the fashion industry, which discusses ways to reduce the clothing environmental impact, exalting the role of designers as systemic change facilitators [5].

Designing for sustainability is about developing products with low environmental impact and high social quality, analysing the criteria, methods and investments of *Life Cycle Design*. This requires the designer to increase his attention to all phases of the product life cycle, from the raw material extraction stage, in order to product materials, to the final phase of use, which needs to be considered as early as the beginning of the project, named stage of its decomposition or discard [6]. Faced with the possibilities of sustainable actions in the fashion industry, there is a moment of change of scenery, in which a new and more selective consumer emerges, aware of the impact that their actions may have on current generations and their descendants. The consumer also demands brands that are aligned with the principles of transforming the world into a better place [7].

2.2 Sustainable waste management systems of Brazilian textile and clothing industry

The implementation of more effective laws, that charge corporate responsibility for environmental and social issues, has led to restructuration of the textile and clothing industry production chain, not only to comply with the requirements of these regulations, but also with the objective of fulfilling the demands of a growing market, which starts to adopt a more conscious consumption. Under this approach, innovative actions, although still incipient, are being identified. These are redesigning the productive structure regarding the textile and garment industry waste's reuse with reverse logistics practices and cleaner production. The actors involved in this context change are private companies, nongovernmental organizations, public agencies, community associations, class institutions (trade unions, professional associations, etc.), academia and consumers themselves, who seek alternative and innovative solutions. However, the challenge of balancing production and consumption patterns is still a complex task, aggravated by the fact that sustainability is still a concept in evolution, also by the difficulties in its practical implementation [8].

To make a better comprehension, the actions that are being developed in the Brazilian context, and in order to deepen the knowledge about the sustainable systems construction of the textile and clothing chain, we mapped sustainable initiatives examples, that have been practiced by differentiated actors of this productive chain, as shown below.

2.2.1 Project of Fashion Retail. The "Retail Fashion" project is held in Bom-Retiro - São-Paulo through a partnership between Sinditêxtil-SP (Union of Spinning and Weaving Industries of the State of São Paulo, BR) with the support of ABIT (Brazilian Textile Industry Association and São Paulo City Hall), as well as other institutions in an area that concentrates more than 1200 clothing factories. These generate approximately 12 tons of textile waste (clean waste) per day, which represents 2 % of the annual wastage generated in Brazil [9].

The project, which is still in its initial stages, aims to manage the commercialization of this waste in order to contribute to the reuse of it as raw material for the textile companies and to propose a waste management plan in accordance with the National Solid Waste Policy. In order to avoided that the industry not to be subject to compulsory regulations [10].

2.2.2 The Brandili Textile Brand. The Brandili Têxtil brand has been working in the area of children's clothing for over 50 years and, for the past five years, it has taken a sustainable stance by using natural resources responsibly.

The company, based in the state of Santa-Catarina, reuses textile waste for ecological yarns production. This process relies on a partnership of companies that provide raw material, (cline industrial waste), for reuse in the ecological yarns production, from textile materials and bottles made of polyethylene terephthalate (known as PET bottles). Reverse logistics actions are observed in the company, since the post-consumer distribution channels are formed by reverse products' flow and materials from products' disposal, once their original functionality has been exhausted, returning to the production cycle in another way [11].

2.2.3 The Insecta Shoes Brand. The Insecta Shoes brand was created in Porto-Alegre – Rio-Grande-do-Sul in 2014, is distinguished by marking vegan footwear with a positioning that works with animal protection values, since it does not use any animal input in its products. The brand adopts a sustainable posture, because all of its footwear is made of used clothing or leftover fabrics, industrial rubber waste or recycled plastic. All the material is carefully searched in second hand articles fairs, as well as in products of the Reusable Fabric Bank of São Paulo, case study object of this work. In a research carried out in Porto-Alegre, with Bárbara Mattivy, founding partner of the brand, it is observed that there is a concern in extending fabric's life and, at the same time, guaranteeing a reduction of materials in the production line [12].

2.2.4 The Ecosimple Brand. Created in 2010 in the city of Americana – São-Paulo, the merger result of other textile companies with a business model, added to an innovative and sustainable concept. The fabrics and brand products use 100 % recycled materials, combining technology with sustainability. The raw materials used are recycled PES from bottles, discarded clothing or fabric's leftovers from garment factories and waste from spinning processes that give rise to more sustainable products which are used in a wide variety of segments. Ecosimple presents itself in the Brazilian textile context as a company that uses innovation by adopting a production model that minimizes environmental impact and favour's poor communities.

2.2.5 Bank of Clothing from Caxias-do-Sul. The Clothing Bank of Caxias-do-Sul (BVCS), in Rio-Grande-do-Sul, was founded in October 2009 as a centralizing body for textile waste from the industries of the Rio-Grande-do-Sul state region. The BVCS receives the waste from the industries, performs a sorting by types of materials and organizes the fabric's leftovers for posterior assignment to registered communities, which will reuse these materials. What cannot be reused by the communities goes to other industries that make reuse for stuffing or is destined for co-processing, closing the product cycle.

3. Methodology

The research method used was the case study, in order to investigate in greater depth a contemporary phenomenon, in this case, the phenomenon of sustainability in the textile sector. Since it was a technically singular situation, an analysis unit was used, defined by the business model criterion, which performs the collection service, separation and commercialization/disposal of the leftovers from the textile and garment industry, which would have landfills or other destinations that could have a negative impact on the environment and society.

The unit that served as the study analysis object was the Reuse Fabric Bank of São-Paulo capital, which will be explained later. In the second phase of the empirical work development, after categorizing the data, the information was submitted to a tool called Sustainability Design-Orienting

Toolkit (SDO), which aims at guiding the design process for the sustainable systems solution. It is an open-source software with a *copyleft*, license, also it has the option to be used online (www.sdo-lens.polimi.it) or downloaded and installed on a local internet network (LAN) [2]. The tool is originally structured based on three dimensions of sustainability: (1) the environmental dimension; (2) the socio-ethical dimension and (3) the economic and political dimension. For each of the three proposed sustainability dimensions, requirements are used to evaluate a given system and to guide the design process [2]. For each criterion, the SDO system sets a project priority level to A (High), M (Medium), B (Low), or N (Not applicable). The definition of the priority level is set by the user (in this case by the researchers of this investigation).

4. Results and Discussion

4.1 Case Study - Reuse Fabric Bank of São Paulo

The Reusable Fabric Bank structure of São Paulo (BTR) was created in January 2015 with the objective of extending the life of stopped fabrics, stockpiles, clothes cuts leftovers or small rolls of fabric and scraps; also enabling them to circulate again, extending its life cycle through new uses, preventing it from ending up in landfills. The fabrics to be reused are taken to the units and are organized and sanitized. After this process, they are put up for sale, and marketed per kilo to the current value of R$ 45. In case of the user deposits fabrics in the Bank, he will receive credits for each kilo deposited and later with these credits can take new fabrics. The store's inventory capacity is 1.3 tons and this stock has already been renewed about 4 times, so it is estimated that more than 5 tons of fabric have already been reused in just one operation year of the business. Currently, Reuse Fabric Bank operates with more than 200 users (account holders) who simultaneously deposit and take fabrics. The users' profiles are small artisans, young designers, renowned stylists, companies that make a more personalized work with the fabrics and even brands recognized for sustainable jobs. All fabrics deposited have the origin registry that allow their life cycle mapping, which guarantee to be a reuse part, certified by a label of guarantee created by BRT (figure 1).

4.2 Application Tool SDO- Sustainability Design Orienting Toolkit

4.2.1 Environmental Sustainability Radar. The diagram of Figure 2 shows the environmental dimension radar of the Reuse Fabric Bank (BTR); the analysis process result of the system's environmental priority for each criterion established by SDO.



Figure 1: Reuse Fabric Seal given by BTR. Source: website BTR

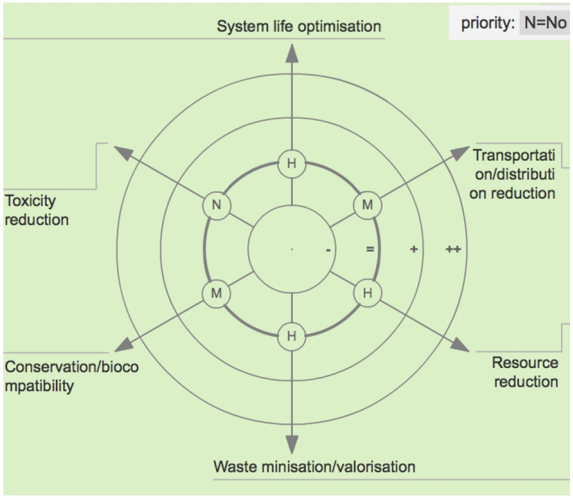

Figure 2: BTR- environmental dimension radar. Source: www.sdo-lens.polimi.it

The visualization shows that the BTR system has a medium environmental priority when it comes to the issues related to the waste's transportation and distribution since it does not have the responsibility

of collecting the waste. Another point of medium priority is related to the consumption of non-renewable energies; also the item "No Toxicity" does not apply to the system under study, because it does not use fabrics with toxic substances. However, there is a high priority of the system regarding its optimization and concern to both the minimization and to valorisation of the wastes. This awareness is conveyed to all partners and valued in all BTR actions.

4.2.2 Socio-ethical Sustainability Radar. The diagram of the **figure 3** refers to the socio-ethical dimension analysis result, in which five items with high priority in the BTR system are observed. It is worth mentioning: (1) Working Conditions, (2) promotion of Equity and Justice, (3) promotion of Responsible Consumption, (4) Integration of Marginalized Persons and (5) In function of this system, guarantee great visibility to the actions practiced by the different actors of its structure.

4.2.3 Economic Sustainability Radar. The diagram presented in **figure 4** shows that three of the analysed requirements were evaluated as being of high priority: (1) Profitability, (2) Added Value for the customer and (3) Partnerships/Cooperation. The other three were categorized as medium, namely market position and competitiveness, long-term business development and macro-economic threats, as it is a business model with little time existence and, mainly, because it is inserted in a market that is experiencing a serious financial crisis.

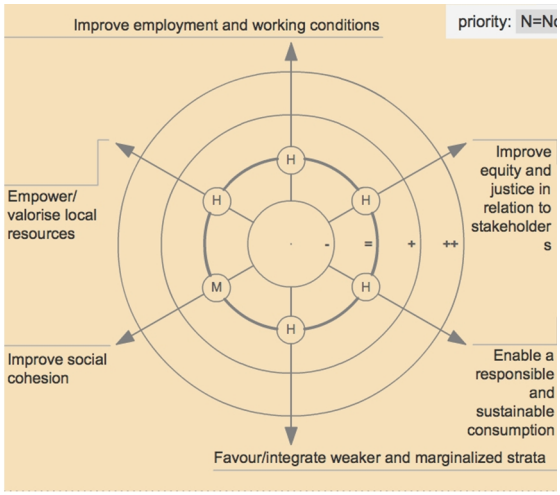

Figure 3 BTR socio-ethical dimension radar . Source: www.sdo-lens.polimi.it

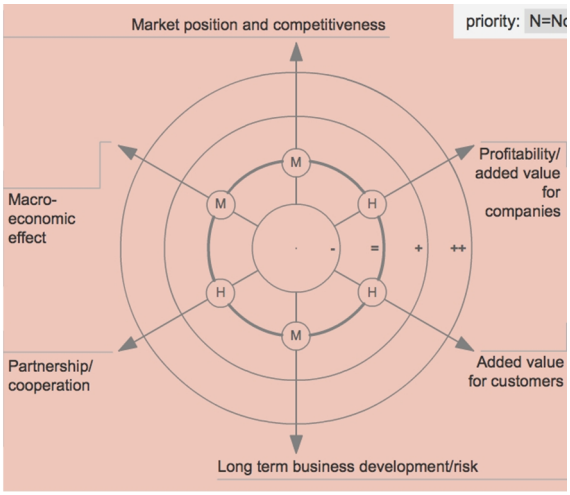

Figure 4: BTR economic dimension radar Source: www.sdo-lens.polimi.it

5. Final considerations

The application of the SDO - Sustainability Design Orienting Toolkit, designed to support the planning and management of eco-efficient systems, allows to analyse the priorities within each sustainability dimension, thus achieving a mapping of the process. In the case of Reuse Fabric Bank, a relative balance was observed in the three dimensions of sustainability under analysis, although a weakness in the macroeconomic context was observed.

The BTR has a strong inclination to value the environmental and social dimensions. The strong partnerships network, established by the Bank (BTR), reinforces the idea of the need for cohesion between different partners that, despite having different specific objectives, are united in a cooperative work. On the other hand, there is still a small fragility in relation to the economic dimension. That is due, because the BTR is involved and facing a national economic crisis context. It still has no solutions to take advantage of the system's full potential. However, it applies efficient techniques aiming at guaranteeing the maintenance of its structure, and despite being a recent business model, already presents evidence of its eco-efficiency.

Acknowledgments

"This work is supported by FEDER funds through the Competitivity Factors Operational Programme - COMPETE and by national funds through FCT – Foundation for Science and Technology within the scope of the project POCI-01-0145-FEDER-007136"



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