

## Sustainable Trend: A Study about Innovations in the Productive Chain of the Textile Sector

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**Abstract**--The productive chain of the textile sector comprises steps and processes that have an impact on the environment. Such impacts range from the high consumption of raw material to the generation of waste and its consecutive disposal. Sustainable design, however, consists of developing products and services with low environmental impact, while not neglecting the social demands and the economic viability of the business. Considering this context, the present study aims to analyze the contribution of a sewing studio to sustainability in the production chain of the Brazilian textile sector. Regarding the theoretical background, the following are covered: Innovation, Sustainability and trend, and sustainable production chain. Thus, the methodological procedures are qualitative, exploratory, descriptive, and conducted via a case study in the Bianca Baggio studio. Data was collected using a semi-structured research script that was conducted with the company managers. The results show a change in the profile of companies in the textile sector, especially regarding the sustainable production chain and its acceptance in society, so that the innovations contained in its processes contribute to sustainability and the dissemination of responsible consumption.

### I. INTRODUCTION

Activities related to innovation are very important for the industrial development of a nation. Considering the economic situation in Brazil where annual rates of GDP growth undergo a severe downturn [58], what is observed is the stagnation of industrial activity and the decline of innovative dynamics [1]. These issues could jeopardize the country's development.

However, there are companies that conform to the concept of sustainable design, that is, economically viable, environmentally friendly and socially equitable businesses [44] that may ease the situation presented. To this end, the innovation issues relate directly to the concept of sustainability.

According to [55], the development of new technologies or processes should ensure the optimization of organizational management, and reduce or prevent the environmental impacts caused by the activity performed. To this end, it is necessary to integrate economic, social and environmental issues that cover the entire production chain [26].

While the conventional production chain has processes and operations that harm the environment and society, a sustainable production chain operates with a minimum of required resources using clean technology and techniques that do not degrade the environment [37]. In the textile sector, specifically, the environmental impact is considerable, both in consumption and in disposal.

The Spinning and Weaving Industry Union of the State of São Paulo - Sinditêxtil-SP [62] has released a survey showing that, of the 175 thousand tons of textile trimmings resulting from Brazilian clothing industry, over 90% are discarded in inappropriate places or landfills. Whereas in Europe and North America, according to Ellen MacArthur Foundation [30], it is estimated that around 15 million tons of clothes are discarded annually in landfills, not considering the waste that is generated during the productive process.

In this scenario, a reflection on the importance of waste management in the textile sector becomes relevant considering that the impacts caused by improper disposal of waste leads to a series of harmful consequences to the pillars of sustainability: environmental, social and economic [25].

According to the context presented above the following research question is presented: How does the contribution of small sewing studios happen on the sustainable production chain in the apparel industry? Thus the overall objective was formulated: to analyze the contribution of a sewing studio to the sustainability of the productive chain in the Brazilian textile sector. The specific objectives were also defined: to describe the productive chain of the Brazilian clothing industry; to identify and describe the characteristics of the studied company regarding innovations for sustainability; to verify the company's contribution to a sustainable production chain in the apparel sector.

The justification of this research is to present a relevant topic to the current situation considering the discussions about sustainability and consumer culture, more and more harmful to the available natural resources. Thus, the debate on sustainable production chain and its consequences is highlighted as it has been happening in the context of developing countries, such as Brazil. The reported experience can also contribute to the development of government, business and society actions in similar contexts.

This study is organized as follows: after the introduction the theoretical aspects that underpin the study, subsequently the methodological procedures adopted, and then the presentation of results and final considerations are presented.

### II. THEORETICAL REFERENCES

This section discusses the issues addressed in this study, namely: general aspects of innovation; perspectives related to fashion and sustainability; and sustainable production chain.

#### A. Innovation

In the beginning of the Industrial Revolution a major transformation started in the methods of production, with innovations grouped into three principles: replacement of

human skills by machines; replacement of the energy type used from static electricity to dynamic electricity and, finally, the use of more abundant new raw materials [32].

Innovation is responsible for improving the quality of work efficiency; it enhances the exchange of information, refining the entrepreneur's ability to learn using technology and new knowledge [43]. According to the Oslo Manual prepared by the Organisation for Economic Co-Operation and Development (OECD), innovation is:

the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations [43].

However, innovation is related to the ability to establish relationships, identifying opportunities and benefiting from them [53]. Its activities include scientific, technological, organizational, financial and commercial stages, responsible for conducting and implementing these innovations, which are divided into 4 types: product; process; marketing and organizational.

Demand plays an important role in organizational management in which "firms often spend substantial resources on researching demand and can adopt marketing measures to influence or create demand for their products" [43], although there are disagreements [23], like the Schumpeterian theory indicating that innovations do not come from the consumer [14] and are associated with the introduction of a new item in the market; a new production method; opening of a new market; conquering new source of raw materials; establishing a new organization of the industry. Still according to Schumpeter [43], "radical" innovations provide more intense ruptures, while the "incremental" continue the change process [43].

The four types of innovations are representative within a company, are often interconnected or overlapping. To this end, the studied case presents the innovation of process and product, since it is based on a new way of manufacturing clothes besides offering the public an exclusive handcrafted-like product.

The innovation of processes is characterized by the introduction of a new method or significant improvement of production or distribution, involving new techniques, equipment or software [43]. The innovation of product as well as the introduction or improvement of a good or service includes new materials or components techniques. According [35] the development of products and processes in industry can sometimes be considered as two sides of the same coin, so to Larger development of process is:

defined as development driven by internal production objectives. Such objectives may be reduction of production costs, higher production yields, improvement of production volumes and product recoveries, environment-friendly production, etc [35].

On the other hand, product innovation is stimulated by the desire to innovate properties as well as by the performance of the finished product, its goals being to improve product properties, quality or develop new products [35]. Innovation of product is mostly stimulated by the needs of the market, while innovation of processes starts from an internal need of the company [5].

This concept is defended in the Oslo Manual [43] as part of the process of development and implementation of innovations of products. So this feature is critical to the case study presented, since the design of the new product is the result of solid waste management, aiming at sustainability in the production chain.

### 1) Innovation and sustainability

Although the Oslo Manual does not address innovations specifically related to the environment, companies are under pressure to adopt measures to protect the environment [26], increasing investment in technological products and processes along the production chain. This pressure can come from the consumer, the State through environmental policies, or the market itself when introducing new "cleaner" products or processes.

To that end, the environmental effects of economic activities that are caused by the impacts of the production, use and consumed waste [55], are key pieces in innovation management where companies tend to develop products or technologies through new processes or improvements of organizational methods, trying to reduce or avoid negative impacts on the environment [34]. Today, it is essential that companies see sustainability as a strategic issue in the routine of the company [26] finding in sustainability an innovation factor that repositions these companies in relation to the environment:

This approach can be achieved through eco-design practices, which presupposes an evolving productive chain, formed by companies that work together to develop products that cause a lower impact to the environment and to experiment with new innovative approaches [26].

The process of implementation of sustainability in a chain happens through pressure and incentives based on customer demands, response to stakeholders, competitive advantage, pressure groups and reputation loss [59], and also on differentiating themselves from competitors [24].

A research of [32], regarding young companies, shows that the integration of sustainability in all the steps of innovation process is a challenge due to lack of knowledge and uncertainties that involve the problems related to sustainability and how to address them. Some companies also showed sustainable innovation beyond the traditional environmental focus, incorporating social aspects and trying to create a sustainable behavior awareness through their products [32].

Ethics and values are included in the development of sustainable projects [42], where "Through this lens it is possible to value e.g. redesigned objects according to their environmental value" [42], using eco-materials, product leftovers, as well as recycled parts and products. The challenge for innovation does not only depend on economic potential, but also considers the introduction of the innovative activities that induce social changes [49].

Considering this, the importance of using strategies that interact with problems in the flow of production chain arise, including product design management, waste, recovery processes [26]. So, the textile sector, which includes apparel and clothing, presents countless challenges to sustainability, since it is responsible for a large impact on the environment, ranging from high consumption of raw materials, energy, to the generation of waste [38].

### *B. Sustainability*

For greater understanding of the need for innovation with more sustainable means of production it is necessary to understand the historical process that involves the concern with environmental problems and what is being done to reduce the impacts caused to the environment by human action.

Between the 60's and 70's, attention was focused on the problems of environmental degradation [4, 22, 45]. Although countless meetings have taken place since then, what stands out is the report written by the World Commission on Environment and Development which in 1987 presented the report *Our Common Future* in which they released the term *sustainable development* as the one that meets the needs of present generations without compromising the needs of future generations.

Many authors criticize the concept of sustainable development prepared in 1987 [18, 22, 40, 48] due to it being anthropocentric, not having a universality, and mostly for considering the economic focus, although other theories embrace the idea of sustainable development together with economic growth and technological development [41].

Regardless of differences between radical reformist changes theories, what is observed is that there is a consensus on the need to preserve the planet. Therefore, it is necessary to address the modes of production and how the product chain can be more sustainable in order to reduce the effects caused to the environment. Thus, "product development policies focusing on sustainability require an integration of economic, social and environmental issues covering the entire production chain" [26].

### **1) Sustainability and fashion**

The clothing industry sector in Brazil represents about 17.5% of the GDP of Transformation Industry, which corresponds to about 3.5% of Brazil's total GDP. According to IEMI data - Institute of Studies and Industrial Marketing - Brazil is the 5th largest global textile producer, after China, India, USA and Pakistan, being the only country in Latin

America with good results in the ranking [6]. Data on the disposal of waste is alarming.

According to the Spinning and Weaving Industry Union of the State of São Paulo - Sinditêxtil-SP (2012), annually 175,000 tons of textile trimmings are produced only from the folding clothing cuts in Brazil. It is estimated that over 90% of this is destined for landfills or environmentally incorrect disposal [62].

In the USA only 15% of generated textile waste is sent to recycling programs [47], which represents around 3.8 billion pounds of textile. The remaining 85%, however, ends up in sanitary landfills.

Thus, it is necessary to reflect on the importance of managing waste produced by the sector in which "impacts caused by the incorrect disposal can pollute the soil as well as the water and air, triggering a series of harmful consequences on the pillars of sustainability: environmental, social and economic" [25].

The Marrakech process, provided by the Ministry of Environment, defines "sustainable production" as incorporating best possible alternatives that minimize environmental and social impacts throughout the life cycle of goods and services [9], trying to lengthen the lifespan of products reusing as much as possible the raw materials produced when recycling new production chains.

The agreement made at the UN Conference Rio 92, between the United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Programme (UNEP) defined cleaner production (CP) as a continuous application of preventive environmental strategy that, integrated into processes, products and services, would increase eco-efficiency and reduce health and environment risks, the evolution of this concept led to the idea of Sustainable Consumption and Production (SCP) [9].

In this situation, the development of new forms of consumption and production of fashion is imminent [38]. In order to reach sustainability the fashion industry offers different practices such as: use of organic fibres; reuse and recycling of materials; vintage practices and second hand; clean technologies and green certifications [12]. However, some manual or craft work employing textile waste are treated as recycling and not reusing material [62] and, although the management of this textile waste happens just for the social bias of sustainability, the environmental is forgotten.

Studies show that the end customers have presented more interest in knowing the origin of the clothes and products they use [28, 56]. Thus, "sustainability should be considered not only during product design and manufacturing phases but also in supply chain design and management" [12].

What concerns this study is to note that the case study represents waste management as social and environmental sustainability.

2) Sustainable production chain

Productive Chain is the set of activities that progressively articulate from the basic raw materials to the final product, including distribution and marketing, organized into segments (bonds) of a chain [9]. It is therefore a succession of directly linked processes, which range from the extraction of raw material to the discharge of the final product.

A more complex view in which sustainable speeches and the concern with the environment become increasingly recurrent, the position of the Association Française de Normalisation (AFNOR) is emphasized, where the production chain concept is understood as follows:

[...] a chain of changes in raw material with economic purpose, which includes from the exploration of this raw material in its natural environment, to its return to nature, going through the productive circuits, consumption, recovery, treatment and disposal of effluents and solid waste [3].

Therefore, it is noted that although its purpose is economic, this set of activities called the supply chain not only covers the stages of manufacture or marketing, but also the disposal of waste from the industrial process, so that its impact on the environment is reduced or neutralized.

The sustainable production chain, however, operates with a minimum of required resources, using clean techniques and technology that will not degrade the environment [37]. Thus, all the functional steps in the process must be aligned to this

dynamic, trying to minimize the impact of harm to the environment. Still according to [38], the transition from a conventional supply chain to a sustainable one requires a number of systemic changes. In this situation, not just the technological innovations become indispensable, but also social and cultural innovations that directly or indirectly influence the development of the entire production chain.

In textile production, specifically, the production chain is structured into the following stages: (1) production of raw material (fibers and strands); (2) spinning; (3) Weaving; (4) processing; and (5) manufacturing. The stages mentioned here can be seen in the figure 1.

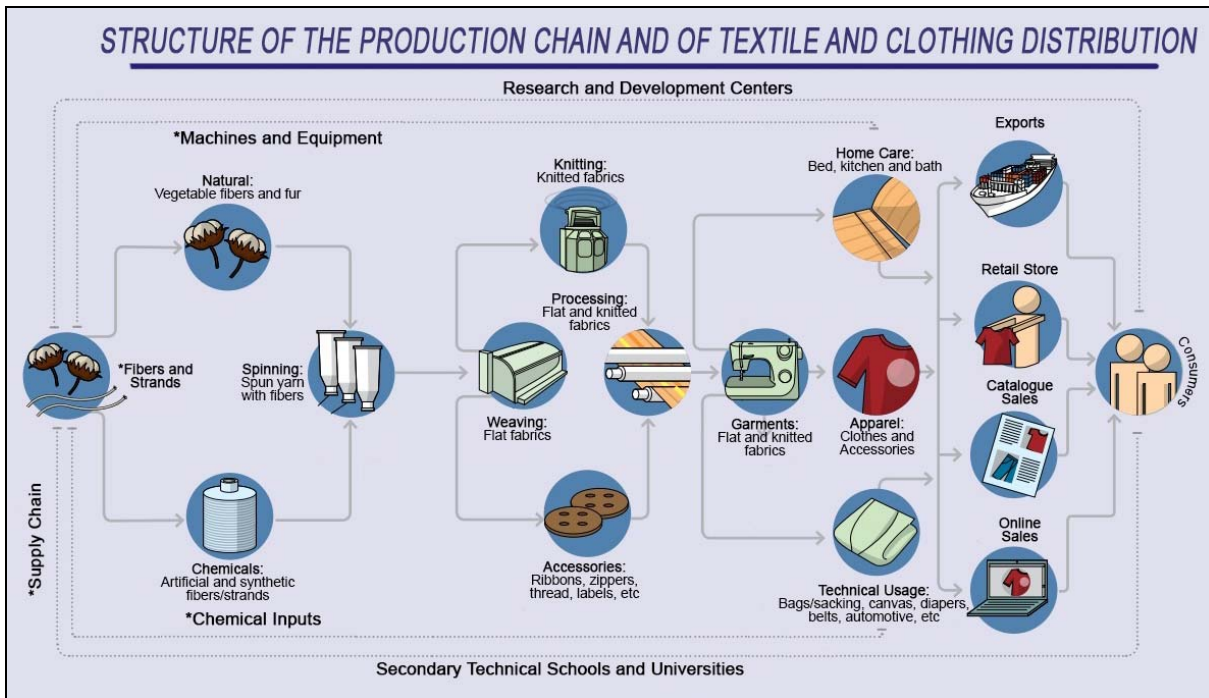
Below is an individual description of the items:

Production of raw material

The textile industry uses different types of raw materials. From natural or chemical fibers, their purpose is to offer the most diverse textile solutions to the market [2].

The natural fibers may come from vegetable sources such as cotton, linen, ramie or gunny, or animal sources, such as wool and silk. The chemical or manufactured fibers are produced from vegetable or petrochemical origin materials and are classified into:

**Artificial** produced from the cellulose found in wood pulp or cotton linters, examples are viscose rayon and acetate; and **synthetic** produced from petrochemicals, examples are polyester, polyamide (nylon), acrylic, spandex (lycra) and polypropylene [2] (our italics).



Source: [http://www.abit.org.br/conteudo/informativos/relatorio\\_atividades/2014/abit\\_digital-final.pdf](http://www.abit.org.br/conteudo/informativos/relatorio_atividades/2014/abit_digital-final.pdf) (2015)

Figure 1 – Textile Productive chain

According to [15], among the fibers used in the Brazilian textile production, 71% are natural fibers while synthetic fibers represent about 24% and artificial only 5%. From this disparity, the preference for natural fibers is observed. Still according to [15], 85% of all products manufactured by the textile industry in Brazil are derived from cotton. So, "in order to comply with most environmental requirements great care is necessary with the origin of this raw material which is the main part of the production process" [50] therefore, processes such as planting, fertilizing, growing, harvesting and manufacturing are critical to fiber quality and should be taken into consideration during the entire production process.

According to [13], the common cotton crops are the ones that use the most pesticides in the world, causing poisoning and death of farmers, birds, fish, insects and many other animals, and they also pollute the air, soil, groundwater and other water sources. So, focusing essentially on sustainability, organic cotton has been developed in this sector, which is grown without the use of chemical fertilizers, pesticides or any other substance toxic to living beings or the environment.

### *Spinning*

The spinning step is a process where a mass of textile fibers (raw material) is transformed into yarn, varying according to the type and quality required.

Both natural and chemical fibers, whether artificial or synthetic, pass through the spinning machines, which can be classified into three types [27]:

Ring spinning machine: are based on the traditional principle of stretching the cotton wick combined with a twist in the yarn. Especially effective for producing yarns of all thicknesses.

Rotor spinning machine: also known as open-end spinning, this machine eliminates the traditional spinning steps and for this reason it reaches a greater production speed being faster than the ring spinning machine.

The jet-spinner machine: recognized for its high productivity, this spinning machine is particularly used for the production of thinner yarns. Although highly innovative, it is still not widespread in Brazil.

"Yarns that can be produced from natural fibers (cotton, silk, wool, among others), synthetic (chemical or cellulose), or from the mixture of these, are generally of two types: carded and combed" [27] varying according to the spinning method used.

It is understood, however, that regardless of the method used there is a legitimate preference for natural fibers, particularly if organically grown where not only the production is encouraged, but also environment protection.

### *Weaving*

Weaving is based on interlacing yarns to form the weft, or the fabric. This process uses threads of natural fibers, as well as the chemical ones. However, it should be noted that depending on the required fabric the amount of yarn and methodology used are different. So, [27] reported that "the

knitted fabric manufacturing process is relatively simpler than that of flat fabrics, not requiring the previous procedures of yarn preparation", consisting of warping, in which yarn is rolled up in one axis, and then bonding, which provides more resistance to yarn so that they bear the pressure caused by the weaving machine.

However, to be considered a sustainable process and actually fit into this production chain, weaving should be free from any chemical agent and should replace the paraffin grease used in weaving machines by the beeswax [13], so that the developed process will not degrade the environment in which it is inserted.

### *Processing*

The process method aims to improve the characteristics of textile products - fabrics, fibers and yarns, varying according to their purpose.

Thus, below are the main operations and processes that make up the textile processing stage [20]:

The first step, called primary processing, tends to prepare the product for subsequent steps such as coloring, for example. In this moment, all the waste (oils, waxes, pigments, dirt, etc.) from the spinning and weaving steps are eliminated.

In the secondary processing step the dyeing and printing processes occur, whose aim is to give color or design to fabrics.

Finally, the tertiary processing consists in operations aimed at improving the product characteristics, such as dimensional stability, gloss and sealing, so that their appearance becomes more attractive.

Composed of a series of chemical processes, if poorly managed textile processing compromises all the sustainability of the production chain because for each textile ton of product around 270 tons of water is used, and it eliminates 90% of their waste after completing the steps of dyeing and printing [51] Thus, in order to ensure the sustainability of the process, the option is to use natural dyes, considering their biodegradability and low toxicity [16].

### *Clothing manufacture*

The manufacturing process is based on cutting, sewing and various textiles finishing operations.

According to the [20], this production chain step comprises the following stages: receipt of raw material, separation and distribution, cutting, sewing, final finishing and conference and shipping.

In addition to clothing, the same process can be used in toll manufacturing companies, namely "clothing businesses that do not have their own brand or stylists, designers, stores, etc" [20], in most cases characterized by large and medium-sized clothing service providers.

Focusing on the sustainable aspect, particularly regarding the manufacturing process, there are many management practices where not only the financial aspect is highlighted, but also the social and environmental as it is the case of the

studied organization which, by reusing waste and/or textiles patches of great clothing companies, develops its own collection under the brand Bianca Baggio.

The whole textile production chain tends to generate immeasurable impacts on the environment, either through effluents, solid waste or by atmospheric emissions. However, the sustainable supply chain has to optimize operations in this process so that both living beings and the environment are safe from industrial practices.

### III. METHODOLOGICAL PROCEDURES

This research has a qualitative approach, is exploratory, descriptive and developed via a single case study.

The chosen unit of analysis was the Bianca Baggio studio, since the company's characteristic is self-declared sustainable using basically reused raw materials as well as developing a social project linked to their activities.

As for the data collection procedures, the survey used both secondary data collected in the company's website, reports on the studied company and internal documents, and primary data using semi-structured interviews with the company's leaders.

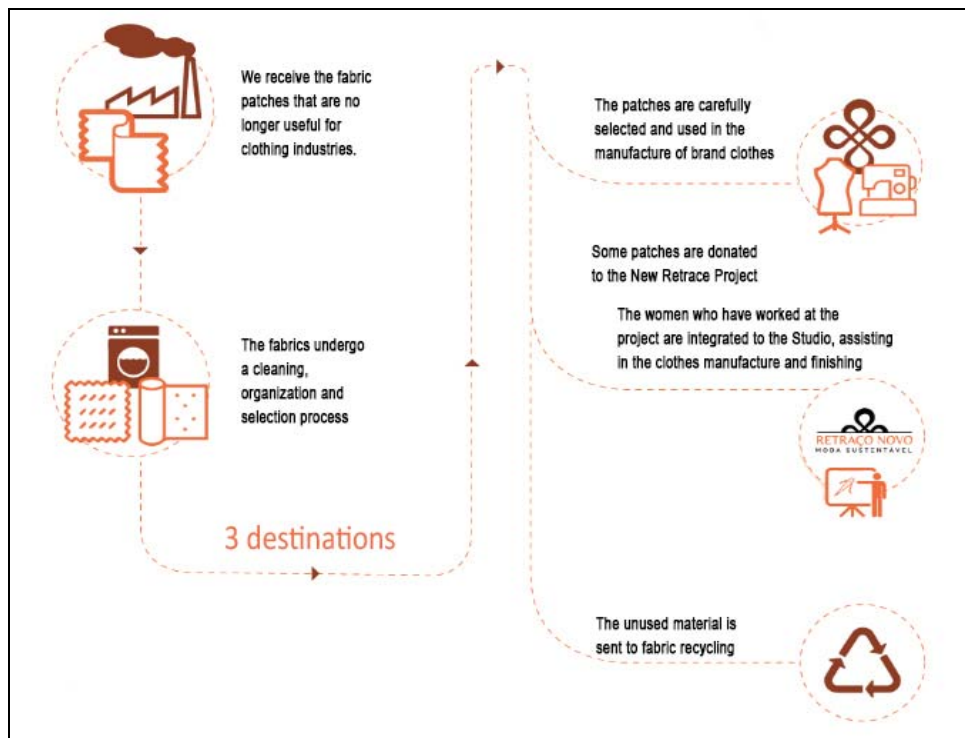
Data analysis is qualitative. After transcribing the interviews and organizing the secondary data, the data triangulation process was made. Data was categorized and separated according to the macro categories identified in the literature review. The assumptions recommended by [61] were followed in this study indicating the data analysis protocol on case studies.

### IV. ANALYSIS AND PRESENTATION OF DATA

The Bianca Baggio studio (BBS) was founded in 2009 by its owner who named it after herself and is located in the north of Paraná / Brazil. The owner has a degree in Fashion Design and a post-graduate degree in Design Management, both from the State University of Londrina / Brazil. She is also the creator of the New Retrace Project.

BBS started its activities with a process called upcycling. For [39], the main objective of upcycling is the transformation of waste into more important products so that the reuse of existing materials will reduce the waste of more resources. The core business of this company is based on a semi-industrial production, based on craft and industrial techniques whose aim is mainly at making clothing based on a sustainable know-how. Therefore, the production of Bianca Baggio studio uses industrial textile waste from other garments industries that, in this situation, represents raw material. Because it is waste, without productive use for the industries, there is no effective cost to obtain this material, which means they are donated. Upon receipt the patches are cleaned, organized and separated according to the project to which they will be sent.

The following figure illustrates the processes of receiving and separating the patches, with the New Retrace Project also highlighted besides the brand, and recycling of fabrics, which will be discussed later.



Source: <http://biancabaggio.com.br/como-atuamos> (2015)

Figure 2 – Receipt and separation of patches

BBS works with exclusive female items related to the slowfashion movement that, according to [21], values sustainability and not only cares about increasing sales and the economic growth, but also about social and ecological effects relevant to their productive chain. More than stimulating consumption, the slowfashion movement denotes its preference for natural and durable fabrics, besides timeless pieces that tend to meet consumers needs for a longer period.

The largest patches are therefore intended for manufacturing where production happens according to the seasons - spring, summer, autumn, winter. The clothes are sold in retailing stores and in sustainable fashion events where the concepts of upcycling and slowfashion are already fully disseminated.

Smaller patches that are not used in the manufacture are sent to a social project linked to BBS. The New Retrace project started in 2012 parallel to the activities of the studio and is characterized by developing cutting and sewing workshops for socially vulnerable women.

Besides the theoretical and practical training offered, the project encourages the sales of products for future alternative income. Although it is handmade, the production process aims to "transform the industrial textile waste into real design products with high added value" [7].

The remaining patches are separated according to the composition of the fabric - natural or synthetic - and sent for recycling. According to Federal Law 12.305 recycling means "the process of transformation of solid waste that involves changing its physical, physical-chemical or biological characteristics in order to be transformed into raw materials or new products" [8].

Natural fiber fabrics are passed on to other industries, have the fibers removed and are recycled as raw material at other industries. The process described above compromises the quality of the processed material and there is no possibility in this case to reverse the situation. The name of this process is downcycling. For [38], the downcycling process consists in converting waste into new products, with lower value and functionality. It was also observed that the majority of the recycled materials easily fall into this category because of the reduction in its quality over time.

Fabrics composed of synthetic fibers, on the other hand, are difficult to recycle mainly due to the quantity of additives, including oil. Although more difficult, this process is also possible and covers the following steps [62]: a) the shredder (responsible for tearing the fabric into several pieces, removing its fibers); b) polyester addition to the tissue (where it is inserted in a new machine that mixes both agents forming mixed fibers); c) roving machine (responsible for coiling the cotton fiber) and; d) spinning machine (responsible for manufacturing the yarn and / or string).

Due to its complexity, the textile recycling process is still not widespread among industries in the sector. Thus, the option is to outsource the service so that the waste is sent to other clothing industries. However, still according to [59], "the recycling process in the clothing industry reduces risks and damage to the environment contributing to reducing costs

while providing benefits to the company and the community in general."

Hence, it is noted that all textile waste received at the studio is properly reused, not only in manufacturing, but in social projects and recycling processes which, in turn, contribute to the development of society and preservation of natural resources.

The concept of sustainable design explored by [44] denotes that it is an excessively extense and complex process where the product or service offered is economically viable, ecologically correct and socially equitable in order to meet the basic needs of all society without major damage to the environment. In this context, by using the textile waste from other industries to create their own collection, it is understood that the Bianca Baggio studio clearly illustrates the concept presented here, confirming the definition formulated by the ICSID - International Council of Societies of Industrial Design, in which design is understood as "a strategic problem-solving process that promotes innovation, builds business success and leads to a better quality of life through innovative products, systems, services and experiences" [31], not only during their production and consumption, but also in the disposal, recycling or reuse.

#### A. Discussion about the data

The owner of BBS has a particular view on sustainability and tries to apply it to all processes related to her production.

Relying on the concept developed by the [43] innovation provides the improvement of efficiency not only through technology but also new methodologies and knowledge acquired. In this context, here is the position of the owner of BBS:

*My biggest innovation is working with waste, because when you work with waste, there are several levels of usage. In upcycling, which is my case, we take the largest retraces or medium-sized pieces and work without physical or chemical transformation. It is the simplest way, the most rustic.*

For [39], upcycling aims to transform waste into more meaningful products, which clearly depicts the process developed in the Bianca Baggio studio.

Regarding sustainable fashion, it is important to consider, besides upcycling, the following examples: vintage clothing stores, sustainable clothes market, model of remediation and textile waste prevention [19, 29, 30, 52, 57]. From the mentioned alternatives, a series of actions are observed aimed at reducing the impact of the textile production chain in the Brazilian and international environments. Thus, the textile recycling example of England is highlighted, in which according to [36] is composed of textile collection banks – organized by local authorities and charity institutions – where after a selection, around 8% of the collected items are resold by charity stores so that the remaining items – equivalent to 92% of the pieces – are destined to countries like Rwanda, Kenya and Somalia as donations.

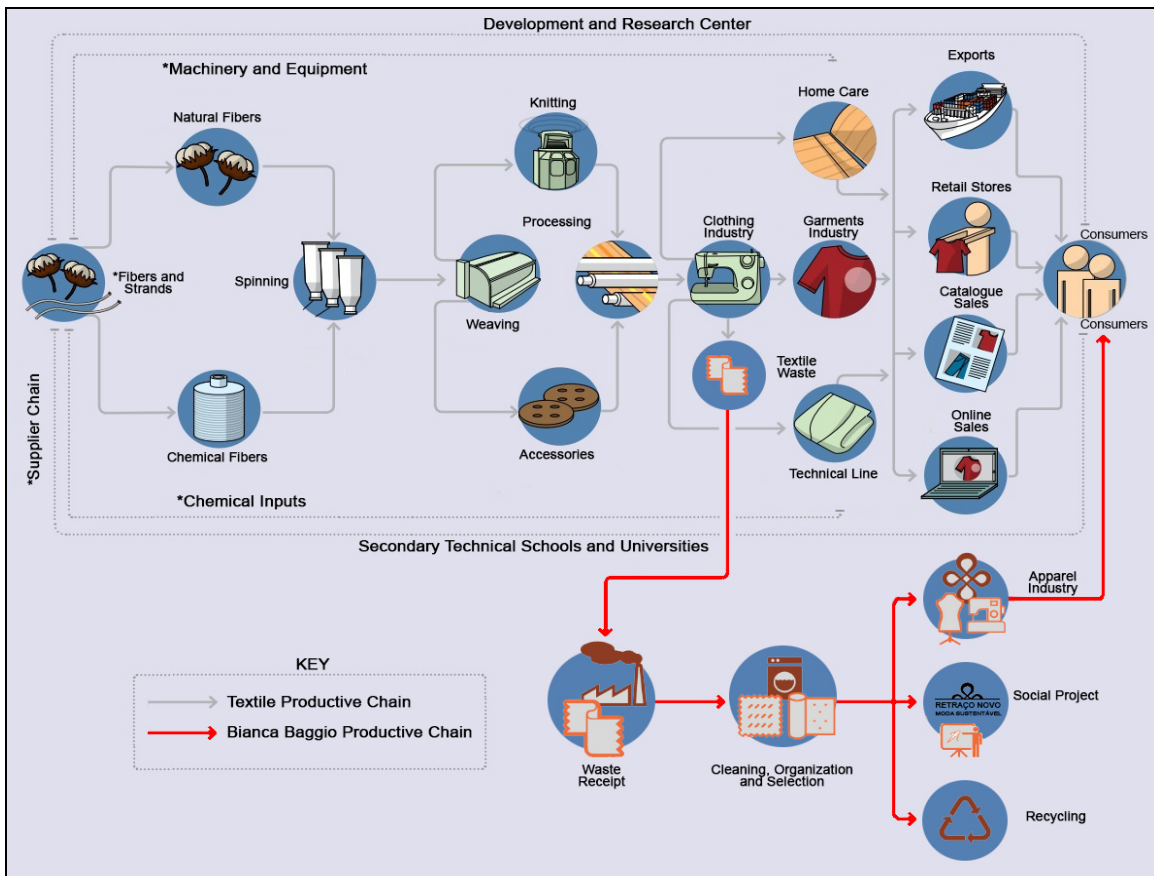
The innovation of processes depicted by the [43] consists in introducing a new method or significant improvement in production. Bianca states that large companies are already able to manage their waste, mainly by optimizing their operations, however, the existence of toll manufacturing companies must also be considered, which has already been addressed by the Industries Federation of the State of Minas Gerais, and refers to garment industries that do not have their own brand and that provides services mostly to large and medium-sized clothing industries. According to the owner, in these toll manufacturing companies there is no awareness about textile residue disposal, and there is no separation or recycling.

According to the Union of Spinning and Weaving Industries of Sao Paulo State - Sinditêxtil-SP [46], of 175,000 tons of textile trimmings produced by Brazilian clothing industries, over 90% are discarded in inappropriate places or landfills. According to [46], in the USA the situation is not different. Considered the largest world economy, with a growth of 2.4% in 2015, little has been done to reduce environmental impact of inappropriate disposal of waste. It is estimated that 85% of the textile waste generated is destined to sanitary landfills without any type of treatment [47]. The interviewee believes that the knowledge about the waste in the industrial sector is still limited.

*We have to take a step back and start a culture of sustainability within companies, because it does not exist yet.*

The reference [23], state that sustainability policies require an integration of economic, social and environmental issues. For [17], industrial business models do not have further responsibilities, but simply meet the demands of legislation and regulatory agencies. So, it is necessary to broaden the discussions regarding sustainability in the textile sector. For the interviewee, the business must be understood as an experience process surrounded by challenges, that is, beyond a feasible economic equation, it should provide quantity and means of production. In addition, smaller patches which are not used in the manufacture are used in the New Retrace Project, which develops cutting and sewing workshops in order to provide female empowerment. She also reports that this is a good means of social inclusion, as many women in vulnerable situations make a living from handicraft made in the project.

Therefore, the production chain, conceptualized by the [9], consists of a set of activities that are organized from primary raw materials to the final product. The Bianca Baggio studio, however, has broken this chain working with the waste from middle and large clothing industries, as can be seen in the figure below:



Source: Adapted from ABIT (2015); BIANCA BAGGIO (2015).  
Figure 3 – Productive Chain: Biana Baggio Studio



The owner says that she works in a semi-industrial way and considers the craftsmanship as the competitive edge of her products. For her, the waste received is enough for production scale which also requires the machinery and skilled workforce.

Highlighting her sustainable position and social scope, Bianca ensures that 100% of textile waste received in her studio is properly reused. Thus, waste that cannot be used for sewing and for the project is sent to companies that do the shredding of the fabric, transformimng it into cotton balls which are then spun and become more rustic yarns, which are used by upholstery and automobiles industries, for example. Thus, the importance of innovation through the production process is observed. By using waste that had no commercial value, BBS was able to establish its own brand, aimed at the real balance between environmental and social practices, while prioritizing, however, the financial sustainability of the business. Reference [26], argue that sustainability, linked to the innovative process is a determining factor in the adjustment of businesses regarding the environment, so that the established practices contribute to the well-being of living beings and of the entire planet.

### V. FINAL CONSIDERATIONS

This study aimed to analyze the contribution of a sewing studio for the sustainability of the productive chain in the Brazilian textile sector. The specific objectives were then defined: to describe the productive chain of the Brazilian clothing industry; identify and describe the characteristics of the studied company regarding innovations for sustainability; verify the company's contribution to the sustainable production chain in the apparel sector.

As for the purpose of describing the productive chain of the Brazilian clothing industry, it was observed that among the conventional processes the environmental impacts are extremely negative. However, by opting for a sustainable production chain, the manufacturing practices are optimized so that both living beings and the environment are safe from the industrial processes.

Regarding identifying and describing the characteristics of the studied company about innovations for sustainability, it turns out that through its management all textile waste received is properly reused, whether in production, social projects or simply in the recycling process. Innovation in this case is the introduction of a new methodology that reduces damage to the environment through its processes and significantly improves the development of production.

As for the company's contribution to the sustainable production chain in the garments sector, from its upcycling process using waste from medium and large clothing industries, BBS works for sustainable development reducing the waste of resources generated along the textile production chain. Organizations such as BBS that propose new alternatives and production possibilities can contribute

significantly to improve concepts such as awareness in production and sustainability.

From the above, the importance of sustainable practices for the development of the textile production chain is observed. Through Bianca Baggio studio, the case study of this research, we tried to illustrate in a clear and concise manner the contribution of a company, however small, for the sustainability of its supply chain. To that end, the discussion on sustainable production chain and its consequences is highlighted when observed that it has been happening in the context of developing countries, such as Brazil. In countries with low levels of social and economic development, the work developed through reusing waste tends to contribute not only to environmental issues, but also to generating income and business opportunities.

Under these circumstances, the social project developed by BBS can be implemented in other communities, providing training of workforce, as well as promoting emancipation of the participants and thus the overcome of social dependence. The reported experience can also contribute to the development of government, business and society actions in similar contexts.

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## 2016 Proceedings of PICMET '16: Technology Management for Social Innovation

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