Life cycle design and design management strategies in fashion apparel manufacturing

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Abstract. The generation of solid textile waste in the process of development and clothing production is an error that causes serious damages to the environment and must be minimized. The greatest volume of textile residues is generated by the department of cut, such as textiles parings and snips that are not used in the productive process. (MILAN et al, 2007). One way to conceive new products environmentally conscious is turned to the adoption of a methodology based on Life Cycle Design (LCD) and Design Management.

1. Introduction

Textile and Apparel Productive Chain (TAPC) has a great relevance at global market in productive capacity, jobs and commercialization. Due to your expansion, there was an increase of inputs, energy, water and materials, resulting in an addition of residues in all extension of its productive chain. The TAPC adds to Brazilian economy about R$ 114 billion in production every year and generates 1.6 billion of direct and indirect jobs [1]. In 2014, Brazil presented about 30 thousand formally registered companies and 1.2 million ton in registered fabric consumption. On average, the volume of textile waste discarded by the productive process of clothing is about 10% of the raw material consumed, resulting, in that year, in a discard of 120 thousand tons of textile waste that are not properly used inside the sector [2].

The purpose of this research is to present creative solutions applying the concepts of Design Management and Life Cycle Design aiming to minimize and reduce the accumulated production errors in some phases of the productive process of Fashion Clothing Manufacture (FCM), describing the obtained results in cases of Brazilian enterprises of this sector. It is an exploratory study with literature review, observing the social-environmental impacts that permeate in the Textile and Confection sector and the application of concepts of Design Management (DM) and Life Cycle Design (LCD), an important tool for professional from the fashion area. The methodology adopted was based on the strategy of case studies with descriptive approach and research-action, using as fonts: documents, registers, interviews and direct observation. It is still intended with this research, to provide theoretical and practical subsidies that could guide researchers, professionals and students of related areas, presenting new experiences, looks and possibilities for the development, elaboration and production of...
new products with application of Sustainable Design, considering the pollution reduction and the
discard of residues involved in the productive processes.

2. Theoretical Basis
2.1. Textile and Confection Productive Chan and the Environmental
The production of the sector is composed by a great diversity of types of products intended to various
uses, different segments and customers, such as: clothing; socks and accessories; home products and
technical items. Consequently, there is an extensive range of raw materials that initially is
differentiated according to the source of the fibers (naturals, chemicals or synthetics), and which, in
turn, guide the industrial processes that results in large variations.

The TCPC uses many raw materials and inputs that are associated with some kind of social or
environmental impact, or yet, with the lack of concerning with the concepts of sustainability. The
effects of the use of fibers vary according to the different types and their industrial processes. These
materials affect the ecological and the social system and cause effects and aggressions to the
environmental like: effluent generation, color and residual sludge, gas emission, steam and smell of
specific processes for finishing yarn and fabric production, noise and vibrations, beyond the elevated
consumption of water and energy in all the extension of the productive chain. The TCPC is responsible
for significant environmental impacts in Brazil and worldwide, due to its productive processes and the
elevated index of consumption of its products that are discarded long before the end of its life cycle. It
is important and necessary to reformulate its productive processes, steps and sequences, aiming to
boost a cleaner production, in order to improve the efficiency of production looking for the reduction
of its environmental impacts.

Some researchers and authors point to the revision of the essentials steps of production and to a
change of perception as: conception and development steps and planning of productive processes
[3,4,5]. Initiatives based on systemic thinking aim to reach, in the long term, better results and success
for the environmental questions. The search for the selection of right materials and applying them in
the right products and service system has been the better strategy. However, in relation to treatment
and Waste Management, the factor that most of the programs ignore is the identification of residue
causes [6].

At confection industries, the generation of solid textile waste occurs daily mainly from the
department of the cuts of the molds on tissues. The solid textile waste generated are shavings and snips
that are not used in the process. The generation of this kind of residue is inevitable and results in
different variations of volume, types of tissues and, consequently, compositions of the textile fiber.
These residues are not considered dangerous, however represents a great problem to companies in the
moment of your discard [7,8,9].

In Brazil, the regulation of the Law no 12.305 of 2010 established the Nacional Solid Residue
Policy. The law regulated a series of principles, objectives and instruments for the integrated
management and suitable environmental management of the solid textile waste.

2.2. Design Management and the Life Cycle Design Strategy
The Design Management (DM) is responsible for the conception of products that incorporate some
primordial aspects to an organization: company objectives, customer satisfaction, market
competitivitv, delivery on predicted time and the use and application of available resources. To Roda
[10] the DM consolidates itself, more and more, like an interesting study area of many initiatives from
companies, governs and institutions of consulting.

The consequences of this management will have an impact on the internal business environment
and its relations with the external environment. The characteristic of GD is to be present in the three
organizational levels: (i) strategical, acting directly on the image and positioning of the enterprise; (ii)
tactical, an intermediary level, having also actuations on planning; (iii) operational, of more concrete
actions and even more common in most companies. (CABRAL et. al., 2008). Through actions of
integrations of different sectors, the MD establishes competitive strategies so the company can hold itself on the market [11].

In the process of development and production of clothing, the generation of residues can be considered as a mistake that causes serious damages to the environmental and that must be minimized. One way to conceive new products environmentally conscious is turned to the adoption of a methodology based on Life Cycle Design (LCD). The LCD’s approach considers a systematic vision of all the system-product (since pre-production, production, distribution, use and discard) and aims to minimize the possible negative effects and the reduction of the environmental charge associated to the whole life cycle of a product. In this sense, some LCD’s strategies are proposed as requirements that should be observed primarily by the professional involved in the process of product development, such as: minimization of resources and selection of materials and process less impacting; extension of the product’s life cycle; optimization of the life cycle; and, as an applicable strategy, in all cases, the facility of assembly and disassembly [12]. Nevertheless, in practice, enable the management of a whole system of a product’s life cycle becomes extremely difficult, mainly due to the fragmentation and complexity of different productive process and the participation of actors and companies involved. However, some authors consider the possibility to introduce and develop the Sustainable Design in a partial form, in one of the phases of the system and/or processes, focal point of this research.

It is in this context that are considered the approaches of Design turned to environmental sustainability and the relation of the designer professional activity looking for the environmental preservation. The Design enters in the product project encompassing various aspects as ergonomics, technology, environmental economy, social, aesthetic and anthropologic, acting in an ample way in activities such as fashion, graphic industries and services. The current challenge is to produce products respecting the environmental. The MD establishes competitive strategies for the integration of various sectors and the [13].

The adoption of a clear strategy, a proper and compatible with the company pretension management enables new opportunities of business, economic security, processual and sustainability to the future. In this process, it’s up to the designer an important role to the improvement of the product along its life cycle and with the environment, when it will pass to rethink methods to do Design, the productive processes, the materials available, the excessive consumption, among others processes and important decisions for the full development of a product.

3. **Case Study**

The aim of this research is to apply the strategies of Life Cycle Design and Design Management, observing the management of solid textile waste generated by the cut department of the Case Study companies.

For this paper, products of the Winter Collection/2017 were selected from two Brazilian fashion brands of the women fashion market.

3.1. **Case Study 1**

This study refers to the collection named "Sport" and for better identification of the products they will be named as: Sport Dress 1; Sport Pants 2; Tunic Sport 3; Top Sport 4 in Figure 1.
In Case Study 1 we emphasize the strategies of resources minimization and also the facility of assembly and disassembly. The Sport mini collection has 4 garments composed by 1 pant, 1 dress, 1 tunic and 1 top. The highlight of this mini collection is the combination of the details in colors different that those in the base of the garments, for instance: the black dress receives a frontal strip (of same tissue), but in beige color; the black pant has a snip of beige color (of same tissue) at the frontal of the garment; the white rob receives a black strip and a pocket in beige color (both from the same tissue); the white top receives a pocket in beige color (of same tissue). In the moment of collection development, the designer planned the fit and cut of the strips for the dresses and pants (that has the same width) and the pockets to the tunics and tops (that has the same dimension). Figures 2 and 3 show the molds of the strip and the pocket which were engaged in the molding study of the dress and the pant. In this case study, wastage of textile residue was avoided during the collection development process.

Figure 1. Collection “Sport”

Figure 2. Molds of the strip which were engaged in the molding study of the dress
3.2. **Case Study 2**

In this case, we gathered 3 articles from the same mini collection that use a neoprene tissue with dubbing in the reverse side in a different color, and that were named: Neo Coat 1; Neo Top 2 and Neo Rob 3 (figure 3a). For these garments, the designer used the characteristic of the tissue that enable the double-side use. The Neo coat 1 has a finishing of embedded seam and the snip at waist height provides a differentiation between the silver grey at superior part and the opaque gray at the inferior. It is noted that in the inside of the garment the colors are inverted. The Neo Top 2 and the Neo Rob 3 were made with a neoprene tissue in a dark grey tone with dubbling in the reverse side in white. In these garments, the double-sided was also planned by the designer. We highlight the Neo Tunic 3 that has a pocket in a tissue of silver knitted, this pocket is a reuse of the fitting study of the Shorts fabric from the Academy 1 collection, figure 4.

![Figure 3. Molds of the strip and pockets which were engaged in the molding study of the pant.](image)

![Figure 4. Collection “Neo”: Neo Coat 1; Neo Top 2; Neo Tunic and shorts Academy Collection](image)
4. Final Considerations
It is perceived that the fashion industry has been more and more sensible to environmental concerns in the last years, adopting attitudes and searching creative solutions looking for an “ecological fashion”. However, there still a vast research field and opportunities to the development of innovative solutions and the constructions of corporative and environmental strategies oriented to an increasingly conscious market.

We emphasize that the adopted solutions were based on the approach of Lyfe Cicle Design aiming a better use of the solid textile waste. It is noticed the importance of awareness of the designer as direct responsible to the opening of the necessary changes in the product development and in the productive processes of the studied companies, once that this study relates design and sustainability in your aspects relatives to the LCD. In this case, the development of new products has as objective to consider all the project phases and the possible environmental implications linked to the phases of the own product’s life cycle. That is, it must be considered the steps of pre-production, production, distribution, use and discard aiming to, like this, minimize all the possible negative effects.

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