Implementation of an environmental management system: case study

Implementação de um sistema de gestão ambiental: estudo de caso

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Abstract

In the current scenario, Brazil is ranked as the 5th largest textile producer in the world, behind only China, India, the United States and Pakistan. This factor is of great importance in relation to the effective number of jobs provided by the sector around its manufacturing hubs. On the other hand, the high production rate that companies are exhibiting ends up using a large amount of the country’s natural resources. In the case of clothing industries, their waste can cause significant environmental impacts, however, through the use of Environmental Management is possible to reduce environmental degradation and pollution. In this way, the present study made use of the application of the Environmental Management System (EMS) linked to the Cleaner Production methodology to resolve environmental problems in a clothing factory located in the northwest of the state of Paraná. After the implementation of the EMS, important environmental and social gains were noted, such as the disposal of wastepaper, cardboard, plastic, and paint cans used in screen printing for an Association of collectors in the city and the use of fabric scraps in making products for pet shops, waste destined for a

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group of women artisans also in the city. The study also promoted the reduction of waste from larger clothing scraps, by using them to make by-products that could be sold at popular prices. Thus, the effectiveness of implementing the EMS for the company can be seen, making it comply with its environmental policy and adding social gains to it.

**Keywords:** EMS. Environmental Gains. Cleaner Production. Textile Recycling.

**Resumo**

No cenário atual, o Brasil está classificado como o 5º maior produtor de têxteis do mundo, atrás apenas de China, Índia, Estados Unidos e Paquistão. Este fator é de grande importância em relação ao número efetivo de postos de trabalho proporcionados pelo setor em torno dos seus centros de produção. Por outro lado, a alta taxa de produção que as empresas exibem acaba utilizando boa parte dos recursos naturais do país. No caso das indústrias de vestuário, seus resíduos podem causar impactos ambientais significativos, no entanto, através do uso da Gestão Ambiental é possível reduzir a degradação ambiental e a poluição. Dessa forma, o presente estudo utilizou a aplicação do Sistema de Gestão Ambiental (EMS) vinculado à metodologia de Produção Limpa para resolver problemas ambientais em uma fábrica de confecções localizada no noroeste do Paraná. Após a implementação do EMS, foram observados importantes ganhos ambientais e sociais, como o descarte de papel residual, papelão, plástico e latas de tinta usadas na serigrafia para uma Associação de colecionadores na cidade e o uso de restos de tecido na fabricação de produtos para lojas de animais de estimação, resíduos destinados a um grupo de mulheres artesãs também na cidade. O estudo também promoveu a redução de resíduos de sucatas de vestuário maiores, utilizando-os para fazer subprodutos que poderiam ser vendidos a preços populares. Assim, pode-se ver a eficácia da implementação do EMS para a empresa, fazendo-a cumprir sua política ambiental e agregando ganhos sociais a ela.

**Keywords:** EMS. Ganhos Ambientais. Produção Limpa. Reciclagem Têxtil.

**Introduction**

The textile sector in Brazil began in the 19th century, achieving high growth, due to the increase in the domestic market resulting from the First World War. Textile manufacturing was of great importance for the development of national industrial policy, currently made up of companies of different sizes. According to the Brazilian Association of Textile and Apparel
Industry – ABIT, Brazil is ranked as the 5th largest clothing producer in the world, with an average production of 9 billion pieces per year. The concentration of clothing companies in Brazil exceeds 30 thousand, spread throughout the national territory (ARAÚJO; FONTANA, 2017).

The largest cluster of these companies is established in the southern regions, in the state of Santa Catarina; southeast, in the states of São Paulo and Minas Gerais; and Northeast, in the states of Pernambuco, Bahia and Ceará. With the union of all regions, approximately 10 million direct and indirect jobs (ARAÚJO; FONTANA, 2017). The textile industry is considered one of the most polluting in the world. This note reflects the life cycle of the materials used to manufacture clothing, which is considered the fourth product with the greatest impact on the environment. In a global view, 3% of all greenhouse gas emissions arise from the manufacture of textile materials. Clothing production is directly involved with an important cost in terms of consumption of energy, water, chemical products, and nutrients, also resulting in impacts on land areas that are related to cotton cultivation (NORUP et al., 2018).

Given the environmental scenario presented in the world today, clothing industries are looking for increasingly innovative alternatives to reduce their damage to the environment. This is due to the impact that the textile sector has on the ecosystem, from the extraction of raw materials, its manufacturing and maintenance processes, to creating the finished product. The large use of natural resources, along with the enormous waste and the high number of solid wastes that are generated within manufacturing processes, are some of the main challenges faced in the environmental development of the sector. The textile market is very saturated, in which a portion of the waste generated is destined for donations and companies that sell a line of non-compliant products. Due to the low price and great competition in the sector, companies turn their focus to increasing productivity. Because of this factor, many products cannot be reused and end up being discarded incorrectly (ARMSTRONG et al., 2015).

The manufacturing process is approached as the movement of materials in time and space, until the input is transformed into a completely finished product. The analysis of a production process verifies the flow of the material or product, its sequence of operations, the work performed in relation to the products and the waste that is consequently being caused by all the processes involved. Among the main stages of the manufacturing process, the essential raw materials for production and the main waste generated are considered. The description of
the processes begins to be defined from the planning of the order, a step that generates the paper of the order and customer routes as waste (SENAI, 2007).

Within the cutting stage, the risky processes of cutting modeling and wrapping the fabric and cutting are related, respectively generating leftover Kraft paper, paper or plastic tubes and fabric scraps as waste. Following the process, the cut pieces enter the screen printing or sublimation sector, in which the process of engraving the art on the garments is carried out. Within this manufacturing sector, paper, discarded from sublimation, and leftover paint that comes out when washing the paintings are generated as waste. Finally, the product reaches the sewing process, where the piece will be closed, finishing it, and creating the final product. In the sewing stage, waste is generated such as defective pieces, fabric burrs, thread scraps and oil. After the sewing section, the piece is ready to be packaged and delivered to the customer (SENAI, 2007).

On the other hand, industrial development incorporated waste generation patterns, as the large volume discharged into nature is smaller than the absorption capacity. Since it becomes impossible to absorb and recycle this immense amount of destined waste from the environment (ARAUJO; FONTANA, 2017). Amaral et al. (2018), in their research entitled “Industrial recycling and textile reuse in Brazil: Case study and considerations regarding the circular economy”, highlights that an alternative that could prove to be extremely viable for both the industrial sectors and the environment is the recycling of textile waste, which occurs through the crushing of fabrics, forming fiber again, which can be reused to manufacture new fabric yarns.

Conceptual Underpinnings

2.1 History of Sustainable Development

The term Integrated Management System – IMS, appeared in 2000, acting for the responsibility of the organizations' production chain. In this way, life cycle assessment began to be a new partner for both industry and society due to the current environmental situation. This caused the emergence of a socially organizational structure (GUSMÃO; MARTINI, 2009). The Bali conference, which took place in Indonesia in 2007, established even more ambitious goals than the Kyoto protocol regarding the effects caused by greenhouse gases. The conference resulted in a road map, which defined the date of December 2009 to define the reduction percentages and the implementation of the effective agreement (BRASIL, 2012).
In 2011, an event was held in Durban, South Africa, which brought together representatives from 190 nations who aimed to decide on the renewal of the Kyoto Protocol. In the end, the foundations were laid for a future agreement that will control pollution in 2015, coming into force from 2020. Another issue defined was the Green Climate Fund, which from the same year onwards, will provide financial support for initiatives to combat global climate change. In 2012, more than 45 thousand constituents, including heads of government and civil society, met in the city of Rio de Janeiro. The 188 countries present at Rio +20 have committed to investing around US$513 billion in projects, programs, and actions over the next ten years in the areas of green economy, transport, environmental protection, climate change, among others (BRASIL, 2012).

In this context, a series of standards emerged that aim to determine guidelines to guarantee environmental management within companies. As previously stated, in the 90s, International Organization for Standardization – ISO saw the need to develop standards that dealt with environmental issues and aimed at standardizing the processes of companies that used resources extracted from nature or caused recurring environmental damage. of its activities (CARDOSO; BRISOT, 2013). In 1993, ISO created a committee entitled Technical Committee TC 207, which aimed to develop the 14,000 series standards. ISO 14,000 works as a set of guidelines that establish as a principle a community basis for environmental management (CARDOSO; BRISOT, 2013).

The application of ISO 14,000 is based on the definition of goals that must be achieved in all sectors of the company's production process, from administrative to production. Due to its scope and complexity, ISO is aimed at companies that already have a certain management system (SEIFFERT, 2011). The principle of ISO 14,000 provides complete guidelines for the implementation of an Environmental Management System (EMS) in relation to compliance with and monitoring of environmental laws and regulations. Thus, showing that the vast majority of institutions are focusing on the process of continuous improvement (CARDOSO; BRISOT, 2013).

2.2 Environmental Management System – EMS

Within these 14,000 series of standards, there is ISO 14,001, which deals with Environmental Management System and its specifications and guidelines for use. This standard requires the organization to establish a procedure to identify and access legislation and other requirements to which it subscribes, applicable to the environmental aspects of its
activities, products, and services (MACENO et al., 2013). The first stage of the Environmental Management System deals with defining the company's environmental policy. At this stage, there is a specific requirement to formalize a commitment to comply with legislation relating to the organization. However, certification criteria require the company to comply with legislation. This issue is addressed in step two of the EMS (CARDOSO; BRISOT, 2013).

A starting point for any company in Brazil is federal laws, starting with the constitution, CONAMA resolutions and ABNT standards, which serve as a basis for research and verification of the legislation applicable to the company's enterprise. Federal Law No. 6938 – National Environmental Policy Law, of August 31, 1981, together with Resolution No. 237 of the National Environmental Council – CONAMA, established Licensing as one of the Environmental Management instruments (BRASIL, 1981). However, in the case of the activities of manufacturing clothing parts and accessories, professional clothing, interior pieces, manufacturing of textile artifacts from clothing fabrics, are exempt from licensing. To do so, interested parties simply need to go to the environmental agency and request the License Exemption Certificate – CDL.

Only in the case of knitwear, that is, industries that manufacture knitted fabrics, which include materials other than the mesh itself, these require an Environmental License, as they are considered polluting sources. As for solid waste, NBR 10.004/2004 establishes that the dangerousness of a waste is divided according to its physical, chemical, or infectious properties, which may present risks to public health (causing mortality, incidence of diseases or increasing their rates) or risks to the environment (when waste is managed incorrectly) (ABNT, 2004).

NBR 10.004/2004 also classifies waste into Class I – Hazardous, Class II A – Non-inert and Class II B – inert. Class I – Hazardous waste are those that present a risk to public health, or that in some way may increase the mortality rate or the incidence of diseases. These wastes may present characteristics such as flammability, corrosivity, reactivity, toxicity, or pathogenicity. Class I – Hazardous solid waste from the clothing sector includes light bulbs, solvents used to clean machinery parts, used or contaminated lubricating oil from machines (sewing or cutting), cloths and tow contaminated with oil. used or contaminated lubricant (ABNT, 2004).

Class II A – Non-Inert waste is waste that does not fit into the Class I (hazardous) or Class II B (inert) waste classifications, under the terms of standard 10.004/2004. These residues have properties such as biodegradability, combustibility, or solubility in water. As Class II A – Non-Inert waste, coming from the clothing sector, we can highlight textile waste,
such as fabric scraps and trimmings, plastic waste from tissue rolls packaging, for example, paper and cardboard, waste sewing lines and threads and also food waste from the company's kitchen or cafeteria. And finally, Class II B – Inert waste, which is any waste that, when sampled in a representative way, in accordance with NBR 10.007/2004, and subjected to static dynamic contact with distilled water at temperature environment, according to NBR 10.006/2004, do not have any of their constituents solubilized at concentrations higher than water potability standards, with the exception of appearance, color, turbidity, hardness and flavor. Class II B – Inert waste, coming from the clothing sector, is glass waste and leftover buttons (ABNT, 2004).

State Law No. 19,261 of 7, 2017, has as its main attribution the same principles and guidelines as Federal Law No. 12,305/2010, in which its main objective is integrated waste management, using all control and inspection tools and institutions to carry out the development of waste management. Still within the second stage of the EMS, after checking the legislation, goals are defined based on the objectives to be achieved. Subsequently, the third stage deals with the execution of the planning from the previous stage. The execution phase involves the training of all personnel involved and concern with information, which will be crucial for the data collection phase. The fourth stage continues with the verification of what was implemented in the previous phase. In this stage, the numbers indicated for each indicator (goal) are evaluated, and thus, the necessary corrective actions are analyzed and defined (CARDOSO; BRISOT, 2013).

Finally, the last stage of an EMS deals with the internal audit that must be carried out by the company's senior management in order to verify the performance of the applied system. The main data to be evaluated in internal audits are associated with activities carried out in processes that have an influence on environmental aspects and that can generate significant environmental impacts on the environment (SEIFFER, 2011). The environmental management system – EMS can be integrated with cleaner production actions. To this end, the cleaner production methodology can be used immediately after the environmental diagnosis of the second phase of the EMS is carried out. The alignment of the EMS performance standard in conjunction with cleaner production is an essential requirement for the effective reduction of the environmental impacts of projects, not only with regard to the reduction of pollution (atmospheric emissions, water effluents, sewage, and solid waste), but particularly at the level of consumption of natural resources (MACENO et al., 2013).
Methodology

In the analysis to determine opportunities for optimizing the company's environmental activities, an Environmental Management System – EMS was used in all processes. In this way, significant themes about relations with the environment were exposed to those involved. Subsequently, a questionnaire consisting of the guidelines of an environmental management system was addressed to members of the company's senior management and those responsible for each sector. As a result, the EMS implementation methodology was developed based on the steps in Figure 1.

![Figure 1 - EMS methodology integrated with cleaner production](image)

Source: Own authorship

Regarding the first stage presented in Figure 1, it refers to environmental policy. At this stage, senior management defined its commitment to environmental issues. Moving on to step 2, planning was addressed. Within the planning, the application of cleaner production was defined, which will have as its principle to act on optimizing the waste of the company's economic and environmental resources. Following Figure 1, in step 3, cleaner production was implemented in each of the industry's manufacturing processes. And later in stage 4, verification of the effectiveness of this implementation was applied. Finally, in the last stage
Implementation of an environmental management system: case study

Results and Discussion

Company X covered in the study is a clothing industry. It has been located in the northwest region of the state of Paraná since 2010, with its main activity being the production of personalized clothing. The production process works through four sectors, which are defined as: Cutting, screen printing, sublimation and sewing. The industry's range of products includes simple t-shirts, polo t-shirts, sports sets, shorts, vests, pants, aprons, sweatshirts, sweatshirts, jackets, and coats. The production system characterized in company X is pull production, in which the customer places an order, and subsequently, the order proceeds to the manufacturing stages until it is completed within a specific manufacturing time.

The company in question did not have any defined Environmental Policy. Therefore, the first stage involved developing an Environmental Policy together with the company's Senior Management. The Environmental Policy defined was: “Company X is committed to the continuous improvement of its processes and products. As a vision, the company seeks to apply the principles of environmental management, through continuous environmental improvement. Based on sustainable development, its strategic sustainability plan is guided, outlining objectives, targets, and indicators to seek new results.” The second stage of applying an EMS deal with the identification of environmental aspects, legal requirements and definition of objectives and goals. For this study, it was decided to use the Cleaner Production Methodology at this stage. Thus, in the third stage, which consists of implementation and operations, the company's environmental aspects were identified, and the action plan was then determined, which consisted of applying cleaner production. The environmental aspects found in the company are found in Table 1.

<table>
<thead>
<tr>
<th>Environmental Aspect</th>
<th>Origin</th>
<th>Classification in NBR 10.004:2004</th>
<th>Environmental impact</th>
<th>Proposed Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic</td>
<td>- Line cones - Appliance packaging - Bags in general</td>
<td>Class II - A</td>
<td>- Occupation of space in landfills - Soil and water contamination</td>
<td>- External Recycling</td>
</tr>
<tr>
<td>Paper/cardboard</td>
<td>- Fabric Tubes - Unused cardboard boxes - Paper arising from the risk of molding</td>
<td>Class II - A</td>
<td>- Occupation of space in landfills - Soil and water contamination</td>
<td>- External Recycling</td>
</tr>
</tbody>
</table>
To implement cleaner production, the first action to be taken was to identify the waste generated in the process and then characterize it in accordance with the Brazilian Standard NBR 10.004/2004. According to the standard in question, the waste are classified into Class I – Hazardous and Class II A – Non-Inert and Class II B – Inert. In the category of Class I (Hazardous) waste, the company found: lubricating oil from sewing machines, and scraps of fabric contaminated with oil that were used to clean the machines during lubrication, paint cans and solvents from the printing sector and screen-printing screens for disposal. In the Class II A (Non-inert) waste category, textile waste was identified, that is, scraps of fabric from the company's cutting sector; plastic waste such as fabric packaging bags, fabric roll support cones and bags in general; wastepaper and cardboard from disused cardboard boxes and paper that has been discarded due to the risk of cutting damage and waste threads and threads from the sewing sector. As for the Class II B (Inert) waste category, no waste was identified in the company.

Following the methodology of cleaner production, after identifying the waste, two paths of action were defined for it: reducing this waste and recycling. And to assist in sorting this waste, the housekeeping methodology was applied. Housekeeping is a tool used by companies to ensure a more pleasant environment for employees and bring greater productivity returns to the company, including waste elimination, cleaning, and tidiness. Housekeeping is a version of the 5s program consolidated in Japan. In this scenario, the first stage of housekeeping deals with sorting for disposal. At this stage, the waste was separated into categories based on their nature and potential impact on the environment.
into waste for reuse (internal recycling) and waste for recycling. For recycling, it was determined with the company's senior management which waste would be recycled externally and which would be recycled internally, that is, would be returned to the process. Figure 2 illustrates the waste collected and defined in this stage.

![Figure 2 - Cleaner production: Waste disposal phase](source)

Thus, the fabric scraps found that were of an acceptable size for cutting pieces were returned to the cutting process, with the purpose of making small pieces for promotional sales. The remaining scraps, which were not ideally sized for use, were sent for external recycling. The scraps were donated to a group of women in the city who make crafts and accessories such as bows and bandanas for sale in pet shops (Figure 3).

![Figure 3 - Pet shop products made with fabric scraps](source)

Plastic waste such as line cones and bags and packaging, screens, and paint cans from screen printing (Figure 4) were sent to an association of collectors in Goioerê, ATA (Environmental Action and Treatment).
Paper/cardboard waste, which was tissue tubes, box cardboard and paper resulting from the sublimation process, began to be stored in big bags and collected daily by an individual collector in the city.

Finally, the effluent generated in the screen-printing process, which is destined for the city's sewage network, a meeting was held with senior management and the environmental impacts generated by this effluent were explained and the construction of a small treatment station was suggested in the company. These effluents generated present a high concentration of color present in their effluents, so an effluent treatment system by coagulation/flocculation was proposed. After implementing the proposed actions, the fourth stage of the EMS was carried out, which dealt with verification and corrective actions. At this stage, the effectiveness of the implemented EMS was verified by the company's senior management. It was found that in relation to the segregation and destination of solid waste sent for recycling, the program had a positive impact in relation to sustainability and thus began to meet the environmental policy proposed by the company.

It is also important to highlight the immense environmental gain since before the implementation of the SGA, waste was sent for selective collection of urban solid waste and
its final destination was landfill. Another aspect verified by senior management was the improvement in the company's organization after the application of housekeeping, as illustrated in Figure 6.

![Organization in the screen printing sector](image1)

![Organization in the cutting sector](image2)

**Figure 6 - Organization of the company after applying housekeeping**
Source: Own authorship

Finally, at this stage, the importance of environmental audits scheduled to be carried out throughout the year was highlighted, and quarterly meetings of the company's senior management were scheduled to carry out a critical analysis of the EMS, remembering that it deals with a cycle continuous process that must always be improved.

### Conclusion and Implications

In the present study, issues related to the sustainable development of a textile manufacturing industry were addressed, highlighting all the weak points in the company's production stages. Based on the analysis of waste and negative impacts that were being generated in the manufacture of the final product, the implementation of an Environmental Management System linked to a cleaner production methodology in the process was applied, with the purpose of meeting the environmental policy proposed by the company.

After surveying the environmental aspects, structural and organizational improvements to the housekeeping processes were carried out. The result obtained with this method was extremely effective, increasing employees' productive time due to the organization of materials used in operations and the indicators established in relation to waste identified within the process and the impacts that were being generated by them. Also based
on environmental aspects and with the help of the cleaner production methodology, waste was sent for both internal and external recycling within the company, resulting in significant environmental and social gains.

In short, with this study it was possible to conclude the effectiveness of the application of the Environmental Management System, even in micro-enterprises, meaning that they can also comply with their environmental policies and be in accordance with public policies such as the National Solid Waste Policy in an effective.

References


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