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RESEARCH ARTICLE OPEN ACCESS

REVERSE POST-CONSUMPTION CYCLE FOR A PAPER ITEMS MANUFACTURING INDUSTRY

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ABSTRACT

The growth in competitiveness, the relentless search for cost minimization, the reduction of environmental impact, sustainability and compliance with laws, have leveraged studies on the potential of Reverse Logistics when implemented in the most diverse means of the industry to explore its benefits. Therefore, this research aims to demonstrate how the implementation of reverse logistics can establish ways of adapting to the new needs of the industry, enhancing its gains, visibility and productive growth within an industry producing school and office supplies. To this end, a qualitative research was carried out based on technical visits and interviews with professionals in management positions at the company. During the development process, reverse logistics techniques were also used, such as product life cycle assessment. In addition to contributing to the development of the literature on reverse logistics, this work brings positive results to all links involved in the system.

I. INTRODUCTION

In view of the worsening of environmental issues, there are many initiatives that can be taken by companies that commonly contribute to certain damages to occur. Parts of the mitigation actions may come from logistics, either in their usual flow or through the reverse flow.

It is known that logistics has the function of creating and maintaining processes for the storage and distribution of internal and external raw materials and products, and one of its important areas is reverse logistics, which involves all operations related to the reuse of products and materials, in the search for a reintegration of these to sustainable productive processes, therefore being an instrument of economic and social development, aiming at the reuse of industrial residues for their reintroduction in the productive cycle that revalues a product or material, still preventing residues from being thrown directly into nature [1].

Regarding the available literature, the expressive informative content on reverse logistics is perceived, however few address the application of this method to the industry of the manufacture of articles of the paper industry. Thus, the motivation for this research came from the need to propose measures that improve the service to consumers of these products, reduce the generation of waste, minimizing the use of water and raw materials, improve financial income, maintaining the quality of their products and meet the requirements of the law.

Methodologically, the present study was developed from a case study in an industry producing school and office supplies, consisting essentially of paper, located in Itaboraí in the State of Rio de Janeiro, carried out by consulting documents of private ownership company, interviews with managers, technical visits to the site to recognize their production and develop a strategy for applying the reverse post-consumption cycle.

In this way, the present research aimed to demonstrate how reverse logistics can establish ways of adapting to the new needs of the industry, enhancing its gains, visibility and productive growth within an industry that produces paper goods.

In the structural aspect, the article is divided into five parts: in a first, contextualization and the final objectives of the approach proposed in this study are exposed. In a second part, the main characteristics of reverse logistics are presented, in order to set the stage for the development of a strategy for the application of this area of logistics to the chosen case. In a third part, the

environmental concern and public policies related to the reduction of solid waste are addressed. The fifth part provides an understanding of the methodology used in the analysis of the enterprise where the study was carried out, as well as an exhibition of characteristics, the examination and documentation of the application of the method for industry, which translate the main results of the research. And in a fifth and final phase, the achievement of the goals pursued in the objective of the study is concluded.

II. REVERSE LOGISTICS

Solid waste (commercial, industrial, domestic, hospital) is a serious environmental, social and economic problem for today's society. And reverse logistics is one of the possible solutions to mitigate it, and strategies like this are increasingly desirable, since it is practically impossible to give an adequate end to all the waste that we generate daily [2].

Actions involving a given cycle that includes the final disposal of a product are treated by the field of study of Reverse Logistics, provided by the Reverse Logistics Executive Council - RLEC, as being the process of planning, implementing and controlling the flow of raw materials, work in process and finished product (and its information flow) from the point of consumption to the origin in order to recapture value or offer an ecologically appropriate destination [3].

Direct logistics operates in the flow of materials, services and information, from generation to consumption. However, reverse logistics is concerned with reversing such flows from consumption to origin, adding values and creating more suitable destinations, so this technique has increasing visibility and space. [4].

The reverse distribution channels are made up of two distribution categories, defined as post-consumption and after-sale, the first category of which occurs when goods, with little or no use, return to the different links in the direct distribution chain for various commercial reasons, for example: error when ordering, exchange for warranty, manufacturing or operating defects, or even for damage caused during transportation. While the reverse distribution channels of post-consumption are constituted by the reverse flow of products at the end of their useful life, their packaging, as well as industrial waste, which receive different treatment due to its great importance [5].

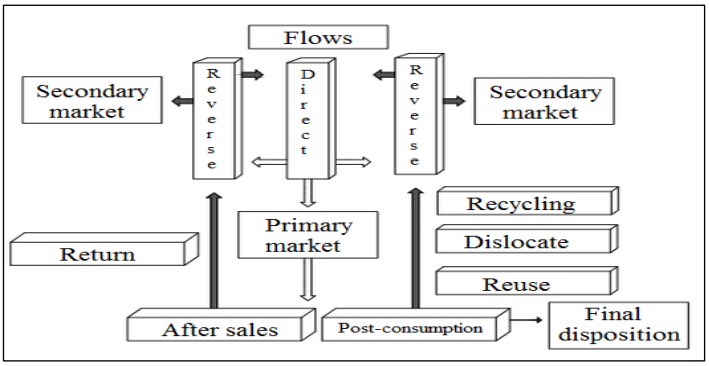

Figure 1: Direct and reverse distribution channels.
Source: [5].

A rational and ecologically correct cycle for waste generated in industries has been one of the goals of companies of this century, due to environmental legislation with strong growth in their restrictions and consumers more aware of the adequate treatment given to industrial waste, companies are being forced to rethink new ways of structuring themselves in the market, focusing on attention to the total life cycle of their products, as well as their final disposition [6].

Only recently has a concern been raised with regard to the reverse distribution channels, their stages, ways and means in which a percentage of these little used products after sale or after the end of their useful life, may return to the production or business cycle, regaining value in different ways, in the same market, in secondary markets, through the reuse of its components or constituent materials [5].

Reserve Logistics can be defined as the process of planning, implementing and controlling the efficiency and cost effective flow of raw materials, in-process inventories, finished products and the corresponding consumption information to the point of origin for the purpose of recapture the value or allocate to the appropriate provision [3]. Considering that logistics is an integrative concept that seeks to develop a vision of the company as a comprehensive system to meet the needs of the market strategically [7].

An important issue is that in recent years, environmental legislation has encouraged several companies to decide to implement Reverse Logistics policies for their products and packaging, because of the need to differentiate between services offered and policies to continuously cut costs [8].

Reverse logistics is a sustainability strategy that companies can use as an economic opportunity for ethical reputation, society and its ties, and can generate more dignified conditions such as better quality of life, employment, income, ethical attitudes, among others. And according to the three areas in the triple botton line concept, economic sustainability combines the preservation of the environment with the financial return, so that it involves the areas of environment (planet), social (people) and economic (profit) [9], which must be seen in an interconnected way in favor of sustainable development, as can be seen in Figure 2.

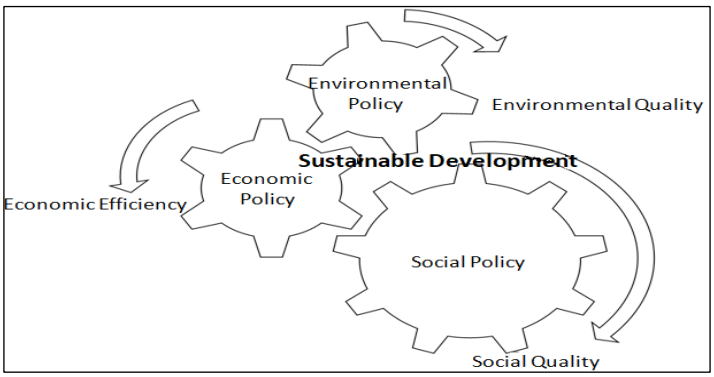

Figure 2: Interconnection of the three dimensions of sustainable development.
Source: [10].

It is important to awaken in the managers of different organizations, the interest so that more and more sustainable actions are incorporated into companies and can influence the community to also adopt such practices, believing daily changes and simple daily actions has this potential [11].

With the intense competitiveness present in the current market, investment in sustainable measures as a differential in the market makes it necessary that, from the beginning of business activities, managers align their processes strategically through process management techniques applied in this sense [12].

III. ENVIRONMENTAL CONCERN AND PUBLIC POLICIES

The worsening of environmental problems appears with greater visibility in a large portion of sectors of the population, especially in developed countries, from the 20th century onwards, being affected by the impacts generated by the industrial revolution [13].

Since then, the environmental issue has been addressed in several conferences and documents, such as the Club of Rome, the Stockholm Conference, the Report "*Our Common Future*", ECO 92, the Kyoto Protocol, among others, in order to seek sustainable guidelines for the environment, which has been influencing the population's behavior [14].

A large portion of the population has been increasingly concerned with the various aspects of ecological balance. According to the author himself, this has been proven through public opinion surveys that reported that the increase in awareness in today's society is true, especially in countries with greater economic development [5].

Based on biological analogies with natural ecosystems, Industrial Ecology identifies and proposes new arrangements for the flow of energy and materials in industrial systems, having as basic principles the search for integration of economic activities and the reduction of environmental degradation [15].

In order to reduce part of the impacts that culminate in an environmental crisis, the National Solid Waste Policy (PNRS) was developed, instituted by Law No. 12,305, of August 2, 2010, and regulated by Decree No. 7,404, of December 23, 2010. And in terms of its principles, the following stand out:

I. protection of public health and environmental quality;

II. non-generation, reduction, reuse, recycling and treatment of solid waste, as well as environmentally appropriate final disposal of waste;

III. encouraging the adoption of sustainable patterns of production and consumption of goods and services;

IV. adoption, development and improvement of clean technologies as a way to minimize environmental impacts;

V. incentive to the recycling industry, with a view to promoting the use of raw materials and inputs derived from recyclable and recycled materials; [...] [16].

The implementation of a National Solid Waste Policy (PNRS) in Brazil is a complex process, as the country has significant continental dimensions. On the other hand, this policy is important to boost and create new opportunities in several areas, in particular reverse logistics [17].

In order for the industries to have greater responsibility in their conduct, there are some laws that restrict certain actions, as is the case of Law No. 9,605, of February 12, 1998 - Providing for the criminal and administrative sanctions derived from conduct and activities harmful to the environment environment, and other measures.

From the crimes against flora in article 46, the previous law deals with receiving or acquiring, for commercial or industrial purposes, wood, firewood, coal and other products of vegetable origin, without requiring the display of the seller's license, granted by the competent authority, and without using the route that should accompany the product until final processing.

Another relevant article is related to pollution and other environmental crimes, when in art. 54 deals with causing pollution of any kind at levels that result or may result in damage to human health, or that cause the death of animals or the significant destruction of flora [18].

IV. CASE STUDY

IV.1 METHODOLOGY

As for the approach, it is stated that this research is characterized as qualitative, that for [19], it is an approach that prioritizes studies where the variables are still unknown, as it is a method in which the quantity is replaced by intensity, through the analysis of different sources that can be crossed.

The technical procedure used in this work was the case study, which is a form of research that seeks to investigate a contemporary phenomenon within its context and a reality, especially when the limits between these are not clearly defined [20].

For this reason, a company was chosen with its business focused on the area of school supplies, being called "PAPER S.A" during this work so that its original name is preserved. It is an industry that uses a large amount of paper in its production as the basis of its products, which is a key component for the creation of this work.

In the search for the solution of these aspects, technical visits were made to the production industry, where a bank of questions was answered by an outstanding professional within the company.

IV.2 PRODUCT LIFE CYCLE

The company uses some materials such as paper, wire, paint and cardboard, the focus of which is on a specific material, which is paper. Made from wood, from which cellulose fibers are extracted, converted into paper after a series of industrial processes.

For each ton of paper that is recycled, 32 pine and 3 eucalyptus trees are saved, having even more benefits when compared to the amount of water used for white and recycled papers, when for the production of 1 ton of recycled paper it is necessary 2 thousand liters of water and for traditional, white, this volume can reach 100 thousand liters [21]. As a result, there is a concern to reduce this use by analyzing the product's life cycle with the implementation of reverse logistics techniques.

The production of the objects generated by this company follows a simple direct flow starting from the arrival of the raw material (see Figure 3), which according to one of the responsible engineers it is estimated that about 80% to 85% of these come from the paper through the reels of white and recycled paper. Currently, the use of white paper rolls is approximately 9 times greater than that of recycled paper.

Figure 3: Paper rolls.
Source: Authors, (2020).

From this stage, the coils are sent to production, where they are ruled, cut paper and covers through specific machinery and join the parts in a manual service. The production sector also has a machine of German origin, called Bielomatik, which eliminates all production processes, as it is a technology that allows the entry of raw material into its initial door and at the end of its delivery cycle. the fully finished product.

After finalizing production and inspecting its quality, the products go to stock, where their destinations for the most diverse customers are managed, for example, the wholesaler and retailer network, according to the supply chain in Figure 4.

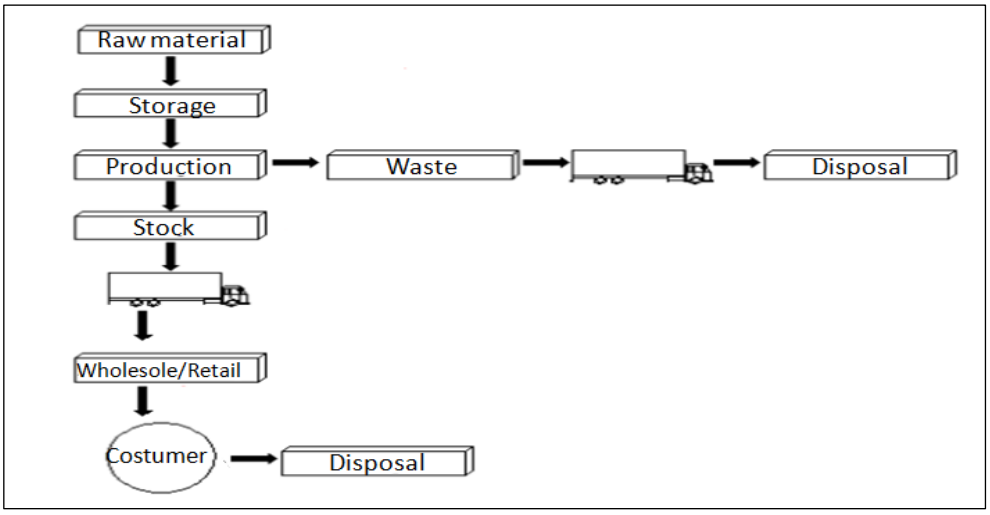

Figure 4: Product life cycle in the studied company.
Source: Authors, (2020).

During the production of all the company's products, waste is generated, such as wire, springs, pieces of paper, cardboard and plastic. These materials are sent to the sector responsible for dividing these waste categories, which makes it possible to sell these materials to a partner company that takes care of recycling them. However, this measure does not influence the materials in circulation after they leave for their customers, being uncontrollable the destinations given by consumers who often act inappropriately, letting it contaminate the environment. These products, in addition to having the potential to damage nature when disposed of inappropriately, contribute to the increase in paper production in order to meet the demand for this type of product.

IV.3 REVERSE FLOW IMPLEMENTATION PROPOSAL

Based on this situation, it is proposed to implement a reverse cycle of these products as a way of minimizing the circulation of these materials and their residues, contributing to the gain of prestige by the visibility of the company's name, with regard to involvement with projects. responsible production, gains from the loyalty of its customers and gains from the sale of products returned in this cycle, which may pass on part of this benefit to customers.

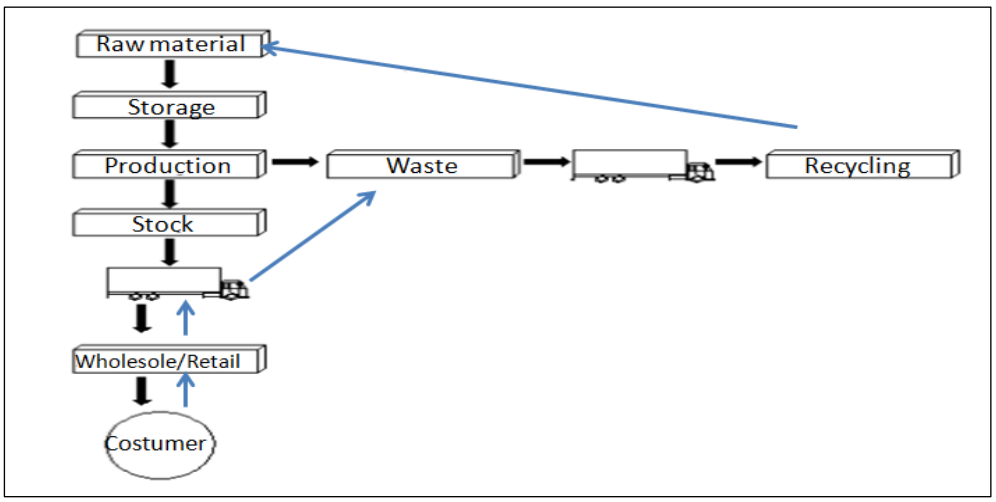

Figure 5: Reverse flow proposed to the studied company.
Source: Authors, (2020).

Figure 5 shows clearly how the implementation of this system would act in this type of process. The idea would be to implement a reverse system for these materials, where it was possible to reduce their waste, reduce the use of raw materials and enable a sustainable production cycle. Returning these products giving buyers the possibility of reducing environmental impacts

and at the same time benefiting them with an award in the form of a discount at the time of delivery of this material and purchase of a new product from the brand.

As for the logistics used in this return, one can perceive a potential in its costs, as it is a system that would take advantage of structures and transport already used in the current system of distribution of these products (Figure 4). The first stage focuses on the creation of collection points, strategically implemented with the four main buyers of materials produced by the company.

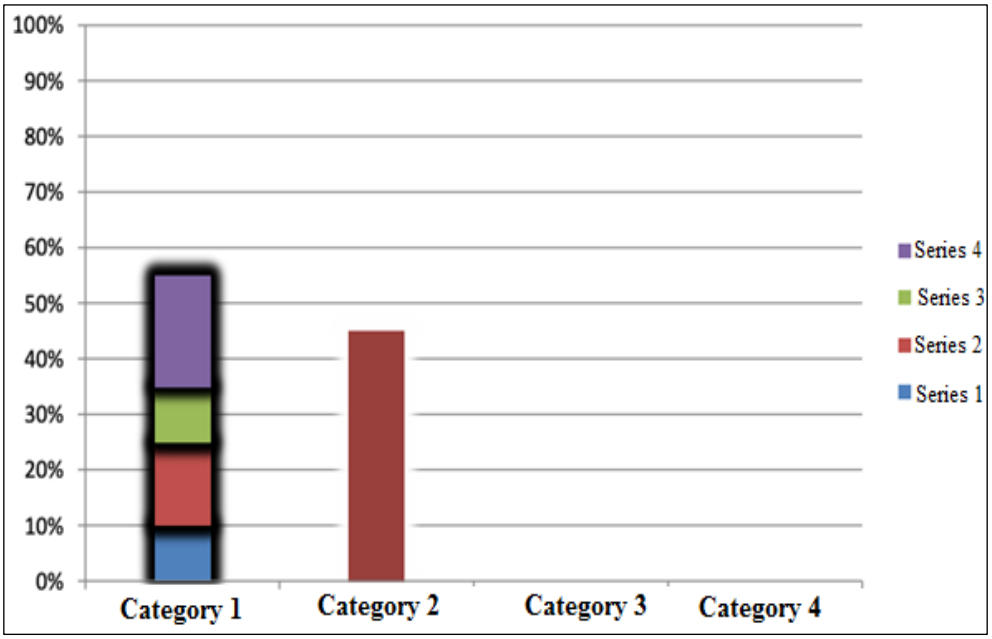

Figure 6: Potential Buyers Chart.
Source: Authors, (2020).

The chart of potential buyers represents the company's current sales, showing that 55% percent of sales are given to four large buyers, which brings the initial focus of installing collection points to these four customers, making it possible to attack a significant amount of products in a few points initially.

As a means of comparison, a Table 1 was made with the calculation of the values obtained from the sale of waste.

Table 1: Demonstration of values in the sale of waste.

Notebooks (10x1)	Material (Kg)	Price/Kg	Value Partial
paper	0,616	0,90	0,5544
cardboard	0,086	0,23	0,01978
spring	0,018	0,23	0,00414
Total			0,57832

Source: Authors, (2020).

Table 1 used as a calculation basis between the weight of each type of material contained in a ten-item notebook, multiplied by the resale value of these materials for the recycling industry. Therefore, the unit value obtained for each notebook that returns within the proposed reverse cycle is obtained.

Table 2: Values by notebook template.

Notebooks	Return Value (BRL)
1x1	0,29032
10x1	0,57832
15x1	0,85552
20x1	1,13272

Source: Authors, (2020).

Table 2 shows the values obtained for each type of notebook within this cycle, which allows us to analyze the balance of the return values of each type of notebook, which by calculations represent between 7.5% of the most expensive model sold by the company and 10% of the cheapest model, which gives us an average of 8.75% based on sales figures.

After all these crossings of information were made, a survey was made to calculate the profitable potential of this project. The values obtained with the return of these products if we think of an approximate number of 50% of return would allow an approximate figure of R$ 920 thousand, being passed on to the clients part of these values as benefits for the purchase of a new product of the brand.

However, for an efficient implementation of the reverse cycle, it is necessary to use the technology that has been evolving to develop various systems and architectures for control, supervision and data acquisition in different types of industries or processes such as, for example, a SCADA system, which provides reliability, flexibility, increased production and improvements in operating conditions. In addition, losses, accidents due to human errors decrease, product efficiency and quality increase with a decrease in production costs [22].

V. CONCLUSIONS

From this research, it was possible to analyze the entire product cycle, applying reverse logistics techniques to it, where it became clear the importance of this system as a way to minimize impacts to the environment.

After the field research and the proposal to implement a reverse cycle for these products within the company "PAPER S.A", the potential for the project regarding the system implementation measures became clear. Because no type of investment with facilities, machinery or vehicle availability would be necessary, since all of these are already part of the current production system.

As for profitable benefits, it was found through an analysis of the values obtained by the return of these materials that this

system is capable of generating a significant amount of benefits to all the links involved, such as customers, resellers, the recycling industry and the industry itself producer. Because the system is capable of producing resale values in the brand of up to 10% of the value of the product.

Through this system and after the analysis it was possible to notice that the recycling industry will benefit from the growth in the quantity of products destined for this activity, also strengthening this type of market.

The proposal to implement a reverse logistics system for after-sales and post-consumer goods applied to the school materials production industry proved to be efficient in all the points analyzed during this research, being a system beneficial not only to the market, but also to the environment and that benefits the whole society. However, future studies are recommended that compare the best information systems for the implementation of more efficient reverse cycles.

VI. ACKNOWLEDGMENTS

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VII. REFERENCES

[1] G. C. Machado, P. P. Feres, and M. F. S. Gonçalves, "Reverse logistics: feasibility analysis of the collection and restitution of lubricating oil used or contaminated", JETIA, vol. 5, no. 17, Mar. 2019.

[2] J. G. Silva, M. P. S. Silva, L. G. Maia, and K. R. B. Souza, "Reverse Logistics: An analysis of the discarding of overdue supermarket products in the city of Petrolina-PE", JETIA, vol. 5, no. 17, Mar. 2019.

[3] D. S. Rogers, and R. S. Tibben-Lembke, "Going Backwards: Reverse Logistics Trends and Practice." Nevada: Reverse Logistics Executive Council, 1998.

[4] G. T. S. Ho, C. H. Y. Lam, and D. W. Wong, "Factors influencing implementation of reverse logistics: a survey among Hong Kong businesses." Measuring Business Excellence, vol.16, no. 3, 2012.

[5] P. R. Leite. "Logística Reversa: Sustentabilidade e Competitividade." São Paulo: Saraiva, 2017.

[6] C. F. Coelho, "Análise de Fluxo de Material no Processo de Preparação do Minério de Ferro para Indústria Siderúrgica." Dissertação de Mestrado, Programa de Pós-Graduação em Engenharia de Produção da Universidade Estadual do Norte Fluminense Darcy Ribeiro, Rio de Janeiro, 2013.

[7] A. M. Nascimento, M. S. Machado, R. S. A Meneguelli, U. A. F. Barreto, R. F. Toledo, "Fatores críticos de risco no gerenciamento logístico de alimentos perecíveis", Revista de Trabalhos Acadêmicos Lusófona, vol. 2, no 2, 2019.

[8] M. Fleischmann, P. Beullens, J. M. Bloemhof-Ruwaard, L. N., and van Wassenhove, "The impact of product recovery on logistics network design." Production and Operations Management, vol. 10, no. 2, 2001.

[9] A. S. Miranda, R. S. N. Santana, R. F. P. Oliveira, and S. S. Oliveira, "Reverse Logistics Competitiveness Factor And Sustainability In Companies", JETIA, vol. 2, no. 6, Jun. 2016.

[10] D. V. Barboza, F. A. Silva, W. H. Motta, M. J. Meiriño, Faria, A. V. "Aplicação da economia circular na construção civil." Research, Society and Development, vol. 8, no. 7. Jul. 2019.

[11] J. F. Silva, D. V. Barboza, R. L. F. Bella, and M. J. Meiriño, "Sustentabilidade em microescala: estudo de caso de uma padaria de bairro." Mix Sustentável, vol. 5, no. 3, Jul. 2019.

[12] A. M. Costa, A. K. M. Mattos, Rodrigues N. M., and D.V. Barboza, "Aplicando a modelagem de processos de negócio em uma retificadora de motores em Cabo Frio-RJ", Brazilian Journal of Production Engineering, vol. 5, no.2, 2019.

[13] R. Dias, "Gestão Ambiental: Responsabilidade Social e Sustentabilidade." São Paulo: Editora Atlas, 2017.

[14] V. S. Gonçalves, E. R. Gonçalves-Júnior, D. L. Rocha, and B. S. Gonçalves, "Análise de Casos Múltiplos no Setor Hoteleiro quanto a Sustentabilidade e Gestão Ambiental." Revista de Trabalhos Acadêmicos Lusófona, vol. 2, no. 2, Mai. 2019.

[15] M. M. Costa, "princípios de Ecologia Industrial aplicados à sustentabilidade ambiental e aos sistemas de produção de aço", Tese de Doutorado, Programa de Pós-Graduação em Planejamento Energético da Universidade Federal do Rio de Janeiro, Rio de Janeiro, 2002.

[16] BRASIL. Decreto nº 7.404, de 23 de dezembro de 2010. Regulamenta a Lei no 12.305, de 2 de agosto de 2010, que institui a Política Nacional de Resíduos Sólidos, cria o Comitê Interministerial da Política Nacional de Resíduos Sólidos e o Comitê Orientador para a Implantação dos Sistemas de Logística Reversa, e dá outras providências. Diário Oficial da União, Brasília, 23 dez. 2010. Disponível em: <http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Decreto/D7404.htm>. Acesso em: 01 abr. 2015.

[17] C. E. G. Farias, "Mineração e Meio Ambiente no Brasil", 2002, Disponível em: < http://www.em.ufop.br/ceamb/petamb/cariboost_files/miner_c3_a7_c3_a3o_20e_20meio_20ambiente.pdf>. Acesso em: 21 abr. 2018.

[18] BRASIL. Lei Nº 9.605, de 12 de Fevereiro de 1998. Dispõe sobre as sanções penais e administrativas derivadas de condutas e atividades lesivas ao meio ambiente, e dá outras providências. Diário Oficial da União, Brasília, 12 Fev. 1998. Disponível em: <http://www.planalto.gov.br/ccivil_03/leis/l9605.htm>. Acesso em: 27 mar. 2018.

[19] J. W. Creswell, "Projetos de pesquisa: Métodos qualitativo, quantitativo e misto", 3. de, Porto Alegre: Artmed, 2010.

[20] R. K. Yin, Estudo de caso: planejamento e métodos. 3. ed. Porto Alegre: Bookman, 2005.

[21] M. Bravo, "Meio Ambiente e Sustentabilidade", CBN Vitória, 2011. Disponível em: <http://gazetaonline.globo.com/_conteudo/2014/07/cbn_vitoria/comentaristas/marco_bravo/1482286-conheca-os-efeitos-positivos-do-uso-sustentavel-do-papel.html>.

[22] J. E. G. Arteaga, S. B. Barroso, L. V. Coca, O. U. Pascual, and L. H. García, "Implementation of scada system to the central liquor factory", JETIA, vol. 4, no. 13, pp. 66-71, Mar. 2018.