E-WASTE REVERSE LOGISTICS IN THE CITY OF RIO DE JANEIRO AND THE BRAZILIAN POLICY ON SOLID WASTE: SOCIAL, ENVIRONMENTAL AND TECHNOLOGICAL ASPECTS

Hermann Flávio Fernandes do Nascimento
Undergraduate Student of Environmental Engineering,
7th period, Universidade Federal do Rio de Janeiro.
Period PIBIC or PIBITI/CETEM: August 2017 - 2018
hermann@poli.ufrj.br

Lúcia Helena Xavier
Advisor, Doctorate in Production Engineering
lxavier@cetem.gov.br

ABSTRACT

Waste electrical and electronic equipment (WEEE or e-waste) is growing significantly in importance, especially in the last decade. However, they do not yet receive due attention from the general population or from public power, largely because the information about environmental harm and human health brought about by inadequate waste disposal does not grow as fast as the generation. Reverse logistics, regulated by the Brazilian Policy on Solid Waste (BPSW, Law 12,305 of 2010), which main focus is the responsibility for managing the life cycle of the post-consumer products to manufacturers, importers, distributors, and traders, from the disposal to the end-of-life. The e-waste represents one of the categories with the highest added value among the post-consumer materials, being considered secondary raw material. The state of Rio de Janeiro has specific regulations for the management of electrical and electronic waste since 2008, Law 4,969 of 2008. From the bibliographical survey, field research and interview with managers, the present research proposed the identification of the main actions implemented in the management of waste electrical and electronic equipment (WEEE) in the city of Rio de Janeiro, to identify the recovery potential of materials according to the concept of urban mining and circular economy.

Keywords: management, solid waste, e-waste and urban mining.

1. INTRODUCTION

In a scenario of increased generation of electrical and electronic waste, especially in the last decade, urban mining researches indicate a tendency for Waste Electrical and Electronic Equipment (WEEE or e-waste) as the fastest growing waste category in the world (Awasthi et al., 2018) and has valuable materials in its composition, such as metals and especially the Rare Earths Elements (REE). In addition, many electronic devices are often discarded with parts that can still be used or even in full operation, only due to the phenomenon of perceived obsolescence.

Therefore, not giving such waste the proper attention is hurtful to the environment, but also characterized as a waste of economic resources. The adequate management of WEEE, in accordance with legal requirements (BRASIL, 2010) minimizes these negative impacts. In this context, the strategic importance for the protection of ecosystems, the preservation of not renewable natural resources, the basis of traditional mining, and their role as a business opportunity for managers can be perceived (Di Maio et al., 2017).

It is also important to promote the proper functioning of this logistics chain. However, its structure in Brazil is still not completely clear, since variables such as the role of each actor are still not accurately understood, and the presence of several chain models makes it a challenge for researchers and entrepreneurs working in the sector. Thus, the objective of this research was to elucidate the model of reverse logistics in Rio de Janeiro city, as well as the actors involved, their motivations and activities. Thereby, it is possible to increase the understanding of possible failures in this system, how it might be improved and how to engage the reverse logistics agents.

2. OBJECTIVES

Aiming at the functioning of the reverse logistics system, it was necessary to inform the population about its fundamental role in this context, since, according to the Brazilian Policy on Solid Waste, is it is the consumers´ responsibility to return the WEEE in a store, collect point or to a responsible manager. The first objective was to assist the population, providing information on where and how properly dispose the e-waste, especially in a high-generation locality such as the state of Rio de Janeiro. We attempted to analyze the scenario of WEEE management in the city of Rio de Janeiro, in order to structure and identify the factors that have shaped this chain of management into its current operational structure.

Finally, from the basic data from the e-waste reverse logistics chain, the final objectives were to use this data to propose subsidies for managers decision-making and propose an improvement in the way WEEE reverse logistics works in the city of Rio de Janeiro.

3. METHODOLOGY

The research was developed in two stages. The first one, which consisted in reading the reference bibliography and participating in research seminars, aimed at identifying the elements that make up the reverse logistics system (SLR). For that, scientific articles and regulatory instruments were consulted. Next, an exploratory research was carried out to identify and analyze the performance of the main agents that make up the reverse logistics chain of electrical and electronic equipment in the city of Rio de Janeiro, as a source for urban mining.

The agents of the public sectors (Superintendencies of Regional Supervision) and private (entrepreneurs, managers, collectors and nongovernmental organizations) were contacted by telephone to conduct interviews from a semi-structured script, with the purpose of mapping the actions for the management of WEEE existing or under preparation in the city of Rio de Janeiro, verifying which of them proved to adequately destine the collected waste.

For the accomplishment of the objectives, the preliminary phase included the preparation of a manual for the adequate destination of WEEE, with the purpose of informing society about the good practices of the destination of the consumer electronics. By the manual's elaboration, it was possible to understand and analyze the Reverse Logistics chain of electronics. As a final methodological step, questionnaires with closed questions were applied. The main objective was to identify the indicators and aspects would be the most relevant in the management of electrical and electronic waste.

Aiming to understand how the electronic equipment production chain integrates to reverse logistics, a new simple flowchart model was developed. Its purpose was to be a tool, which could easily be consulted by specialists and managers in a direct way, providing a broad and accurate version of the general process - both direct and reverse supply chains. Accordingly, a simple Excel diagram was used to draw the scope of a simplified flow chart, which would be accompanied by a table of calculations. Finally, after all the mentioned data collection, the scenario for the management of WEEE in the city of Rio de Janeiro became very clear for the team of researchers, in a general way.

Thus, the final step in project closure was to organize and disseminate this information to the general public, including the verification of which of that data could be further developed in future projects.

4. RESULTS AND DISCUSSION

In general, the results show that the public administration of the city of Rio de Janeiro is at a very incipient level regarding the management of WEEE. The state environmental agencies, the State Environment Secretary (SEA, from Portuguese, "Secretaria de Estado do Ambiente") and State Environmental Institute (INEA, from Portuguese, "Instituto Estadual do Ambiente"), do not have any practical actions to assist the citizen in regard to the correct disposal of this waste, and the same holds true for the Administrative Regions (A.R.), the smaller governmental administrative subdivision. In the case of the Superintendencies of Regional Supervision, it is noticed that there is a greater proactivity when compared to the other competent organs. However, this fact is only true for some particular cases, which are Superintendencies that have some project still in the process of elaboration (only two). The capital of the state of Rio de Janeiro lacks practical public policies in this regard, and just a few actions related to the management of electronics are still in the embryonic stage.

The results obtained in the contacts established with the Superintendencies and the A.R's were compiled in a table, indicating also in which of the means of communication the contact was used, since many of these contacts took a long time to be accomplished. In short, it was noted that none of the 16 Superintendencies have projects in this sense (some could not be contacted owing to the lack of means of communication), although two of them (Pavuna and Grande Tijuca) affirmed at the time of the research (second half of 2017) they were elaborating projects on the topic.

Finally, it is perceived that, unlike the public sector, the private sector absorbed the importance of the management of WEEE, especially perceiving the possibility of inherent profit. Also, it is noticeable that the city's market is becoming increasingly attractive to companies that operate in the area, since many of them are just arriving in the city, or plan to do so in a short time.

Starting from the analysis of the classification of waste electrical and electronic equipment and the opinion of the managers participating in the research, it was possible to propose an alternative classification to those presented by the Brazilian Association of Electrical and Electronics Industry (known in Brazil as "ABINEE" and the Brazilian Association of Industrial Development (known as "ABDI").

The qualitative analysis of the results of the applied questionnaire showed that the economic and environmental variables are considered the most important in the system, while the social strand, especially the inclusion of cooperatives, is relegated to the background. The adequacy of the legislation and the economic issue are still the most relevant impacts for the agents, while management actions aside from the private sector and the inclusion of cooperatives are the least important.

Yet another neglected impact was society's predisposition to collaborate with the system. However, the impact related to effective collaboration of society has had a much better score, integrating the top of the list of importance. In this way, it is perceived that the agents consider it more important that the population collaborates with the reverse logistics than to make it willing to do so.

Regarding concrete products, the research resulted in the following items:

- E-book: Manual for the destination of electrical and electronic waste (2017);

- Brazilian Congress Paper: SEMBRAGIRES "CENÁRIO ATUAL DA GESTÃO DE RESÍDUOS ELETROELETRÔNICOS: o Caso do Rio de Janeiro";

- International Congress Paper: Symposium of Urban Mining and Circular Economy (SUM) – "BARRIERS TO THE IMPLEMENTATION OF THE CIRCULAR ECONOMY IN BRAZIL: AN ANALYSIS OF THE E-WASTE CLOSED LOOP SUPPLY CHAIN ELECTRICAL AND ELECTRONIC EQUIPMENT";
- Brazilian Congress Paper: CONRESOL: Geração De Resíduos Eletroeletrônicos No Estado Do Rio De Janeiro: Logística Reversa A Partir Dos Pontos De Entrega Voluntária (PEVs)
  - Being expanded for a technical magazine publication.

5. CONCLUSIONS

Although WEEE management is a relatively new issue, its importance is already at stake. The city of Rio de Janeiro is, in fact, a place with great potential for the implementation of an effective chain of reverse logistics, as it had already been verified. There are a number of actors who are interested in the topic, whether for environmental or financial reasons. However, some obstacles are still present: in addition to the high costs inherent to the city, the lack of information, both by stakeholders and by the population at large, difficult the proper implementation of WEEE closed loop supply chain in an adequate manner.

Therefore, by elucidating how WEEE management in Rio de Janeiro actually works and mapping the chain in the city, this research fulfills its role of generating information to aid in the decision-making process and, in addition, it disseminates this information to the interested public and society at large.

6. ACKNOWLEDGMENTS

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