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The Challenge of the Reverse Logistics of the High Tech After-Sales Equipment: A Comprehensive Study

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Abstract. The practice of the Reverse Logistics (RL) has increasingly been in evidence by the academy and by the companies, due to sustainability and costs. In a progressively competitive business environment, cost reduction becomes a global recurring theme, and in this aspect, RL is a strong ally in the strategic plan of the company. With the advancement of the technology it is more and more common the launch of a new product on the market, increasing the probability of improper disposal of electronic waste by the consumers that replace them. This paper aims to analyze the internal processes of the mechanisms of RL of one of the biggest logistics companies around the world that uses RL as economic and environmental strategy, and identify areas for improvement. We conclude giving some suggestions in order to improve the efficiency of the system.

Keywords: Reverse Logistics, Sustainability, Electronic Equipment, High-Tech Residue, Supply Chain

1 Introduction

The growing evolution of the society and the change in their spending habits, stimulated the expansion of the internal market, encouraged by the credit market, requiring constant innovations. The consequent increase in competition from industrial sectors through technological advancement and promotion of innovations to provide demand, led the current situation based on the reduction of life cycle of the products, grounded on disposability [1]. In this scenario the market has been operating at a strong pace, accelerating the production to meet consumption.

The instantaneity and disposability of the current market require from the companies a management that considers environmental impact issues, cost reduction, innovation and social responsibility.

This research was conducted in the context of Brazilian laws and regulations, based on studies of the Brazilian Industrial Development Agency (ABDI) [2], revealing that the control of the generation and disposal of waste is a cost-saving alternative and ally in winning recognition from society through concern about the disposal of electronic products. RL is presented as a tool for business management by contribution in achieving economic advantages, without disregarding the environmental aspects. The Supply Chain Management (SCM) integrates all activities related to the flow and transformation of goods from the initial stage to the proper disposal at the end of the product life cycle.

It is viable [3] to implement a conceptual model where the manufacturing strategy is based on a sustainable model, with the objective of validating management practices and with principles and attitudes that have been requested by the society.

The aim of this paper is to present, through a comprehensive case study, the analysis of the internal processes of the mechanisms of RL of one of the biggest logistics companies around the world, that uses RL as economic and environmental strategy, based on the challenges launched by the Brazilian National Policy on Solid Waste (PNRS) [4], and identify areas for improvement.

2 Literature review

This chapter aims to provide an overview of supply chain, logistic and reverse logistic.

2.1 Supply Chain Management

Supply Chain Management (SCM) is the system that is intended to achieve a more efficient and effective movement of goods, services and information along the supply chain from the first supplier up to the last consumer [5]. SCM is considered a key to improve performance and quality, always focusing and aligning the interests of the organization [6], despite the risks involved, generated by the uncertainties that the organizations have to face to develop their operations [7].
The market for electronic products is increasingly dynamic, because the products have very short life cycles and increasing amounts of value added. The development of SCM for the sector is a crucial factor for obtaining competitive advantages over competitors.
The search for greater flexibility leads companies to look permanently for new alternatives to confront the difficulties that arise in the markets where they operate. Within the SCM, the tasks for the transport of raw materials, components or other products, has now developed into a very promising field for developing outsourcing actions.

2.2 Logistic and Reverse Logistic

In the past, the physical distribution (logistics) used to be usually considered the last frontier for cost savings; today however, it is the new frontier for generating demand and cost savings [8].
Logistics can be defined [9] as the process of planning, implementing and controlling of the efficient and economically effective flow of raw materials, work in process, finished goods and information, from the point of origin to the point of consumption, in order to meet the consumers requirements.
The Reverse Logistic (RL) is understood [10] as the area of the business logistics that plans, operates and controls the flow and the corresponding logistical information, the return of after sales of goods and post-consumer business cycle or production cycle, through reverse distribution channels, adding value of various kinds: economic, legal, logistics and corporate image, among others.
In reality, RL influences all these solutions for solid waste management [11]. It finishes with the old-fashioned concept of "end of line" (end-of-pipe), according to which the product life has a beginning (design and production), middle (use) and end (dumps and landfills). The line became a circle, today its end coincides with the beginning and recovery. The materials from used products, before even called garbage, are now taken as raw material for a new generation of products
However, as a result of this immense variety of new products, new problems arise, such as reducing the lifetime of these products and the consequent increase of disposal.

2.3 Advantages of Reverse Logistics

Behind the concept of RL, there is an even broader concept, which is the product life cycle [12]. The life of a product, from a logistical point of view, does not finish with its delivery to the end customer; products become obsolete, damaged or do not work, and should return to their point of origin to be properly discarded, repaired or reused. The advantage of RL is gathering the financial aspects to the environmental aspects, making this competition more advantageous.
RL has the advantage of combining three important sectors in industry: social, economic and environmental [13]. Social as it generates formal jobs and promotes a greater awareness of the population and of the industry on environmental issues; economic as it allows a return of the raw materials to the market; and environmental because of the reduction of improper waste disposal, among others [13].

2.4 Post-Consumption and Aftermarket

Post-consumer RL has three categories of manufactured goods that are classified according to the lifetime of these products, which are: disposable goods, semi-durable goods and durable goods.
Post-consumer RL can be defined [10] as the area that controls the physical flow and the information of the disposable and durable goods as well as its raw materials, after being discarded by the society until the return to the productive cycle. These products and/or inputs can return to its productive cycle through three channels: reuse, dismantling and recycling.

RL is characterized by the return of products that, for some reason, did not meet the needs and/or the final consumer expectations. The reverse aftermarket channels are made up of returned products without being used, or with little use (as in the case of the Internet return), the general retail obsolescence or by the end of the fashion, aftermarket return to technical assistance, among other reasons.
Aftermarket RL is referred as the specific area of RL that deals with the planning, operation and control of the physical flow and related logistics information of the aftermarket goods that for different reasons return for the links of the SCM.
Aftermarket RL aims to put back the product in the production chain, so that the economic, environmental and social values, and especially the corporate image, can be added to it [14].

2.5 Sustainable Electronics Waste

Electrical and electronic equipment (EE) are the products that depend on use of electric current or electromagnetic fields [2]. They can be divided into four broad categories. Here we are going to focus on the study of "Green Line"; desktop computers and laptops, computer accessories, tablets and mobile phones.
At the end of its useful life these products are considered EE waste [3], and in regard to sustainability, recycling EE allows recovery of many materials, including precious metals, which reconciles economic growth and sustainable development. The main environmental impacts are generally the potential emissions of toxins (lead, arsenic, mercury) of the EE provisions in landfills, as well as the impacts on workers and communities engaged in informal recycling operations.
The reverse flow enables the exhaustion of the possibilities of extend the life cycle of electrical and electronic equipment, bringing therefore, economic, social and environmental benefits. As can be seen in Figure 1, the RL flow benefits all links in the production chain

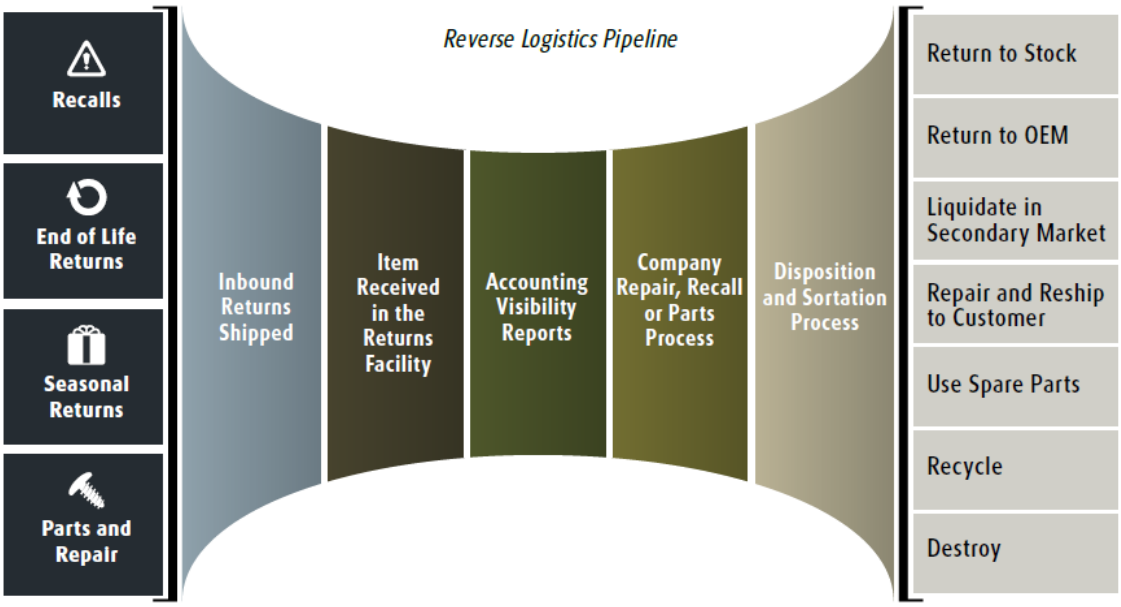

Figure 1: Reverse logistics pipeline (Source: [15]).

3 Methodology

This research uses an empirical analysis with quantitative approach and studies of economic modeling. We presented alternative scenarios for the improvement of the operations. The methodology for the study

was structured in four stages, which in turn, were subdivided into ten macro-activities, as shown in Figure 2.

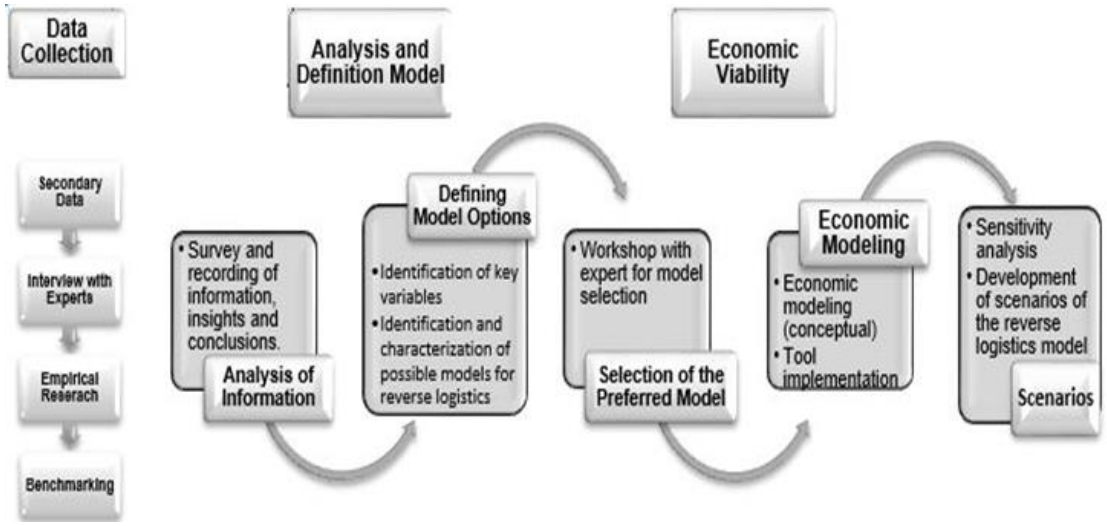

Figure 2: Methodology of analysis (Source: Authors).

4 Case Study

Here follows the case study.

4.1 Company Profile and Current Process

We made the research analyzing an operation basis of the UPS (United Parcel Service) in Brazil, which deals with RL of high tech equipment. Founded in 1907 as a messenger company in the United States, UPS has become a leading corporation in the segment, facilitating commerce around the world.
To collect data, we interviewed the manager responsible for the RL operations of High Tech products, in the city of Cajamar, state of Sao Paulo, Brazil, with a questionnaire of open questions and conducted a technical visit to this operational center.
The current process of RL of this operation is made by a SLA (Service Level Agreement), established between the client and UPS. SLA is basically a contract negotiated between the client and the supplier, where the consumer lists which are the responsibilities of suppliers and the minimum levels of acceptance of service [16].
We analyzed the RL process of an EE producer who operates process "Built to Order", which offers a multitude of possible configurations to the consumer. In this process it was hired an SLA that works through a Call Number created for the client to interact with the UPS system and to generate the RL process. For a better understanding, the process is shown in details in the flowchart of Figure 3.

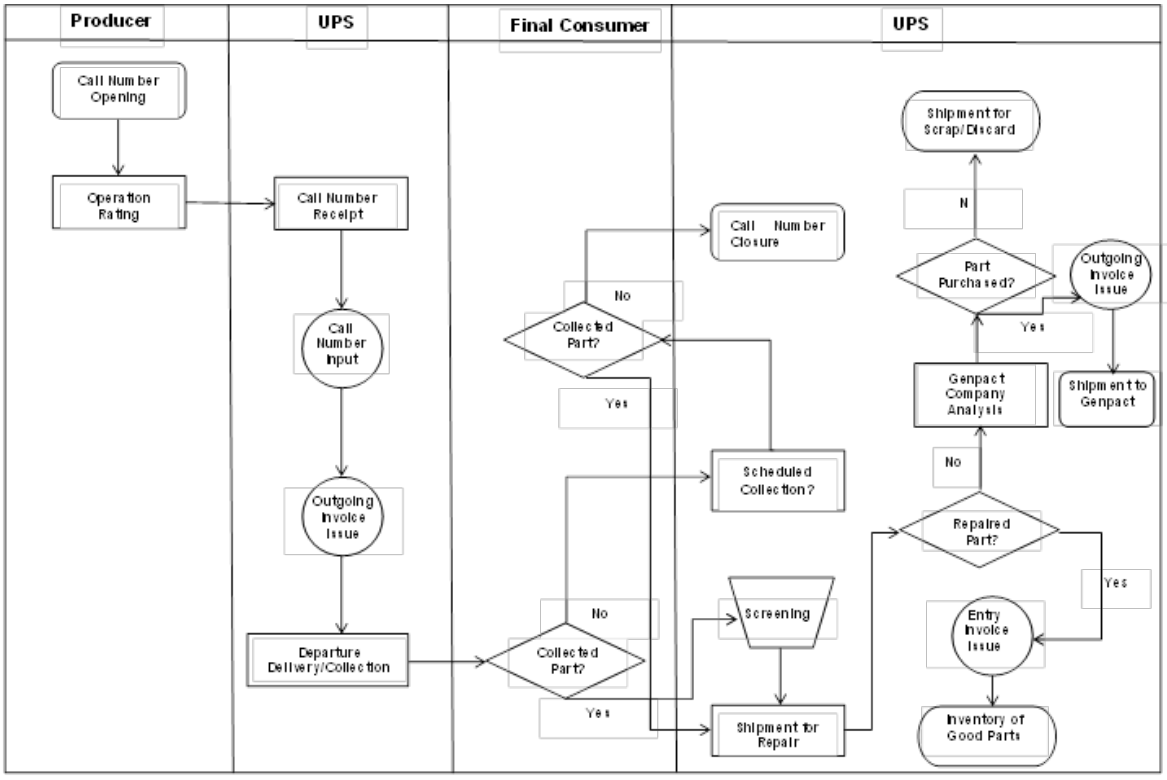

Figure 3: Process flowchart (Source: Authors).

Here follows the flowchart process description.

1. **Call Number Opening**: the end consumer, identifying a failure in the acquired equipment, gets in touch with the producer requesting a repair or its replacement;
2. **Operation Rating**: The producer has four different types of operation procedure for this call, classified according to which is established by contract. These operations can take two, four, six or eight hours to be answered;
3. **Call Number Receipt**: UPS receives the Call Number (called) in its system, with the type of call already classified by the producer;
4. **Call Number Input**: In fifteen minutes time, UPS processes the data and starts the operation;
5. **Outgoing Invoice** Issue: After the call number enters into the system, the tax department issues the outgoing invoice of this stock part, which needs to follow with transportation and be delivered to the final consumer;
6. **Departure Delivery/Collection**: just after the invoice is issued, the selection team takes the part in the stock and gives it to the deliverer for prompt delivery. To optimize the operation, the ideal is that, upon delivery of the new part, the defective part is collected on the same trip;
7. **Shipment for Repair**: After the part is collected, either upon delivery or later, it goes for screening and is sent to the maintenance team;
8. **Inventory of Good Parts**: If the part can be repaired, a new invoice of entry is issued, and the part enters in the stock of remanufactured parts and is ready to continue in the reverse cycle;
9. **Genpact Company Analysis**: if the part cannot be repaired, it is sent to a company that buys some scraps of the electronic components. A list of not repaired equipment is sent to the Genpact Company, that chooses which products will acquire, and only for these equipment, the outgoing invoice is issued and sent to them;
10. **Shipment for Scrap**: the last link in this reverse chain process is the sent for scrap, when the part could not be remanufactured or sold as scrap.

4.2 Problems of the Process

As described above, after the consumer receives the product and finds a defect in a component, the repair is requested to the same producer. From this point, UPS starts the RL operation taking the new component to the customer, and returning with the defective one. In this scenario, the difficulty presented was related to the lack of awareness of some end users of EE in the return to UPS that improperly discards or keeps the equipment without allocation of its possession. This problem occurs mainly due to the lack of adequate infrastructure for collection and information.
Studies indicate that most Brazilian consumers are concerned about the proper disposal of electronics, but due to the lack of information, few know how to give the proper destination [17], [18]. There are frequent cases of individuals and companies that put this kind of material with the regular trash, for lack of appropriate channels or lack of information.
Another difficulty presented by the research involves the maintenance of these parts: the cost and processing time, screening of the maintenance service and tax aspects.

4.3 Proposal for Improvement

We suggest an awareness campaign of the proper disposal of products sold by the producer; showing to the consumer the benefit of RL offered by the company, in which the consumer will be assured that the component will be properly disposed.
The EE reuse, especially information and communication equipment has an importance that goes beyond environmental concern, and can be identified in three areas: private reuse; reuse with commercial value and reuse of a social nature.
We propose two possible scenarios in regard to the current maintenance process:
1º) Scenario - The outsource of a maintenance team inside the UPS plant, eliminating the cost (transport, invoice issue, legal documents and others) and transit time for external maintenance. The producer would have to sublease another room in the UPS warehouse, when there would have a 5% increase in the value of the current contract, but with the reduction of transportation and other costs involved, the producer would have a gain of about 10% on the reduction of RL cycle;
2º) Scenario - A maintenance project carried out directly by UPS, in which the time for deliver and logistics costs would be canceled. This second scenario would promote the provision of two different services (RL and maintenance), offering a package of services to the manufacturing company, which would reduce contract costs with two distinct companies, promoting a mutual gain for both companies (UPS and producer). To make it viable, UPS would have to hire an outsourced company for repair services, which would cost 10 to 15% lower than the current service provider, and the space to be used would be the existing warehouse, which currently does not work at 100% of its operating capacity.

5 Conclusions

This research presented the Reverse Logistics (RL) and its importance for sustainability and reducing costs, showing that RL is a strong ally in the strategic plan of the company[1], [3].
We made an empirical research to analyze the internal processes of the mechanisms of RL of one of the biggest logistics companies around the world that uses the RL as economic and environmental strategy, UPS.
The analysis used quantitative approach and studies of economic modeling. We analyzed the RL operation of UPS, its importance was revealed [8], [9], and alternative scenarios were presented for improving its operation.
The first scenario consists in the outsourcing of a maintenance team inside the UPS plant, eliminating the cost (transport, invoice issue, legal documents and others) and transit time for external maintenance. This process could add value to the RL process and make the producer more loyal to the logistic operator.
The second scenario consists of a maintenance staff 100% outsourced by UPS, the logistics operator, and in our point of view, this process would add value to the RL process and further would make the client more loyal. An advantage for the producer is the hire of only one company to coordinate all their reverse SCM, at competitive costs.

Different from what some companies consider, we observed that RL has a strategic role in the company, and if well managed, it may be the responsible for revenue growth, cost reduction, sustainability and greater control of production processes.
We hope this research can contribute to stimulate future studies of RL of high tech equipment and others.

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