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REVERSE LOGISTICS – CURRENT CHAIN AND ANALYSIS

Project Report in Jerónimo Martins

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Project Report
Master in Management

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Biographical Note

Carla Sofia Bessa de Sousa, born on September 25, 1996 in Castelões de Cepeda, Paredes. Carla grew up and lived in Sobrosa and attended the Secondary School of Paredes until the moment she entered the university.

Her adolescence was marked by extracurricular activities, such as swimming, *Classical Ballet Dance* and theatre. It was these activities that allowed her to grow happily and develop the tools that would help her face the challenges that were approaching.

She entered the Economics course at the University of Minho in Braga, and it was during this period that she had her first experience outside Portugal, studying for a semester at the University of Milano Bicocca in Milan as part of the Erasmus Programme. The six months lived there were an extremely enriching period of intense personal and academic learning.

In 2017, she would join the Faculty of Economics of the University of Porto, opting for the Master of Management, fully taught in English and where this master's dissertation is included. The second year of the master's degree was marked by the development of this company project in partnership with the Jerónimo Martins Group, and by Carla's entrance into the labor market in another company, the Mota-Engil Group as a Trainee in the Financial and Logistics Areas.

Acknowledgements

Abstract

Reverse Logistics (RL) start appearing some decades ago, first as an extra expense without any utility, but as the competitive advantages began to be visible, as well as the economic and operational benefits, and in the relations with the diverse organizational partners, increasingly more companies began to adopt RL practices. This concept means the process of return of products and materials from de point of consumption or selling, to the primary supplier or another point of collection, in order to recover some value from it. This matter implies a concern of companies with all the entire life cycle of the product. More that apply legislation rules, there is a growing concern and pressure from consumers, suppliers and the whole society itself, to make companies take responsibility for what they sell and/or produce.

Taking a real case of a company in Portugal, Jerónimo Martins, this project intends to describe what is actually being done on this area. The first objective here is to Know the company, the area and the motivations and benefits perceived by the company. Additionally, the objectives that follow are to Describe and Understand, by realizing what type of processes exist, how products return and what is their recovery plan. By mapping this information and by exploring the difficulties that appear in the daily operations, its intend to propose improvement guidelines to increase the overall efficiency of this reverse supply chain in the company. This thesis also expects to fill the lack of real case studies in the literature on Reverse Logistics, by providing new literature for both investigators, society and business partners, showing what is happening on this area, how reverse logistics can be a competitive advantage and what can be the next steps.

Keywords: Reverse Logistics, Processes Description, Competitive Advantage and Improvement.

Resumo

A Logística Inversa começou a surgir há algumas décadas, primeiro como uma despesa extra e sem qualquer utilidade, mas à medida que as vantagens competitivas começaram a ser percecionadas, bem como os benefícios económicos e operacionais, e nas relações com os diversos parceiros organizacionais, cada vez mais empresas começaram a adotar práticas de logística inversa. Este conceito significa o processo de devolução de produtos e materiais desde o ponto de consumo ou venda, ao fornecedor primário ou outro ponto de recolha, de forma a recuperar algum valor do mesmo. Esta questão implica uma preocupação das empresas com todo o ciclo de vida do produto. Mais do que aplicar a legislação, há uma crescente preocupação e pressão dos consumidores, fornecedores e de toda a sociedade para que as empresas assumam a responsabilidade pelo que vendem e/ou produzem.

Tomando um caso real de uma empresa em Portugal, Jerónimo Martins, este projeto pretende descrever o que está efetivamente a ser feito nesta área. O primeiro objetivo é Conhecer a empresa, a área e as motivações e benefícios percebidos pela empresa. Adicionalmente, os objetivos que se seguem são Descrever e Compreender, através da perceção do tipo de processos que existem, como os produtos retornam e qual é o seu plano de recuperação. Ao mapear essas informações e explorar as dificuldades que surgem nas operações diárias, pretende-se propor diretrizes de melhoria para aumentar a eficiência geral dessa cadeia reversa de suprimentos na empresa. Esta tese também pretende suprir a falta de estudos de caso reais na literatura sobre Logística Reversa, fornecendo nova literatura para pesquisadores, sociedade e parceiros de negócios, mostrando o que está acontecendo nessa área, como a logística reversa pode ser uma vantagem competitiva e quais podem ser os próximos passos.

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Abbreviations and Acronyms

ALC – Alfena Logistics Center

AR - Area of Returns

ATAS – Area of Transportation Assets

JM – Jerónimo Martins

LC – Logistics Center

LCM - Logistics Chain Management

LM – Logistics Management

RL – Reverse Logistics

RLW – Reverse Logistics Warehouse

SC – Supply Chain

SCM – Supply Chain Management

SD - Sustainable Development

SSCM - Sustainable Supply Chain Management

TAS – Transportation Assets

1. Introduction

This first chapter intends to present the lector the general framework of the theme, the motivation, as well as explain the main objective of the project and its structure.

1.1 General Framework

This dissertation project results from a partnership with Jerónimo Martins (JM), under the *Academic Thesis Program*, which aims a collaboration between universities and the company with the objective of developing new and relevant approaches for the food retail sector. The program it is variable-length stage, which allows the trainee to interact on-the-job with the business reality and improve their technical and transversal skills. Every year, themes and challenges identified by the different business areas of the group are proposed. These challenges lead the trainee to delve into the retail universe, thereby developing solutions to the challenges posed. The information collected in this process, as well as the results obtained, constitute subsequently the final thesis work required. The challenge selected for this dissertation is *"Reverse Logistics: Assessing the Current Chain and Opportunities"*, and the company gave freedom to how the topic could be developed. Being so, the purpose of this work is to describe the Reverse Logistics practices that are present in this company and analyze them critically. This internship does not constitute a work stage, allowing only the student access to the facilities and its work records.

In recent decades, the increased competitiveness of the market and the shift of power from seller to customer has led retailers to focus increasingly on managing their Supply Chains (SC) in an attempt to make them as efficient and profitable as possible. In the 1990s, the need to serve the customer more and better led to Logistics and Supply Chain Management (SCM) becoming essential skills in the retail market (Fernie & Sparks, 2004). Therefore, the growing interest in these areas, allied to the major environmental concerns of society, has aroused a growing interest in the concept of Reverse Logistics and its practices. This is evident at the academic level, with the growing number of articles and publications made in the main newspapers and magazines in the field (Rubio, Chamorro, & Miranda, 2008). On the other hand, retail companies are facing increasing uncertainty about consumer demand, as seasonality of sales and ongoing promotional campaigns throughout the year, a common feature of the largest retail chairs, make it even more difficult to predict the volume

of demand accurately. In response to this uncertainty in demand, ensuring that the quantity of items in stock is sufficient and that the company will not incur excessive purchase costs, establishing return contracts with suppliers for surplus goods is an extremely important measure for retail (A. Taylor, 2002). Consequently, it is becoming increasingly important to improve the way in which reverse logistics is managed within each company, so that it ceases to be labeled as "*the forgotten child of the supply chain*" (Morrell, 2001).

The implementation of an effective and efficient reverse logistics chain is crucial not only for the retail company itself, but for all other market players, such as primary suppliers and customers themselves. Since only with an efficient system will it be possible to achieve the multiple benefits derived from this area and minimize the costs of its processes (Jack, L. Powers, & Beitelspacher, 2010). Even so, it can be said that reverse logistics has always been done in any business, even under another name, in greater or smaller quantity, with more or less developed processes, in stores or in warehouses, with more or less costs / gains associated and with more or less efficiency. This combination of factors depends, among other reasons, on the know - how that exists within the company on the subject, on the effort applied by managers in solving problems and improving processes and on the initial and continuous investment that the company is willing to make.

With high business volumes and great prospects of growth, retail appears in Portugal as one of the most attractive and competitive markets in the country. In 2018, retail sales[1] in Portugal accounted 20.945 million euros[2], representing around 10%[2] of Portuguese GDP[3]. Jerónimo Martins is one of the leaders in Portugal, along with Sonae, where efficiency and planning are key words in the day to day of all its collaborators. No company can survive and be a leader if it does not keep up with the constant evolution and the new and ever more demanding needs of society. Therefore, and given both the current size and the growth of the group, dealing with returns and any other type of return in the most efficient way possible, it is crucial and an ongoing task. As will be seen, it holds benefits at various levels, both in the relations with customers and suppliers, in the efficiency obtained between the departments within the group, and even in the reduction of costs and direct monetary gains, that can only be achieved in this logistics area. Jerónimo Martins is one of the more relevant retail companies in Portugal and Reverse Logistics has been proving that, more than an

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[1] Includes food and non-food retail sectors.
[2] Data collected from *Associação Portuguesa de Empresas de Distribuição (APED).*
[3] *Gross Domestic Product.*

aspiration in the business world, it is a reality that must continually be investigated and perfected by organizations, where Jerónimo Martins is no exception.

1.2 Main Objectives

In order that to all the research and work to develop with the greatest focus and rigor, general and specific objectives must be established, as well as a research problem. However, in this introductory chapter, it is only important to highlight the main objective of this work, which is to provide the company with detailed and precise information on how this area of reverse logistics works and provide guidelines for improvements.

1.3 Structure

Given that, this project results from a partnership with a real company, and both the presented data and the challenges / problems are real, and the proposed improvements can effectively be implemented, this dissertation constitutes a Company Project. In order to achieve the proposed objectives, the present project study will be organized into six chapters.

In the first chapter, we present an overview of the study, from the context of the study and its relevance, both to the organization under study and to society in general, to the main objective and structure of the project.

In the second chapter, a bibliographical review will be carried out on the main aspects related to Reverse Logistics, with the most relevant studies in the field being presented.

In the following chapter, the methodology used to produce the project is presented and described in detail. The objectives of the work and the way in which data collection and analysis have been made will also be presented here.

The fourth chapter describes the case, the company under analysis, and the department targeted in the project. A brief contextualization is provided before the discussion of results.

The following chapter consists of the project itself, with the analysis and discussion of results, which includes the presentation of process maps and guidelines for improvements.

Finally, in sixth and last chapter, a brief conclusion will be made, with the main results obtained, the limitations of the research, and showing how this project can be as an example for other companies in the sector and be an asset to the academic environment.

2. Literature Review

In this second chapter, a literature review on reverse logistics is conducted. The main objective is to present to the reader the main dimensions of this concept, as well as its evolution over time, also emphasizing its growing importance. It will begin the framing of the theme, followed by an evolution of the concept of RL, and a framework developed by Brito and Dekker (2003) will be used to describe the five main dimensions of the study of RL, followed by an analysis of logistics costs and a brief contextualization of the retail sector. The chapter ends with a presentation of the most relevant studies carried out so far.

2.1 Theoretical framework: Supply Chain and Sustainability

Allied with globalization, there was a need for efficiency and for provide a better service to the final consumer, which led to the development of the concept of Supply Chain Management, especially by large retail companies but also by the academic community (Fernie & Sparks, 2004). According with Ganeshan and Harrison (1995), the so-called traditional supply chain is a set of physical and information facilities, responsible for the provision and transformation of materials into intermediate products and then final products, and for their distribution to the final consumer. The supply chain exists in the form of a manufacturing company, or provider of services and products, and its complexity depends on the industry and from organization to organization.

It was during the nineties that the paradigm of company management changed, and the success of a business began to depend on a company's ability to integrate an extensive network of business relationships into its management (Lambert, Cooper, & D. Pagh, 1998). In 2013, the *Council of Supply Chain Management Professionals* (CSCMP, 2013), define SCM as "*the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers (...) It includes all of the logistics management activities noted above, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, finance and information technology*".

Regarding the Logistics Chain Management (LCM), this is a subject that has received significant attention over the years, and includes a set of procedures that aim to efficiently and effectively integrate suppliers, manufacturers, warehouses, and stores, with the objective

of produce and distribute products, in the right quantities and at the right time and place, minimizing costs and meeting the service requirements expected by the final consumer (David Simchi-Levi, Kaminsky, & Simchi-Levi, 2003). In addition, the CSCMP establish Logistics as "*that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers' requirements. Logistics management activities typically include inbound and outbound transportation management, fleet management, warehousing, materials handling, order fulfillment, logistics network design, inventory management, supply/demand planning, and management of third party logistics services providers*" (CSCMP, 2013). Logistics Management (LM) integrates logistics activities with other functions, including marketing, sales, manufacturing, finance, and information technology, and this definition constitutes one of the most complete one, since it considers the reverse flow of goods, services and information (CSCMP, 2013). It is important to note that, although directly related, the concepts of Supply Chain and Logistics are different, as are their management (Frazelle, 2002).

In recent years, the exhaustive exploitation of the planet's natural resources and the growing social awareness of environmental problems have started to shape the way in which SCM is faced by companies. As a result, sustainability has become a fundamental factor to take into account in Supply Chain Management (Barbosa-Povoa, 2009). The concept of Sustainable Development (SD) is relatively new, and was defined by the *World Commission on Environment and Development* (WCED, 1987) as the "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*". In 2008, the authors Seuring and Müller (2008) conducted a study, through which they analyzed 191 papers published between 1994 and 2007, in order to identify the major issues raised by specialists for Sustainable Supply Chain Management (SSCM). The authors defined the SSCM as the entire management of material, information and capital flows, while considering the three dimensions of sustainability, economic, environmental and social. The same study also highlighted the high costs and the complexity and coordination effort required as the main barriers to a sustainable supply chain management.

In an uncertain context of product demand, and with increasing environmental pressure on supply chain management, the need to incorporate Reverse Logistics within companies is becoming evident. Although costly, the implementation of these practices may result in

economic benefits, namely with the recovery of products, and in greater flow flexibility that tends to create a more profitable network (Cardoso, Barbosa-Póvoa, & Relvas, 2013).

2.2 Reverse Logistics

2.2.1 Reverse Logistics: Definition and Scope

Activities such as the return, recycling and recovery of products dates from long ago, and terms such as "*Reverse Channels*" or "*Reverse Flows*" have already appeared in the literature of the 1970s, but mostly in the scope of recycling (Guiltinan & Nwokoye, 1974) (Ginter & Starling, 1978). The research of Quesada (2003) goes back even further, and points Terry (1869) and Beckley and Logan (1948) as one of the main and first authors to address returns, but without referring to them as Reverse Logistics Flows.

The use of the concept of Reverse Logistics as such, took some years, being Murphy and Poist (1988) pioneering authors in this field, defining RL as "*the movement of goods from a consumer towards a producer in a channel of distribution*". Through this definition, these authors pointed out the direction to follow, and which flows to consider as Reverse Logistics flows. From this concept, two aspects can be concluded: first, any product that meets the given condition is considered part of the RL flows; second, the agent identified as "*producer*" is not necessarily the original producer. Doubts about this concept may arise regarding the Reverse Logistics' distribution channel, as being the one previously used in the forward flow or another one created for this purpose (Quesada, 2003).

In 1992, the first international publication of the definition of reverse logistics was made by the Council of Logistics Management (CLM), with Stock (1992) defining RL as "*… the term often used to refer to the role of logistics in recycling, waste disposal, and management of hazardous materials; a broader perspective includes all relating to logistics activities carried out in source reduction, recycling, substitution, reuse of materials and disposal.*". From this year on, the concept and the proper practice of it acquired more relevance, more specifically with the works of Stock (1992), Stock (1998), Tibben-Lembke and Rogers (1998), Brito and Dekker (2003) and de Brito, Dekker, and Flapper (2003)

Soon after, Pohlen and Farris (1992) wondered about the real meaning of "*recyclable*" in the definition, and drew their attention to whether or not recyclable materials had to return through the same supply channel.

A year later, Kopicki (1993) relied on previous concepts to define RL as "*a broad term referring to the logistics management and disposing of hazardous or non-hazardous waste from packaging and products. It includes reverse distribution (…) which causes goods and information to flow in the opposite direction of normal logistics activities*".

In the end of the nineties, Reverse logistics was presented as an extension of the traditional logistics chain, defined as "*the process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal*" according with Tibben-Lembke and Rogers (1998). This definition already includes part of the process involved and the objectives of these particular flows. According to the authors, the redesign of packaging, reduction of energy used and pollution from transport, although important, do not constitute activities of RL but the so-called "*Green Logistics*". In this research, it is recognized, however, the environmental benefits as drivers of reverse logistics, but if there is no movement of goods, then is not RL (Tibben-Lembke & Rogers, 1998).

In 2004, the article *Logistics – Capturing Value in the Extended Supply Chain* (M. Fleischmann, van Nunen, Graeve, & Gapp, 2004) complements the research of Tibben-Lembke and Rogers (1998), and presents potential ways to recapture value, after the different products pass through the so-called traditional supply chain. Among others, the return of excess stock to primary suppliers, the return of used items for sale in secondary markets or their reintegration into the supply chain, as is the case of pallets and boxes, the return of damaged goods for recovery and possibility of reintegration, or simply the return of items for recycling.

More recently, the researchers Pokharel and Mutha (2009) addressed reverse logistics, as including waste management, recycling and reuse of materials, and the recovery of components or products. This approach and the concept of RL itself, imply a change in the paradigm of the life cycle of products. Traditionally, the life cycle of a product has included the period between its production and its end-of-life ("*cradle-to-grave*"). Nowadays, with the growing interest in this concept and its introduction into the strategic and operational decisions of organizations, the life cycle of a product has increased by encompassing the recovery phase, after the end of its useful life, and its reintegration into the supply chain ("*cradle-to-cradle*").

If in the old days, the concept of reverse logistics was seen more as a cost, more as a job or more as a department for the company to manage, and apparently, of no use or return

associated with it, nowadays, this idea has changed. Companies, given the current competitive environment, cannot afford to neglect reverse logistics as part of their supply chain and operations strategy. (Deloitte, 2014).

Once understood the evolution of the concept of Reverse Logistics over the last decades, it is essential to understand what it depends on and how its application happens in a company and in the corresponding supply chain. Brito and Dekker (2003) have developed a framework, where they identify and describe five essential dimensions around Reverse Logistics:

Why to receive?	Intends to identify the drivers that lead an organization to adopt Reverse Logistics practices, which means, to receive the products back.
Why to Return?	Aims to determine the reasons that lead products and materials to be returned, that is, the reasons for reverse flows.
What?	Intends to determine which goods, products and materials, are returning and their main characteristics.
How?	Intends to describe how reverse logistics works in practice. Processes and operations aimed at recovering some type of value, as well as a description of these recovery options.
Who?	It aims to identify the actors in these practices, internal and external to the organization and the functions performed.

Table 1 - Summary of the dimensions identified by Brito and Dekker (2003) - Own elaboration

The authors provide a detailed description for each of these dimensions based on papers published until the date of this research. Since then, many works have been conducted exploring the concept and related aspects. In the following sections, these dimensions will be discussed in detail[4].

2.2.2 Why? Drivers for organizations having Reverse Logistics practices

The literature has over the years pointed out driving factors to explain the growing interest of organizations in the implementation of reverse logistics within their supply chains.

Carter and Ellram (1998) created a model that illustrates the influencing forces of Reverse

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[4] The dimensions themselves were introduced by Brito and Dekker (2003), but references from before and after this work will be used.

Logistics. These forces identified constitute four organizational entities, the suppliers, the buyers, the government and the competitive environment. This model was widely recognized as the first comprehensive RL framework (Hazen, Hall, & Hanna, 2012).

Later, Brito and Dekker (2003), in their research, found that companies began to include Reverse Logistics because either 1) they could profit from it; and/or because 2) they should do so; and/or because 3) they felt socially motivated to do so. Figure 1 illustrates the idea:
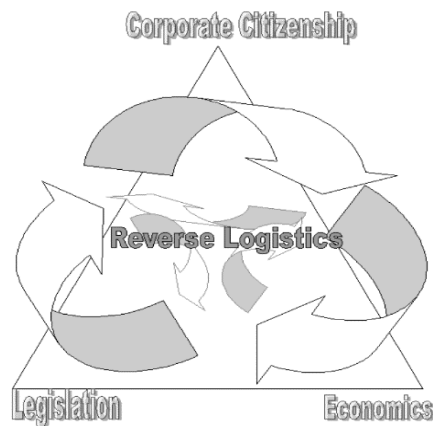
Figure 1 - Driving triangle for reverse logistics (Brito & Dekker, 2003)

- **Economic Factors:** A RL system can bring direct gains to the organizations, from the reduced use of raw material, the increase of value added through the recovery processes, or with the reduction of disposal costs, and the sale to secondary markets of returned materials or products. Even if the profit is not clear and immediate, an organization can benefit from reverse logistics (indirect gains), through marketing and creating a green image, for strategic and competitive objectives, as a strategic step of preparation and prevention for legislation, and the processes of return and recovery can also be used to improve relationships with customers and suppliers.

- **Legislation:** The legislation here refers to any governmental recommendation that indicates whether a company should accept returns and if, and how it should treat them. In Europe legislation has been developed in this context, associated with recycling, packaging and producer responsibility for the goods produced. In fact, customers have the right to return products, and so, companies are legally obliged to accept back those products. This is also perceived as a way to attract clients.

- **Corporate citizenship:** This motivation is related to the set of values and principles that encourage the company or the organization to be involved in a responsible way in a

reverse logistics process. In fact, many organizations have extensive programs of social responsibility, where social and environmental issues are priority.

Over the years, many authors propose new dimensions, new drivers and new frameworks to explore the main influencers for organizations to implement RL processes. Berrone, Álvarez Gil, Husillos, and Lado (2007) state that that RL programs result from a combination of organizational factors (the availability of resources), individual factors (the strategic posture of the decision maker) and external pressures (from consumers, suppliers, governmental and non-governmental organizations, etc.). In addition, the integration of RL in supply chains is increasingly used as a strategy for companies, to increase profits, to promote sustainability and to increase customer satisfaction (Du & Evans, 2008).

Bouzon, Spricigo, Rodriguez, Queiroz, and Cauchick Miguel (2015) based on the analysis of 25 scientific papers, identifies 11 main drivers distributed in three groups: External – General Environment, External – Operational Environment and Internal. It should be noted that the existence of these drivers varies according to the sector, size of the organisation and the country in which it operates (Agrawal et al., 2015). From this analysis, and based on a sample of 38 articles, it may be concluded that the most frequently addressed factors are those of governmental origin (Legislation), those associated with clients/consumers and the economic/financial ones.

More recently, Govindan and Bouzon (2018) has developed a review based on forty-four papers made so far, accessed and classified according to their structural dimensions and analytical categories. From this analysis, it result (See Annexes 1 and 2):

- 8 types of stakeholders, including: Government, Customers, Society/Community, Market/Competitors, Suppliers, Organization (focal company/stakeholders), Employees and Media;

- 37 drivers classified by internal or external, related with one or more stakeholders and classified into eight groups, including: Policy related issues, Governance and SC process related issues, Management related issues, Market and competitor related issues, Technology and infrastructure related issues, Economic related issues, Knowledge related issues and Social related issues;

- 36 barriers classified as internal and external, related with one or more stakeholders and classified into seven groups, including: Technology and infrastructure related issues,

Governance and supply chain process related issues, Economic related issues, Knowledge related issues, Policy related issues, Market and competitor related issues, Management related issues.
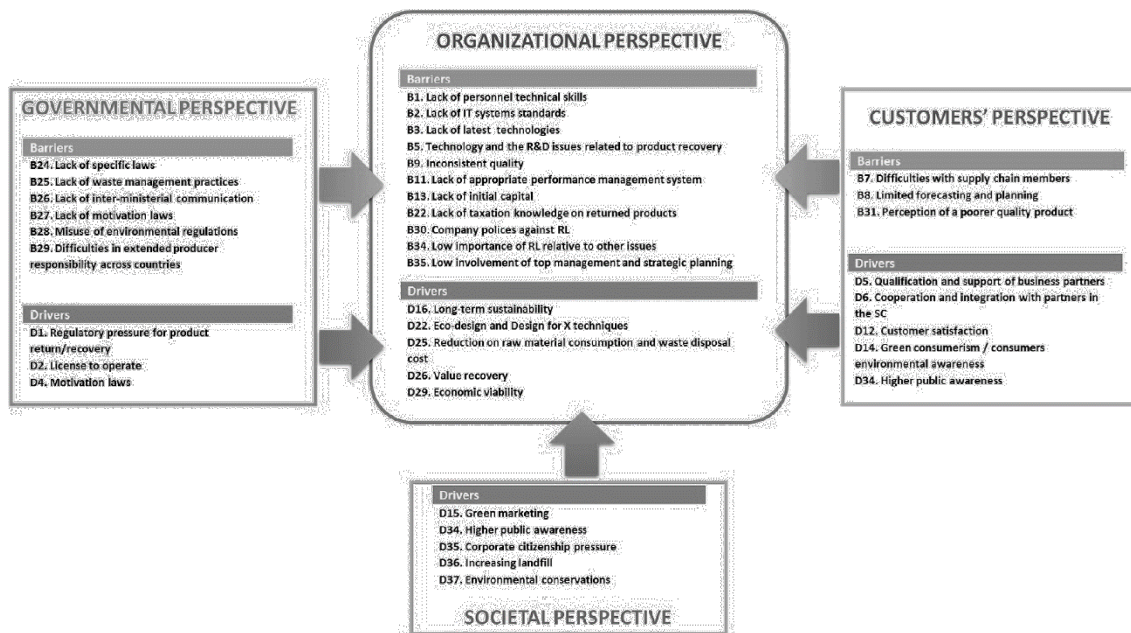
Figure 2 - Multi-perspective framework for RL implementation (Govindan & Bouzon, 2018)

The resulted information served as basis for the development of a multi-perspective framework. This framework (Figure 2) presents the main pressures/drivers and barriers from the previous lists, for implementation of a Reverse Logistics system, from four perspectives, including organizational perspective (OP), social perspective (SP), governmental perspective (GP) and customers' perspective (CP). The main drivers include Regulatory Pressure for product (GP), Green consumerism (CP), Economic Viability (OP) and Corporate Citizenship pressure (SP). In addition, the main barriers are included in the Organizational Perspective, including Lack of personnel technical skills and the Low involvement of top management, and Lack of specific laws (GP) and Difficulties with supply chain members (CP) (Govindan & Bouzon, 2018).

2.2.3 Why? Return Reasons for Reverse Logistics

According with Brito and Dekker (2003), the reasons that lead a product to return, vary mainly with the origin of the reverse flow, along the supply chain.

Therefore, there are reasons[5] at the level of the manufacturer, distributor/retailer and customer, as follows:

- **Manufacturing Reasons:** It includes components or products that have to be recovered in the production phase. The main reasons are when there is an excess of raw material, when there are failures in quality control and when overproduction occurs.

- **Distribution Reasons:** It refers to the returns that originate in the distribution phase. Includes product recalls (with safety or healthy problems), commercial returns (unsold products, seasonal nature, wrong/damage deliveries), stock adjustments (redistribution of stocks between warehouses and/or stores) and functional returns (transportation assets (TAS) that continuously move back and forward in the supply chain).

- **Customer Reasons:** Returns that had origin after the product reach the final customer. The customer may return the product because the product does not meet consumer requirements, commercial returns (reimbursement guarantees or warranty returns), product is defective (need for repair service), end of useful life for the customer, or general end-of-life.

Based on previous studies, M. Fleischmann et al. (2004) combine the reasons for discards and consequently for reverse logistics into two groups: the existence of agreements for returns of excess products and the extended responsibility of producers for end-of-life products. In addition, in the retail sector, retailers are forced to return items because of uncertainty in demand and because of constant devolutions from final customers (Chen, Daugherty, & Landry, 2009).

More recently, it has been pointed out as a reason for the return, the existence of monetary incentives or specific regulations, to encourage collection. Examples are the payment of a deposit at the moment of purchase, which will be returned with the delivery of the product or packaging to the company again, or the existence of exchange programmes for used products that generate discounts on new purchases (Grant, Trautrims, & Wong, 2015).

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[5] The reasons for returns identified by Brito and Dekker (2003) are in line with the types of returns already identified by Rogers, Lambert, Croxton, and García-Dastugue (2002) which will be described in detail.

2.2.4 What? Types and Characteristics of Returns

According to Rogers et al. (2002), there are different types of returns with unique characteristics and challenges. Accordingly, the different types of returns were grouped into five categories as follows:

- **Consumer Returns:** Returns due to consumer regret or product defects. The buyer is allowed to return, as companies believe that with liberal return policies, sales will increase.

- **Marketing Returns:** Companies in a forward position in the supply chain return products to companies back in SC, such as retailers returning to manufacturers (or suppliers) products they were not able to sell, with quality issues, or to replenish inventory. Includes damaged goods in transit, in warehouses or in stores returned by intermediate companies (not end consumers).

- **Asset Returns:** Include the recovery or reallocation of an asset such as a container, pallet, box or rack that companies expect to see returning to be reused in the Supply Chain forwards. It also includes the recovery of used or end-of-life materials/components for reuse in the production process.

- **Product recall:** Returns due to quality or safety issues, either by government order or at the initiative of the manufacturer.

- **Environmental:** Includes the disposal of hazardous products and materials and other materials in order to comply with environmental legislation. Government guidelines on disposal options are essential for this type of reverse logistics to happen.

In this dimension, Brito and Dekker (2003) considered the type of product being discarded or returned and its relevant characteristics in the return process. They refer to the composition, deterioration and pattern of use as the most relevant characteristics.

- **Composition**: It refers to the number and type of components or materials, whether they are hazardous, and the size of the product. These factors may influence how the products are recovered and how they are transported (Brito & Dekker, 2003; Gungor & Gupta, 1999). The level of homogeneity of the product will affect recycling, and the more homogeneous the good, the easier the recycling will be (Bonev, 2012).

- **Deterioration:** In the deterioration process, it is important to consider the velocity of the process, the ease of repair, and the economic depreciation of the product. These

factors will mainly affect the value resulting from the recovery process of the product after its return (Bonev, 2012; Brito & Dekker, 2003).

- **Pattern of use:** This factor includes the location of collection and the intensity and duration of use of the product. It covers the factors that may affect the forecast of quantities to be collected and the planning and frequency of these collection processes (Brito & Dekker, 2003).

Based on these main factors, were discriminated the product categories of: consumer goods, industrial goods, spare-parts, packaging and distribution items, civil objects, chemicals and oils, and other materials as scraps (Brito & Dekker, 2003).

All these aspects should be carefully analyzed by the organization, so that an efficient integration of a RL structure and adequate collection plans is possible, making the recovery of value as complete as possible. Each type of return requires a specific treatment and there are several stages in the life cycle of a product, where it can be returned to the different actors in the supply chain and from there to the original producer (Figure 3). The products can be returned in anyone of these stages, and therefore, it's difficult to predict with precision the quantities returned at each time (Ait-Kadi et al., 2012).
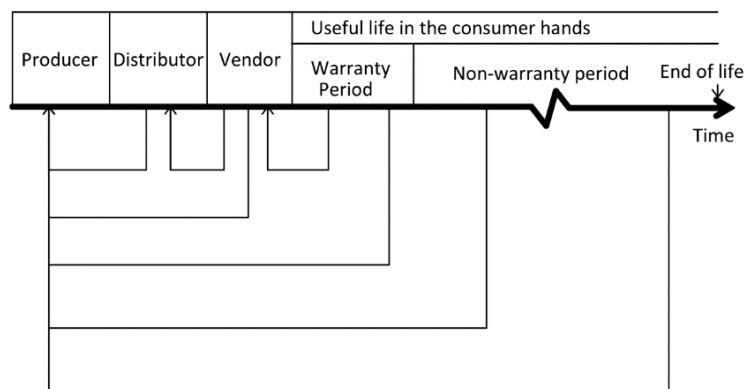
Figure 3 - Possible moments of return in the product's life (Ait-Kadi, Chouinard, Marcotte, & Riopel, 2012)

2.2.5 How? Processes and Activities of Reverse Logistics

Knowing the drivers for organizations, the reasons for the return and the types of products and materials that return, it is necessary to understand how all the reverse logistics activity is conducted along the supply chain and how the value of products and materials is recovered. Based on work done over the years (Agrawal et al., 2015; Brito & Dekker, 2003)four key processes are identified as presented in Figure 4.
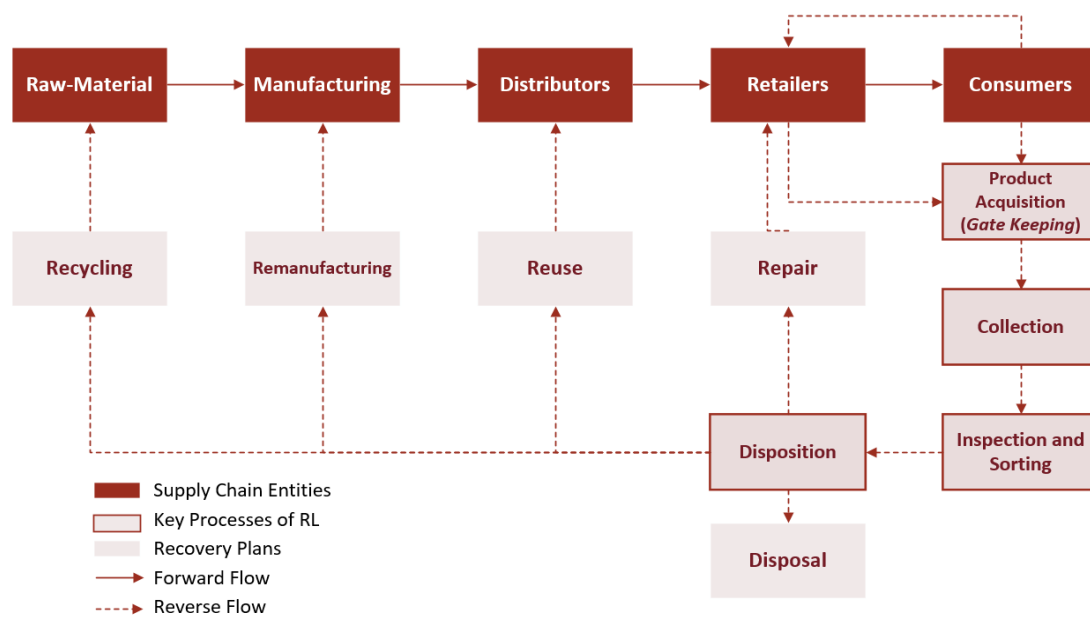
Figure 4 - Forward and Reverse Flows and Processes (adapted from Agrawal, Singh, and Murtaza (2015))

1. **Product Acquisition:** The Reverse Logistics activity begins with a process of acquisition of products, components, materials or used packaging from the end user so that they integrate the reverse flow for processing. This return is usually made by consumers and retailers (Agrawal et al., 2015), but any intermediate actor in the supply chain can generate reverse flow of goods (Brito & Dekker, 2003). This process presents high uncertainty regarding the quantities collected, the type of product and the frequency with which they are returned (Moritz Fleischmann et al., 1997). The entity receiving the good must assess and decide whether or not, it enters the reverse flow of the SC. "Gate Keeping" represents the decision and entry of the article into the flow and is considered a critical factor by Ravi and Shankar (2005).

2. **Collection:** Collection refers to the activity of bringing the products to a point of recovery (Brito & Dekker, 2003), that is, the moment when a company takes possession of the returns (Agrawal et al., 2015), transports them (when necessary) and delivers them to the facilities for inspection and sorting. Kumar and Putnam (2008) discussed three collection methods (Figure 5), from consumers directly to producers, from consumers through retailers to producers, and from consumers to producers via third party companies. The choice of the collection method depends on the quantities returned and on the cost structure that the company has associated for that logistics (Atasu, Toktay, & Van Wassenhove, 2013).
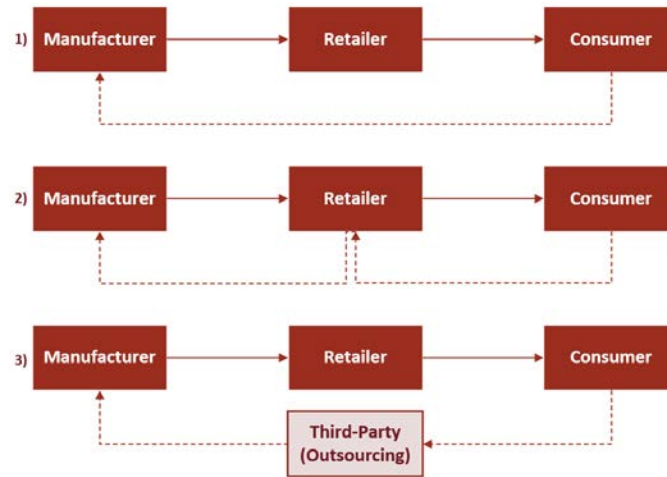
Figure 5 - Types of Collection Processes (adapted from Agrawal et al. (2015))

3. **Inspection and Sorting:** Different types of products can integrate this reverse flow, for different reasons and with different recovery plans (Tibben-Lembke & Rogers, 1998). At this stage, all collected products are inspected, and their appearance, physical condition and quality are evaluated, in order to decide the type of recovery plan will be implemented (Agrawal et al., 2015; Brito & Dekker, 2003).

4. **Disposition:** The last RL case involves a decision on the recovery plan to be followed. The authors Thierry, Salomon, Van Nunen, and Van Wassenhove (1995) initially identified as resolution alternatives the reuse of the product, product recovery and waste management and Tibben-Lembke and Rogers (2002) along with the previous ones, introduce also the product upgrade and the material recovery. The literature is replete with alternatives for recovery, which will be discussed later on.

These flows can be incorporated into the structure of the traditional Supply Chain, or carried out through a channel dedicated solely to RL management, or through a hybrid structure between the two previous alternatives. The decision and design of these structures is referred to as Reverse Logistics Network Design (Srivastava, 2006).

The main objective of product recovery management is, between different alternatives, to make the best possible economic and ecological value recovery of the returned products and materials, and with that reduce the amounts of waste (Thierry et al., 1995). Five common disposal alternatives for returned products and materials are widely discussed by academics, including re-use, repair, remanufacturing, recycling, and disposal (Agrawal et al., 2015; Brito & Dekker, 2003; Thierry et al., 1995).

The recovery of a good can be carried out with the product in the same state in which it was collected (Direct Recovery) or after undergoing some transformation or modification (Brito & Dekker, 2003; Thierry et al., 1995). In the first case, direct recovery, the quality of the products is close to "*as good as new*" (Brito & Dekker, 2003), and therefore are reintegrated almost immediately into the direct supply chain, through re-distribution, or re-sale in the same market or to a secondary market, or through **reuse**, as is the case with pallets and packaging (Thierry et al., 1995; Tibben-Lembke & Rogers, 1998).

In the second case, recovery via transformation or modification can take place at several levels (Agrawal et al., 2015; Brito & Dekker, 2003; Thierry et al., 1995):

- **Repair:** At the level of the product, where a repair is carried out in order for the product to be returned to the consumer.
- **Remanufacturing and/or Refurbishing**: At the level of parts and modules, the product, when possible and if possible, is improved, acquired higher quality and can be reused or resold.
- **Recycling**: The used product being at the end-of-life, can be remanufactured and recycled, and its materials reused for the future.
- **Disposal**: In case it is not possible to extract value from the recovery of the goods through one of the mentioned alternatives, it remains to proceed with the elimination of the products and materials from the supply chain. The elimination process can, nonetheless, to recover some value through donations or for energy production, through biomass or biofuels (Papargyropoulou, Lozano, K. Steinberger, Wright, & Ujang, 2014).

A study carried out by C. Deloitte (2014) identifies 4 strategic decisions for the way of doing reverse logistics in an organization. Taking into account organizational capabilities and objectives, decision makers select an appropriate approach[6], disposition methods, network models and execution plan. The last two aspects are especially important. An organization may choose between a centralized and a decentralized approach (Figure 6), and decision takes into consideration the product life cycle, the product value and cost and the volume and geographic distribution of returns. The execution plan relates to execute all the reverse logistics process "*in-house*" or by outsourcing.

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[6] Reverse logistics as a cost center (focus on improving customer experience) or profit center (focus on revenue generation).

Figure 6 - Centralized vs Decentralized Network Models (adapted from C. Deloitte (2014))

2.2.6 Who? Actors in Reverse Logistics Practices

The responsibility of Reverse Logistics does not belong only to one entity within the Supply Chain, but to the entire SC, and may also include other entities external to the organization or company. Accordingly, three groups of actors were distinguished (Brito & Dekker, 2003; Fuller, Allen, Polonsky, & Mintu-Winsatt, 1995):

- **Forward Supply chain actors:** includes the producer, the suppliers, wholesaler and retailer.
- **Specialized Reverse Chain Players:** includes jobbers, recycling specialists, etc.
- **Opportunistic Players:** includes for example charity organizations.

2.2.7 Costs of Reverse Logistics

Reverse Logistics represents a significant part of an organization's cost structure, ranging between 0,1% to 1% of the sales volume of a product and leading to an annual and global cost of $ 200 billion. Additionally, a properly managed reverse logistics chain has the potential to recover 32% of the original product value (Deloitte, 2014).

If returned goods are not disposed of quickly, or require a long period of time to recover value, the cost of handling and storage increases, resulting in financial losses. Based on that, Panigrahi, Kar, Fen, Hoe, and Wong (2018) described the main costs associated with the practice of reverse logistics in a company, as follows:

- **Processing Costs:** represents the main challenge for the retail industry, and includes the costs of processing the returned item.
- **Logistics Costs:** includes costs related to movement and handling of returned products. Includes costs for freight, handling and warehouse storage.

- **Replacement Costs:** when the returned product involves the issuance of a credit, or exchange for another product.

- **Assets Depreciation Cost:** associated with return goods that may have to be re-stocked, refurbished or sold as waste.

2.3 Retail Sector and Reverse Logistics Management

Historically, small businesses have provided for the supply of the entire population, with a retail market characterized by a large number of small establishments. In the 1980s, there was a great growth in distribution in Portugal, with consumers searching for larger stores and enjoying a greater variety of products, food and non-food, in a single space and at more competitive prices. In 1986, Portugal joined the European Economic Community [7] (EEC), which boosted the growth of imports and exports, and allowed the portuguese population to access products of higher quality and sophistication.

The distribution sector is divided into two sub-sectors with interconnected activities, the wholesale sub-sector and the retail one, the first concerns the first activities in the supply chain and the second relates to direct contact with the final consumer (Mendes, 2005). This previous study presents a decision support methodology for evaluating potential locations of small to medium sized food retail stores, based on sales forecasting models. The location is considered as a critical factor and different types of retail outlets are identified, *Specialized Stores*, *Discount* and *Hardiscount* Supermarkets, *Hypermarkets*, *Large Supermarkets*, *Convenience Stores*, *Proximity Supermarkets* and *Traditional Stores*.

Grocery retailers were the first to pay attention to product returns and develop reverse logistics processes inside their supply chains. This inclusion also led to the development of customer support and reclamation centres, and centralized reverse logistics centres for returns management (Vijayan, Kamarulzaman, Mohamed, & Abdullah, 2014)

A recent study named *State of Retail Returns* (Optoro, 2018) reviews the state of retail returns globally, based on a survey of the 120 largest retail companies in the United States. The main findings are described:

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[7] European Economic Community (EEC) was an organization founded in 1957, with the aim of establishing a common European market.

- The impact of returns on U.S. retailers is greater each year, and has been estimated to be around $380 billion in merchandise.

- About 49% of retailers offer free return policies.

- Many retailers still lack a solid strategy for returns and this is not a priority in the industry.

- More than 50% of respondents said they had no way to report or control their returns.

- About 68% of respondents assumed to have no corporate or representative area to deal with Reverse Logistics and only 30% quantified the costs associated with returns.

- Technologies are beginning to be present in return management, and 23% of retailers already use a technology solution.

- It has been shown that a positive experience with returns encourages a repeat purchase by the consumer, with 69% of respondents supporting this conclusion.

- Even if consumers expect that companies act on social and environmental issues (86%), returns continue to be disposed of without adequate treatment (around 36% of returns volume). In the USA, there are about 5 billion pounds of waste landfills per year.

- Approximately 75% of the companies surveyed believe that by improving their reverse logistics system, it will be possible to achieve positive organizational and environmental impacts and 82% consider Reverse Logistics as a very important element to consider.

In 2018, wholesale and retail trade in Portugal amounted to 43.519,6 million euros. In the same year, food and non-food retail totalled 20.945 million euros, 3.4% more than the previous year, and food alone accounted 12.403 million euros. The top three food categories with the highest growth were Frozen Food (6.1%), Perishables and Snacks (4.1%) and Grocery (4.0%). In addition, the weight of promotions in food retail continued to increase, representing 46.4% of sales and the weight of own brands was around 33.6%, while manufacturers' brands accounted for 66.4% of sales. In non-food retail, capital goods increased by 5.9%, namely telecommunications equipment, which grew by 9.5%. Entertainment and stationery grew 5.1%, fuels sold by distribution companies increased sales by 4.7% (to 3,633 million euros), and clothing registered a 2% increase (APED),

2.4 Chapter Summary

Studies around Reverse Logistics and its dimensions have been extensive, especially in recent decades. Considering the literature review accomplished, some ideas were concluded:

- Efficient Supply Chain Management is crucial to the management of an organization and to the creation of value for the different stakeholders.

- Given the global environmental situation in which we live, following a sustainable strategy in SC is essential and requires the implementation of reverse logistics practices.

- Reverse logistics is the opposite of the so-called traditional supply chain, since it includes all the processes that bring the used products and materials, through a distribution channel to the retailer, supplier or producer.

- The study on Reverse Logistics, however relatively recent, is extensive and conclusive in relation to its necessity. However, before implementation, the characteristics of the sector and the country where the company operates should be taken into account.

- The main drivers that lead an organization to implement RL are organizational (economic advantages and recovery of value), social (social pressure and to be a green company), governmental (comply with legislation) and to meet the needs of consumers and organizational partners.

- The reasons for a product's return relate to the consumer, to the distributor/retailer, to the manufacturer, as a result of monetary incentives or as a result of legislation obliging end-users to make the return.

- The key processes of Reverse Logistics include product acquisition, collection, inspection and sorting and recovery. In addition, the main recovery plans include repair, reuse, remanufacturing, recycling and disposal.

- The actors in this process can be internal or external to the organization, and is not the responsibility of a single area or department, but of the whole Supply Chain.

- In the past, retail appeared in the form of a large number of small businesses close to the population. In the 1980s, small businesses began to be replaced by large chains with larger stores and a wide variety of products.

- Retail in Portugal represents close to 10% of GDP and sales through promotions represent almost 50% of total sales in this sector.

- Returns can have great weight in an organization and in a country's own economy (in the USA, returns are estimated to be around $380 billion).

- Even though the impact of Reverse Logistics is already recognized by organizations and employees, its implementation still remains far from what it could and should be.

3 Methodology

This chapter will describe the methodology used in the development of this work, as well as the methods of data collection and analysis in order to respond to the proposed research problem and related objectives.

3.1 Research Methodology

As previously mentioned, the purpose of this work is the characterization and evaluation of the current reverse logistic chain in one of the main leaders in retail sector, Jerónimo Martins. To accomplish this project, the following fundamental steps were followed:
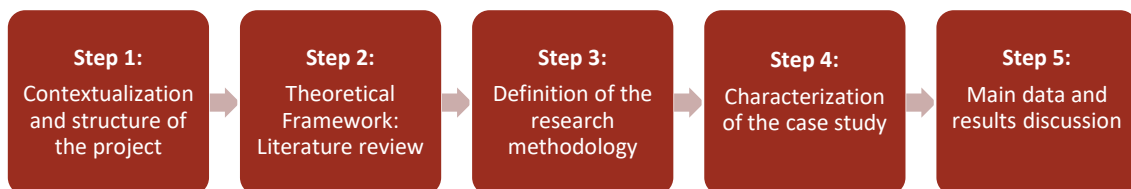
Figure 7 - Steps of Methodology

The methodology of this investigation is mainly qualitative, describing the case selected, answering the question "How is", and making use of investigative methods such as direct observation, analysis of documents provided and interviews with the responsible and operational warehouses and stores. The information collected and analyzed is essentially qualitative, but not exclusively (Saldaña, 2011). In a qualitative research, the objective is to achieve a qualitative understanding of the underlying reasons and motivations surrounding the problem of the study sample, usually small samples, as is the case of the present study area, in a single company. This provides knowledge and understanding of the circumstances and the environment around the selected problem. The collection of data may or may not be structured, and as a result, it is expected to perceive the state of the case under study (Malhotra, 2010).

This project tends to follow a study case methodology that is a strategy of investigation, translated in the comprehension of the presented case and in its unique characteristics associated to the topic in study. This type of research usually combines data collection methods such as documents, interviews, questionnaires and observation (Eisenhardt, 1989). Also, according to the methodology identified in Creswell and Poth (2017), this project is

classified as a case study[8] given that it tends to follow the following steps: 1) description and analysis of one or more cases; 2) understanding of the processes raised; 3) study of an event; 4) use of various sources of information such as interviews, observation and documentation and 5) analysis of the information obtained.

3.2 Process of Data Collection and Analysis

The collection of data occurred along four months, from October of 2018 to January of 2019 in order to achieve the goals of the investigation. In view of the fact that the author of this project is a full-time employee in a company other than the partner company of this research, data collection took place on Saturdays, holidays and other punctual days during this period.

The primary phase of data collection consisted on access private records, from documents to multimedia material, both at company level and at the level of the department on which the study is conducted. Given the opening of the company, for the possibility to be present regularly in the work of research facilities, the main techniques used were direct observation and interviews with employees from warehouse and stores. These interviews were recorded in audio for later transcription and use of the collected information.

All the information presented in this work, from quantitative data to the qualitative data of interviews (See Annex 12) and observation processes, were confirmed and verified by the collaborators, and by the tutor indicated by the company to follow up the investigation.

Note: The Jerónimo Martins Group provided several documents for analysis during the research. In this sense, the quantitative and qualitative data presented in chapters 4 and 5 will not be referenced.

3.3 General and Specific Objectives

The present work is related to the need of an organization to know itself better, to clarify its processes, its strengths and weaknesses, and through this partnership, find ways to improve. The company has processes already designed and properly implemented, which even reaching its main objective, to give an appropriate end to each article or waste that returns, present weaknesses. The activities are carried out in a natural way, although many of

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[8] The report also presents as other alternatives to Narrative Research, Phenomenology, Grounded Theory, Ethnography in addition to the Case Study, which is the one that is closest to the methodology of this project.

the participants are not aware of the entire reverse logistics process. This work is intended to provide the company with a clear and correct representation of all existing reverse logistics processes, characterizing and explaining these same processes in all their dimensions, and furnish the company with guidelines for improvements. Although improvements are presented in this work, these will not be the main objective, but one of them. In short, three fundamental stages of the project are considered: Know, Describe and Understand and Analyze.

Figure 8 - Three Stages of the Project

First Phase: Intends to provide general information about the company under study and more specifically about the target department of this investigation, including a contextualization, a characterization of the physical space and benefits that the organization recognize, for having and want to improve these processes.

Second Phase: comprehend a deep look into the reverse logistics practices of the company. All processes and types of returns will be identified, described in detail and mapped. The objectives for this part include, describe and understand:

- What kind of products and materials return and why?
- How they return?
- What are the logistic monetary costs and gains associated with it?

Third Phase: The aim is to analyze the performance of the processes, mostly to identify existing daily difficulties. Based on this, guidelines for improvements will be presented that are primarily aimed at correcting these same difficulties, and that can promote the overall efficiency of this chain.

Realizing how the various processes of reverse logistics of a giant Portuguese company in the retail sector works, we intend also to be possible to make known the benefits of implementing this kind of logistics to other companies as well as provide new literature on the topic.

4 Case Description

The fourth chapter of this work presents the Jerónimo Martins Group, the company that promoted the challenge for this project and where the internship took place. The history of the company, its mission and values, and its main business areas will be presented here. At last, the theme of this project will be contextualized in the company.

4.1 Jerónimo Martins

The history of Jerónimo Martins began in 1792, when a young Galician with a great entrepreneurial spirit opened a modest store in Chiado. His name was Jerónimo Martins and after 227 years, he still gives his name to one of the greatest food specialists in the world. Currently, the JM group is a Portuguese food distribution and specialized retail business group, present in Portugal, Poland and Colombia. Over two centuries of experience and accumulated knowledge, JM has a solid position, both in the markets where it operates and internationally, having occupied in the annual study *Global Powers of Retailing* (Deloitte, 2019) the 56th position in the ranking of the world's largest retailers. The main segment is food distribution, being the leader in Portugal with the Pingo Doce and Recheio brands and the leader in Poland with the Biedronka brand, where it has operated since 1997. Its activity in Colombia began in 2013, with the Ara stores and is a market with high growth prospects. There are more than 3,800 stores that generated more than € 16 million in sales in 2018. In addition to these brands, JM has more than 40 own brands that weigh on sales volumes, in Pingo Doce this weight is 34% and in Biedronka it is 41%.

	Brand	Description	Stores	Sales (€)
Food Distribution	Biedronka	Super Stores and Hypermarkets in Poland	2900	11.691 M
	pingo doce	Super Stores and Hypermarkets in Portugal	432	3.835 M
	RECHEIO	Cash & Carry in Portugal	42	980 M
	ara	Food stores in Colombia	532	599 M
Specialized Retail	hebe	Health and Beauty Stores in Poland	230	207 M
	HUSSEL Confiserie	Chocolate and Confectionery Stores in Portugal	24	25 M*
	J	Kiosks and confectioneries in Portugal	22	

* includes the remaining sales that were not included in any of the previous brands
M – Million

Table 2 - Jerónimo Martins Business Segments

The group's mission is to satisfy the interests of its shareholders and the needs of its stakeholders, through a strategy focused on the creation of value along with a sustainable development. The company's approach is based on the promotion of health through food, respect for the environment, responsible purchasing and support for communities, being a reference employer for its more than 100.000 employees. Major steps have been taken in all these areas and in improving the service provided to the consumer. Address society's needs and changes is the daily goal of the group, its employees and business partners.

It was in 1980 that JM in partnership with the Delhaize Group set up the Pingo Doce Company with a clear strategy of exploring the supermarket segment. In the following decades, several acquisitions followed with the aim of strengthening its market position, namely the acquisition of Plus Group in 2008 and the absorption of the Feira Nova brand partially in 2008 and 2010. The growth of the Pingo Doce brand is visible both in the growth in the number of stores and in the constant increase in its sales volumes, in 2008 of € 2.503 M and in 2018 of € 3.835 M. Currently, the Pingo Doce chain supports an area of 506.754 m^2, with 432 stores spread over 300 locations throughout the country.
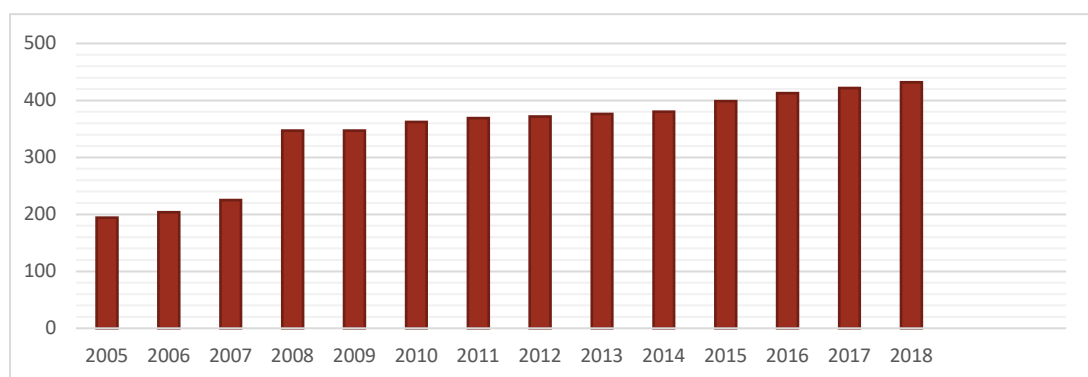
Figure 9 - Evolution of the Number of Pingo Doce Stores

4.2 Contextualization

Jerónimo Martins reaches the homes of the Portuguese through 7 logistics distribution centres[9] , from the north to the south of the country, each one operating independently, and supplying 474 *Pingo Doce*, *Recheio* and *Caterplus* stores. The 432 Pingo Doce stores account with an average of 700.000 daily visits, motivated, among other reasons, by a unique store space, the quality and variety of products and the proximity to the customers. What is

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[9] There are 2 logistics centres in the North (Alfena and Vila do Conde), 4 in the Centre e and 1 in the Algarve

unknown, however, is that this quality and variety of products is achieved through sustainable relationships with suppliers, which in turn, are achieved through the existence of logistics centres and product return points, the so-called *Return Warehouses* or *Reverse Logistics Warehouses*[10].

Additionally, the loyalty and admiration of customers towards the company derives from the same quality and variety of products that are available in all stores, and also from the existence of customer support areas, which aim to strengthen relationships of trust and proximity with customers. In this direction, a specific customer support area was also created, the *"Provedoria do Cliente Jerónimo Martins"*. Created in 2005, this area represents and defends the rights of the more than 4 million customers who visit the group's stores every day, representing a last resort for clients, to analyze and deal with complex and structural situations that have not previously been solved by the traditional service channels, such as stores or customer support services. Only in 2017, the mentioned department registered 1.909 new processes, representing a decrease of 4% compared to 2016, and 33 processes transited from the previous year, totaling 1.942 managed in that year. These areas are intrinsically linked to the process of returning and exchanging products by customers, either by manufacturing errors or by the mere fact that the product does not correspond to customer expectations. All Pingo Doce' stores allow the return of products, which may return to public sale, be eliminated in store, or return to the supplier. In any of these cases, this process of return is considered reverse logistics

On the other hand, several stores have collection points for end-of-life products and materials such as electronic equipment, oils and capsules. This kind of return is also considered as part of the reverse logistics flow. Without realizing it, RL is actively present in our daily life. Each time a product or material retreats in the traditional supply chain, it initiates a set of operations seeking to recover value from them, or at least, give these products/materials an appropriate and responsible disposition. Returns, devolutions and exchanges have existed since the beginning of JM. However, neither the volumes of returns were as large as now, nor the knowledge about the benefits of an efficient RL chain existed from the beginning.

It was in 2012, which gave one of the most recent impulses in this area. The business group conditioned by the crisis established earlier in Portugal, decided to change its

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[10] In portuguese: "Armazéns de Devoluções ou de Logística Inversa".

commercial strategy to meet the needs of the consumer, making a more continuous use of promotional campaigns. All this strategic adjustment, complemented with the increase in the number of stores, came to generate great constraints and challenges at the logistic level. In a particular way, the area of returns saw its return volumes increase significantly, and this implied looking at RL with different eyes in order to make the most of it. The oldest data on volumes of returns worked are for 2014, transportation assets (TAS[11]) and goods included in the amount of 23.474.546 units compared to 40.529.580 units in 2018[12].

Currently, JM is one of the leading market leaders in Portugal, and is seen as one of the companies that most bets on the development of its logistics operations. At the level of RL in the north of the country, and as a result of the group's growth, the strategic change mentioned above and the increase in volume of returns, the group had to start developing in this area, but it was only in 2012 that the first warehouse was born for returns' management. This part of the logistics was developing over the following years, and the company began to realize that it could have returns with it, reducing costs and making logistics operations more efficient. Since then, has been betting heavily on this area, developing increasingly own and self-directed work spaces within the logistic centers and with teams solely dedicated to dealing with these flows, as well as norms and procedures. More recently, the Alfena Logistics Center (ALC), in operation since April 2017, was built with this area in mind, and has a structured warehouse, the Reverse Logistics Warehouse (RLW)[13] and a team dedicated to processing returns. It should be noted that the reverse flows in the Recheio and Caterplus stores are managed internally by the same teams in charge of supplying goods for consumption. Therefore, the RL of these stores does not pass through the RLW, so we will address the topic, excluding the RL practices of these stores, focusing only on the practices associated with the Pingo Doce stores.

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[11] TAS - Transportation Assets (includes pallets, boxes, or any other goods transportation article).
[12] Values based on the KPI's (Key Performance Indicators) elaborated annually.
[13] In the work environment, the entire Reverse Logistics Warehouse is addressed only as a Returns Warehouse. However, for a better understanding of the work, it will be referred to as Reverse Logistics Warehouse.

5 Discussion and Analysis of Results

A detailed analysis of the current situation of Reverse Logistics in the Jerónimo Martins group will be carried out in this chapter. In a business context, reverse logistics is first and essentially associated with the existence of returns, referring to any product or material that makes the flow contrary to that which is directed to the final consumer. Given the size of the group, this analysis will be made according to all the information collected from the reverse logistics warehouse, in the logistic center of Alfena, where the internship project was held, which also represents the group's most recent venture, and the more advanced in logistical terms. The operations associated here also represent most of the group's RL operations, associated with the food retail and given the similarity of operation of all logistics centers, this dissertation will reflect what happens in this company in global.

Over the next pages, I intend to describe in a detailed but concise way all the activities and processes related to reverse logistics, in all its dimensions, as described in Chapter 2 of the literature review. The chapter begins with a characterization of the physical space where the RL processes take place and their benefits recognized by the company. Then, are described all the reverse flows identified, from the reasons of return, to the phases of the return processes and resolutions of each flow, which will be complemented by maps of operations. The operational difficulties identified and the costs and logistical gains inherent in these activities will also be described. In a final phase, and based on all the information presented, will be pointed out viable opportunities for improvement and that make sense both in the operational and organizational perspectives.

It should be noted that all the information presented in this chapter results from what was observed and apprehended during the internship, the documents consulted and the opinions of the collaborators, expressed in the interviews performed. Thus, only the subchapters of the difficulties and improvements bring the opinion of the project author.

5.1 Characterization of Alfena Logistics Center and the Reverse Logistics Warehouse

The Alfena Logistics Center of Jerónimo Martins, has been operating since April 2017, after one year of environmental impact assessment and project, followed by two years of work, in a global investment of about € 75 million. The main objective of this venture is to

be a point of communication and provisioning of the north and central area of the country. Located in a strategic position, occupies a total area of 100.000 square meters, of which 70.000 are covered area, and has at all 170 discharge docks. This center operates 24 hours a day, 6 days a week, supplying 175 Pingo Doce stores, 16 Recheio stores and 1 Caterplus store, from the north and center of the country. In this center, (See Annex 3) there are five warehouses, each with its operational manager and a team of operators.

- The Stock Warehouse counts with a team of 145 people, and with an area of approximately 20.000 square meters. It includes all kinds of non-perishable goods and has mostly in stock the branded products, which cannot be miss ed for selling.

- The JIT[14] Warehouse has a team of 160 people with an area of 23.000 square meters. It is divided into three areas of non-perishable goods, food, non-food and beverages.

- The Fruit and Vegetable Warehouse has a team of 68 people and an area of 10.000 square meters. It is a refrigerated warehouse (8ºC), being the main articles treated, fruits, vegetables, eggs and cod.

- In the Fresh Fish Warehouse, there is a team of 26 people and an area 10.500 square meters. It is a refrigerated warehouse (4ºC) responsible for fresh fish.

The Reverse Logistics Warehouse of the ALC is an independent warehouse of the rest, which works together with the logistics center of Vila do Conde, with a total team of 38 people, distributed by 3 daily shifts of 8 hours each, 6 days a week. Table 3 shows the distribution of human resources allocated to this logistics, including an operational manager, 2 Administrative and 35 operatives[15].

Global	RLW – TAS Area	RLW –Area of Returns	Warehouse in Vila do Conde
• 1 Operational Manager • 2 Administratives	• 7 Operatives – morning • 6 Operatives – afternoon • 2 Operatives – night • 4 Operatives – TAS Washing	• 5 Operatives – morning • 3 Operatives – afternoon	• 8 Operatives – Day

Table 3 - Distribution of Human Resources associated with Reverse Logistics Operations

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[14] JIT – *Just in Time*
[15] The operatives are responsible for all operations from the reception to the expedition of goods or TAS, respectively.

Unlike all other areas of logistics, witch the purpose is to deliver and supply products to their customers, reverse logistics makes these same products and/or materials return. The RLW is in constant contact with the other warehouses, working as a communication point between them, Pingo Doce stores and suppliers. This space brings several benefits and is responsible in practical terms, by:

- Support the remaining warehouses and stores in everything that may be necessary. It includes the storage function of TAS and merchandise and the management of returns to suppliers;

- Organize and control any reverse flow of non-perishable materials and goods associated with the other LC warehouses and stores. The management of these flows is based on the idea of centralization, defined as "*the collection of a certain type of products or residues, from different locations moving towards the same physical space, in this specific case, the RLW* [16]".

Like any other space or area of the group, also this reverse logistics area in ALC required a previous study on what physical conditions should have space, as well as equipment and human resources needed. The study, however, was based mainly on the "general knowledge" that the workers and managers had on the subject. The RLW is located near the administrative building and does not have any passage covered as connection with the other buildings. The warehouse has a total area of 6.000 square meters, works at room temperature and is divided with a physical separation in two equal parts: the Area of the TAS and the Area of Returns. The first has 8 unloading docks and in addition to the employees themselves, there are 1 of the company CHEP[17], 3 of the company LPR[15] and 8 of the company IFCO[15], to which JM gives this space, and in return can use the TAS when necessary[18]. Each of these working groups has their space duly separated and organized (Zone 4). The second area has 2 unloading docks, has a space for loads and discharges, a space for counting and inspection of the prescribed goods and a storage space. At the time of the study, in order to determine the necessary storage space, it was taken into account the quantity of pallets waiting to be lifted, the number of pallets waiting for the conference, and a space to support the stores, for seasonal articles. The study resulted in a total space for the

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[16] Transcribed expression from one of the interviews.
[17] CHEP, LRP and IFCO are suppliers of Transportation Assets, such as pallets, boxes and containers.
[18] It is possible that a monetary compensation paid by Jerónimo Martins to these external companies is associated here, in exchange for the use of TAS. However, it is not possible to confirm this information.

storage of about 1200 pallets for these three types (zone 1), and an open space (Zone 2) that serves to make the reception and sorting of the goods prescribed (Figure 10).
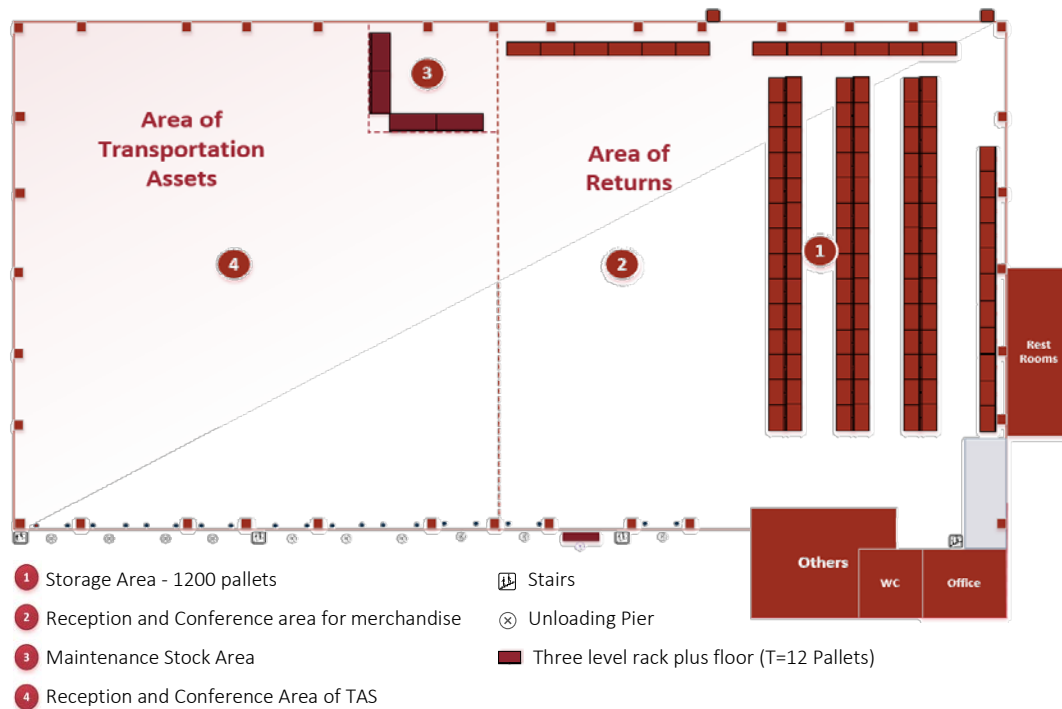

Figure 10 - Plant of the Reverse Logistics Warehouse in the Alfena Logistics Centre

5.1.1 Evolution of the Reverse Logistics Area in the North of Portugal

Until 2012, the RL of north and center of the country did not even have a workplace. Before, all the work associated with returns was done punctually in the distribution warehouses themselves, "*with access to one or two unloading docks, in a small space there in a corner and by the operators who already worked there*" [19]. The planned and seasonal returns were nearly non-existent, and it was up to the suppliers to go the stores to collect their articles. The TAS were returned by the stores to the non-perishable warehouses that made their return to suppliers, and the losses were much higher than the current ones[20]. JM was also dependent on external companies for many RL operations, including the collection of recyclable materials, to which monetary compensations were paid.

The first major change in this area took place in 2012, with the first RL warehouse to be constituted in the north of the country. This change was made, above all, based on the perception that it was possible to have returns with an efficient RL. The northern returns

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[19] Transcribed expression from one of the interviews.
[20] There is no quantitative data to support this information, which was obtained through the opinion expressed by former employees of the group, who saw the growth of this area.

began to be treated independently in three spaces (warehouses), Guardeiras, Laúndos and Vila do Conde. In the first two there was room for collection and treatment of TAS, and in Vila do Conde for the collection and treatment of TAS and merchandise. Since then, the work began to be more efficient and less dependent on external assistance, and with some income starting to be obtained with the sale of damaged pallets, but there was still a long road to be made. Human and material resources were reduced, limited space and operations dispersed by distant locations. There was a real need to centralize all operations and stocks, which only became more visible over the years, and even though know - how about the area was not the desired, the company knew that it was necessary to do better. This reverse logistics warehouse has been the answer to years of inefficiency and needs. Currently, the participants in this process of reverse logistics in the group (north), include the team of 38 people who operates in the RLW and the warehouse of Vila do Conde, the employees of the stores and the other warehouses of the logistic center, the primary suppliers, the companies organizations that receive donations and buyers from damaged pallets. The role of each of these is presented in the following sections.

"It was in the last 5/6 years that we began to develop this warehouse and it is still something that is being built and being implemented in the culture of the company, the collaborators and the stores, but there is clearly a tendency to evolve (...) The biggest difficulty is undoubtedly to make known to our customers (the stores) the best way to work so that everyone win with this (...) Change mindsets, change concepts at the level of people, about the importance that this warehouse has, which is new, is growing, but already has so much dependent on it (...) It is necessary to look at this as something that will help and not as something that only bothers and creates problems. This mentality still exists, especially in stores".

<div align="right">Operational Manager (November 2018)</div>

5.2 Drivers for Reverse Logistics and Benefits

As mentioned, only in the last decade, the benefits of making an efficient and correct RL began to be perceived by the group, resulting in drastic changes in the way returns would be dealt with. In 2012 there was the first major change in this area, and in 2017 it can be said that the JM was affirmed in relation to the way It sees RL. Giving its own space to devolutions and means to work, the company hoped to improve itself in all possible aspects, operational and organizational. The ALC, and in particular this reverse logistics warehouse came to bring challenges, but above all, benefits. This warehouse constitutes a recent area of

logistics, and as other logistical areas does not exist to generate profit, but to work in favor of the company's activity and as such, implies initial investment and operating costs, which then has returns, even more or less direct. Following, we describe those that since 2012 were the main motivations, identified by the company and collaborators, to do RL and above all to make an efficient RL, and that proved as unique benefits inherent to this area:

- *Compliance with the company's needs in this area and legislation*

There is no legislation forcing a company to have this space or this type of processes, but there are internal needs, flows to be processed, goods to be returned and transportation assets that have to circulate, which is the main reason for RL existence. On the other hand, there is great social pressure so that companies to be responsible for the end-of-life of their products, and in this sense, there is legislation that obliges Pingo Doce stores to accept the return of any item marketed or to exchange when the product is damaged, or simply because the product does not correspond to expectations. Also complaints about the state of the product, must be accepted and investigated, and proving the existence of a non-conformity, the stores are obliged to withdraw the affected items from sale and proceed with their return to the supplier or make an appropriate disposal of them.

- *Support to other Warehouses*

RLW provides a huge service to support the other warehouses of the logistic center, assisting them in daily life at various levels:

· The remaining warehouses no longer have to manage and stock boxes and pallets, as they are now concentrated and treated (received and dispatched) in one place (RLW);

· Assuming the work of TAS washing;

· Ensure that all boxes and pallets supplied for transportation of goods are in the appropriate state for use;

· Management of the sale of damaged pallets;

In general, RLW allows all work to be more organized and efficient, leaving employees and managers of the remaining warehouses to be "less overworked".

- *Support to Stores*

The stores also saw their work facilitated with the creation of this area of RL:

· Until centralization of returns, each supplier should move to each store to collect the goods. From the moment when the stores make all their returns to RLW, the supplier starts to move to a single location to perform the collection. In this way, the stores no longer have to store the items for return until the arrival of the suppliers, releasing space for other goods, and no longer have to perform this same return and to follow their conference, saving time, space and resources.

· Throughout the year, there are several stores that go through periods of remodeling, only in 2018 were 10 stores[21] that were in this process, and received the support of the reverse logistics warehouse of the north, namely for the storage of goods.

• *Improving relationships with suppliers:*

What happens countless times, is that for different reasons, products must be returned from stores. In fairs and seasonal campaigns, the stores are stocked in high quantities of products of various brands, sizes and formats, which are often anticipated as soon as they will not be sold completely. On other occasions, goods must be collected by manufacturing errors. For many years, at the end of these campaigns, or when identifying these errors, each supplier should go to each store to collect their products. This constraint affected contractual relations, both in terms of price and quantities provided that were established with suppliers. The existence of this area for RL in the logistic centers has facilitated this situation. The means of transport used to supply the stores, when returning to the logistic centers, began to be used to transport the products that should be returned to the suppliers, being stored there for later collection. Each supplier would make a single trip to a single location to collect their goods and could even resell the returned items. This has become an aspect to be taken into account in contract negotiations, giving more margin and financial advantages to JM, which could also risk more when establishing collection arrangements if there is no consumer adherence. This also allowed small suppliers who previously could have difficulties in fulfilling these collection obligations, to become JM partners.

• *Strengthen relationships with customers*

The group' stores are the mirror of the relationships that JM maintains with its suppliers. The collection pre-agreements that could be established with suppliers together with negotiating margins, have allowed lower prices, translated into quantity, quality, variety of

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[21] There were 10 stores in North Logistics (associated with the Alfena Logistics Centre).

marketed products and stronger promotional campaigns. Since 2012, the group's strategy has been to provide a unique consumer shopping experience, based on variety and low prices, which has become possible early on, with the existence of a more efficient reverse logistics. On the other hand, consumer's knowledge of the company's sustainable practices, namely, the treatment of returns of goods and materials waste, incentive campaigns for recycling, waste management and concern for the end-of-life of the products, promotes their loyalty and confidence in the brand.

- *Make the company's image healthier and more sustainable*

The whole group is recognized for its sustainable policies, environmental concerns and with the environments in which it operates. Pingo Doce stores constantly promote recycling practices and need to adequately address end-of-life products, in particular electronic products. The fact that the recycled volumes are growing, only shows that the message is reaching consumers, and that there is confidence in the brand. The existence of RL of this dimension also allows continuous donations to various institutions, and many of the monetary returns obtained from recycling are destined to social support.

- *Reduce Costs*

In 2012, JM realized that reorganizing and creating spaces and teams of RL, could cease to be dependent on external companies to do certain jobs, such as the management of TAS, and centralize processes in the same space, allowing to reduce costs and be more efficient. In 2017 the centralization was total, and even with a high initial investment, it was perceived that it was possible to reduce several cost items and to increase the income heading[22].

5.3 Types of Returns

Currently, the reverse logistics of Jerónimo Martins considers two main reverse flows, which sub understand other flows, managed separately even though in the same space (RLW): 1) The reverse flow of non-perishable goods and recyclable materials (in the Area of Returns) and 2) the reverse flow of TAS (in the Area of TAS). It then describes in detail how the management of each flow is performed, and for each, a map of operations created with the objective of describing what happens graphically.

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[22] See Subchapter 5.5 to know more about this Costs Reduction.

5.3.1 Area of Returns (AR)

a) Reverse Flow of Non-Perishable Goods

It includes the non-perishable articles that for several reasons could not go to store or had to be returned by them, and will now have to return to their primary suppliers or be properly treated with the objective of recovering some kind of value. The main reasons for devolution have to do with damage to the articles during the supply process, seasonality and demand uncertainty, the volume of acquired goods, quality issues and the existence of return contracts. The reverse flow of goods is distinguished in four categories according to the type of merchandise, location and reason of collection, and its value recovery plan. In this way, the returned goods will be treated through this work, in the same way they are treated in warehouse. The following categories are considered in this flow: *recovered products*, *recall*, *planned returns* and *seasonal returns*[23] and *regrouping*.

The process of returning a product starts in different ways and for different reasons for each category. Most of this flow has a physical origin in stores, but the process always starts with a decision made centrally on which products and quantities will be returned and on what specific dates. Subsequently, the stores prepare the indicated merchandise, which is then collected by the same fleet of trucks responsible for supplying the stores, making use of their return routes to the ALC. The transport area is responsible for the management of the fleet for the collection of these goods. In the returns area the following process is similar for all merchandise categories:

- **Reception:** The reception itself, relates only to the unloading of the goods from the trucks to the Area of Returns, and confirmation that each pallet has the *Return Guide*[24].

- **Waiting before Counting and Inspection:** For reasons of unavailability of time, space or labor, the merchandise on the pallets may have to wait until the following phases are fulfilled. This phase is common at the end of seasonal campaigns or larger promotional campaigns, and can generate months of waiting.

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[23] In portuguese: "Artigos Recuperados, Produtos Recall, Devoluções Planeadas e Devoluções Sazonais".
[24] In portuguese: "Guia de Devolução".

- **Counting:** Happens with the validation of the return guide that accompanies each pallet. For this process, the WPMS[25] computer system is used, where the operator, with the help of a PDA[26], reads the barcode that accompanies the store's return guide and confirms whether the articles indicated therein confer with what physically arrived at the warehouse. In case the physical quantities are equal to those indicated on the PDA the operator confirms the end of the process, passing all the articles to the inspection phase. In case there are differences, the counting made by the warehouse prevails, and the store responsible is credited with the break. Any returned item, is brought in reusable paper boxes (e.g. boxes of vegetables and bananas is the most common case), transported on pallets, and each must not have products of more than one supplier, and for each, a return guide.

- **Inspection:** The verification and inspection of the merchandise happens after counting, being, however, practically simultaneously. This process is done manually, taking into account the physical and functional state of the article and the existence of the barcode. During this conference is placed in each box, only a reference, which can be common to several stores. Rigorous inspection is essential throughout this process for several reasons:

  · Losses in quantity and damaged material are attributed to the store responsible for the return, and this value is incorporated in the item *Losses*;

  · About damaged goods, the supplier may decide not to accept the merchandise, especially if this is explicit in the contract, which will result in losses to the company and to the responsible stores;

  · The decision between destruction or donation is also dependent on this inspection, as it is necessary to ensure that donated items are in perfect condition for consumption, or that it is not destroying articles in full state of use.

- **Storage:** Its duration is variable, not only depending on the category in which the merchandise is included, but also by the type of supplier and the associated contract. The storage space is organized by damaged products, products for donations, products for

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[25] WPMS (Workflow Process Management System) is a specialized warehouse management system for medium-sized warehouses.

[26] PDA (Personal Digital Assistant) - small computers, with a large computing capacity, working together with the warehouse management system.

return to suppliers and products of the season. The merchandise is arranged on pallets organized by each of these areas and by supplier. The storage time of the articles may vary from days to months, which reinforce the importance of the existence of a physical space for the treatment of these flows.

- **Dispatch:** The recovery plan for each returned article is also variable depending on the category type. Whether the recovery plan is the return to the supplier, the recycling, the reinsertion in the direct supply chain or the donation, the centralized collection facilitates these processes, in the sense that the merchandise can be collected to and from one single location. Still, the period of time from the reception stage to the pickup is variable, mainly due to the waiting period before counting and inspection, which obliges suppliers in particular, to wait until all phases are completed. After the RL area indicates that all previous processes have been completed, the commercial department makes contact with the supplier and schedules a collection date of their articles in the warehouse. Even when collecting, the supplier can check his articles quantity and state in the presence of a collaborator of the warehouse and a physical space is also made available, otherwise only the collection is made. In the event of loss or damage identified only at the time of this conference, which have not been assigned to the stores previously, they will now fall on the warehouse itself.

Recovered Products (See Annex 4)

These goods come from the ALC's stock and JIT warehouses. In these warehouses, a previous analysis of all articles received from suppliers is made. When a product or packaging is damaged, it can no longer go to the store, being taken to AR. Note that it is not only the damaged product that is returned, because if the damage of a product damage, even if minimally another product, also this is returned. Take as example a box containing a certain amount of soda bottles (or bottles of wine, olive oil, sauces, etc.), if a bottle explodes, damaging the label or packaging of the remaining bottles, even if they are minimal damage, the whole box is considered damaged and will no longer follow the store. The delivery of these products in AR is made whenever a damage is identified, not requiring a collection order or having specific days for that return. In the source warehouse is given its breakdown, and the merchandise is prepared for return which is often a fast process given the proximity of the warehouses, being transported from truck to the other warehouse. Per day, AR receives between one to two[27] pallets with damaged items, and no separation by supplier.

The products are received, being the target of a second verification, first simple which includes the counting by comparison with the guide accompanying the goods, and subsequently undergo thorough inspection, to ascertain the status of these articles, and to determine the recovery plan. If these, although unsuitable for sale, are suitable for consumption, will be donated to partner institutions of the group, and if they are completely damaged, it is up to the AR to proceed with its destruction, whenever possible recycling, which may result monetary counterpart for the company.

Recall Products (See Annex 5)

These relate to the repealed products. They are goods from stores, whose return comes from customer complaints, detection of some kind of error by the internal employees of stores and warehouses, and can also derive from the supplier itself that for some reason, during its analyses detected a problem with the product. Complaints are due to the existence of non-conformities, manufacturing or packaging, such as an error on the instruction label, barcode, logo, quality control failure, etc. Each complaint is processed by the quality control of the JM in conjunction with the supplier, in order to perceive whether there is indeed a problem, and if so, which products and batches should be withdrawn from sale. This decision process can take between days and weeks[27], and with this investigation it is also intended to ascertain the responsibility of the incident. The return to the supplier is dependent on the content of the complaint, and the agreement between the two parties and so, the articles can be taken to the AR, or can be destroyed at stores. If the final decision is about return to the suppliers, commercial department issue a return order for affected stores to prepare the merchandise, that should be collected in an average time of 48 hours[27]. The merchandise is received and is subject to a simple counting, by comparison with the described in the return guide, and verification of each article. After verification, the merchandise is stored while waiting for pickup by the supplier. During the year 2018, there were 61 requests for recall, which were returned to 43 suppliers.

Planned Returns (See Annex 6)

Returned goods classified as planned are sourced from stores and are always intended to return to external suppliers. These are articles, which because they have previously defined agreements, have a kind of validity within the store, being withdrawn due to the end of a

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[27] Information sustained by employees based on their work experience.

specific campaign and/or beginning of another, because the sales did not reach the expected expectations, or by excess of stock, that restricts the available space for other items. It includes almost all kinds of non-perishable products marketed, such as soft bazars, books, chocolates and articles from the recurring wine and sausage fairs. This flow of articles is largely the result of the company's commercial strategy, constant promotional campaigns, which makes this type of merchandise the largest volume of returns. Every week there are campaigns, consequently, every Monday the commercial department sends return proposals via email, to the stores and to the AR, with indication of the articles that must be returned and received, respectively, along the week. After the collection in store and the reception and counting in the AR, the process proceeds with greater or lesser speed, with the verification of each article, for subsequent storage, and dispatch to the supplier.

Seasonal Returns and Regrouping (See Annex 7)
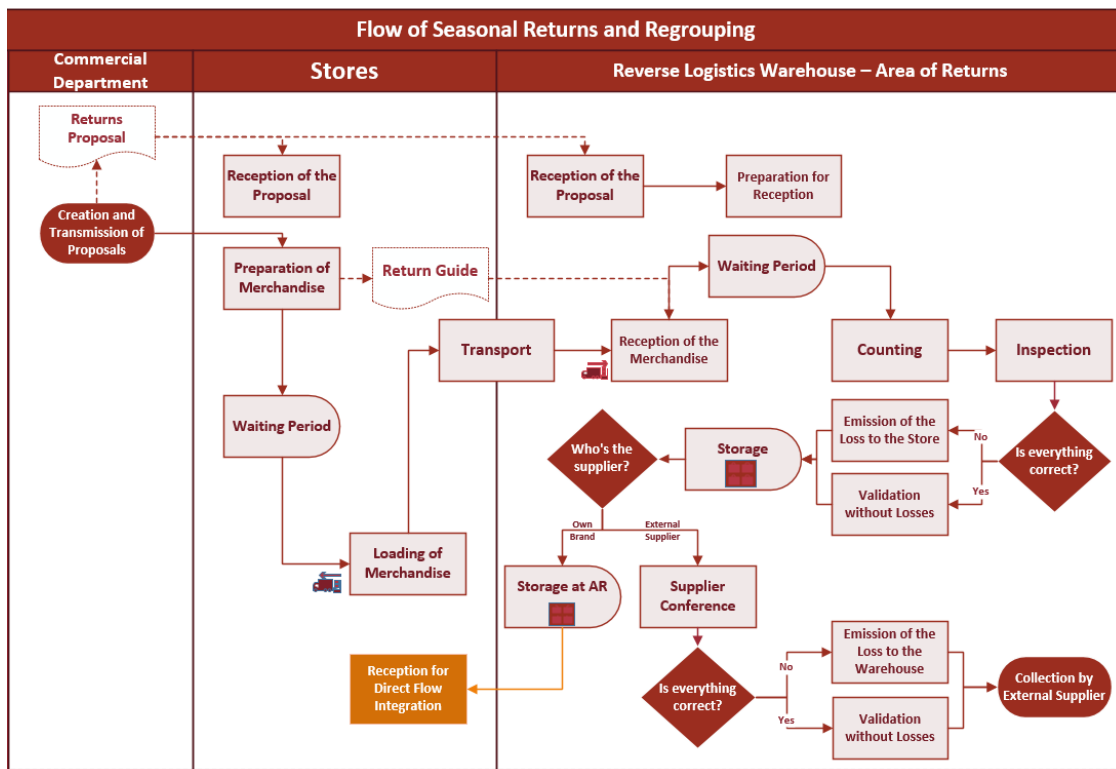

Figure 11 - Map of Operations of the Reverse Flow of Seasonal Returns and Regrouping

In the case of seasonal goods, they come from the stores, and are characterized by a seasonal demand, such as heating and/or cooling equipment, summer items, Christmas or "return to school". Being from external suppliers exists for the most part arrangements for subsequent collection if the products are not sold. In the specific case of their own brand heating/cooling articles, these are returned by the stores at the end of their campaign and are

stored in the RL warehouse until the following year. Regrouping goods constitute those that return and are stored for a period, but aimed to redistribution through the direct supply chain at the next station. In the past, these goods represented a larger volume, with several products and not only seasonal. Currently, regrouping activities are more punctual. The process of returning these articles is similar to that of the planned returns, starting in the commercial department, with the issuance of return proposals (on Mondays) to the stores and to the AR. The stores have the remainder of the week to prepare and send articles, through a centralized collection. The process continues in the AR, with the reception and counting of the returned merchandise, followed by its verification and storage on pallets and boxes, where they await the collection by the external supplier, if applicable. For these goods, the warehouse assumes the function of complementing' warehouse to the partner stores. Thus, in the following season, the commercial department determines a store allocation for these articles, and AR reintegrates them into the direct supply chain.

b) Flow of Recyclable Waste

It is also for AR that return the recyclable materials collected by the ecopoints available in Pingo Doce stores to be properly treated. The management of the reverse flow of recyclable materials is much simpler when compared to the first. All the procedures for its return are already fully defined, from the return dates to the final destination of all materials.

Contrary to previous returns, which came from stores and warehouses, without most times even reaching the customer, the flow of recyclable materials comes directly from the final consumer and can or cannot have been purchased in the group stores. Also can be prevenient from employees of stores and warehouses and are also the result of the distribution operations of JM, which produces high volumes of waste. This JM decision to have collection points for end-of-life goods and miscellaneous waste is part of the company's mission to be every day and increasingly, a healthy company, with concerns, both environmental and with the involved areas where it operates. The recyclable materials that are part of this flow include: paper/paperboard, glass and plastic; batteries; used food oils; coffee capsules; caps and stoppers; WEEE[28]. The latter include batteries, bulbs and damaged appliances and are end-of-life items and/or no warranty in force.

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[28] WEEE - Waste Electrical and Electronic Equipment. In portuguese: "REEES – Resíduos de Equipamentos Elétricos e Eletrónicos".

The return process is similar for all of these residues (see Figure 12), and starts in the stores holding these ecopoints, and the return guides are made manually by the stores. Throughout each month, consumers can deposit their waste, which is collected on the last Wednesday of each month by the distribution trucks. The waste is transported to the AR, where the validation of the return guide and separation by type of residue is carried out, and together with the residues collected in the ALC, are stored for approximately one day until the collection by the company responsible[29]. Given the volume of waste, and also given the fact that a centralized collection has been made, the JM receives a monetary counterpart which at this time ends up equalizing the amount it also pays for the rental of collection deposits in stores and warehouses. Until the existence of this warehouse, this balance was in fact negative (loss) because it was necessary to pay for the rental of the existing collection deposits, whose monetary counterpart of the waste did not cover, due mainly to the absence of a centralized collection.
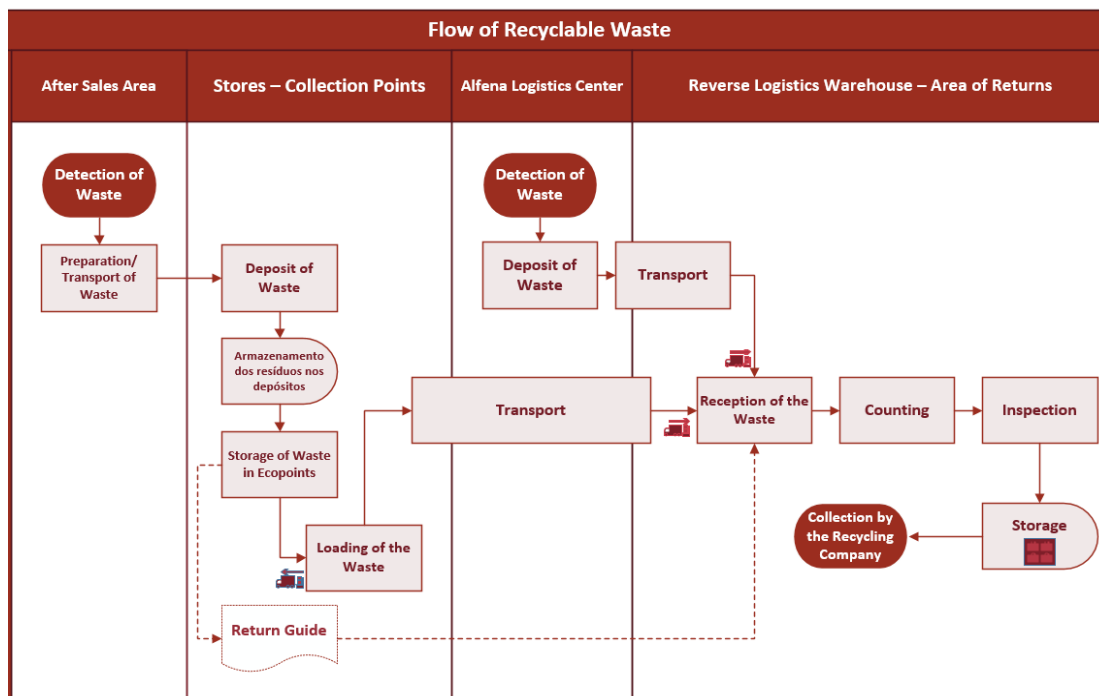

Figure 12 - Map of Operations of the Reverse Flow of Recyclable Waste

Figure 13 shows the number of ecopoints managed by Pingo Doce stores in the country in 2018. The RLW is responsible for the management of 720 ecopoints distributed by 155 stores, about 42% of the national ecopoints

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[29] "Transucatas - Soluções Ambientais S.A (Maia)" – Company responsible for waste treatment.
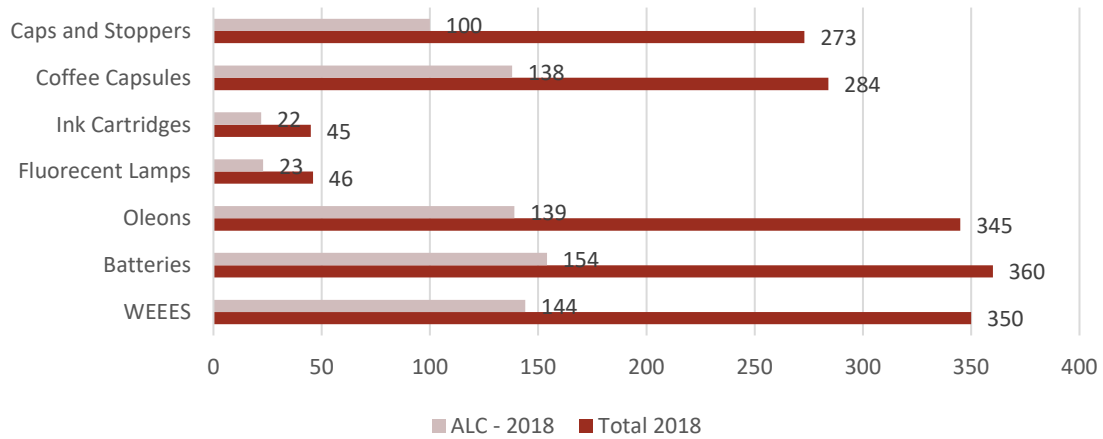
Figure 13 – Number of Ecopoints in the country and associated with the Alfena Logistics Center

Table 4 shows the quantities of residues managed in the years 2017 and 2018. The quantities collected are relatively constant throughout the year, except in festive times or in the incentive campaigns for recycling practices, which can trigger the volumes collected. In this last year, this warehouse has managed about 54% of the national volumes.

Waste (in tonnes)	Total 2018	ALC - 2018	% in ALC
WEEES (*including Fluorecent Lamps*)	97,93	48,15	49%
Batteries	13,79	4,38	32%
Used Food Oils	96,14	42,09	44%
Ink Cartridges	1,81	1,67	92%
Coffe Capsules	118,32	76,67	65%
Caps and Stoppers	15,77	13,00	82%
Total de Resíduos	343,76	185,960	54%

Table 4 – Volumes of Waste Collected - Country and Alfena Logistics Center - 2018

5.3.2 Area of Transportation Assets (ATAS)

The management of the reverse flow of transportation assets is the oldest of the flows. Initially, the management of this was the responsibility of the respective team of each warehouse or department, and since the creation of the reverse logistics department, in 2012, it has been its responsibility. Since the construction of the ALC, it is in the RLW, more specifically in the area of TAS that all action happens. In this flow we include a wide variety

of pallets, plastic boxes, a total of 24 types[30] (See Annex 10). The TAS come mostly from suppliers of goods, who may or may not want to return them. In the first case, it is up to the RL team to proceed with their return, in the second case, the TAS can become JM' property, which can either reintegrate them into the direct flow or sell the damaged ones[31]. There are also three companies working effectively in this warehouse, which in exchange for the space provided by JM, allow the use of transportation assets for the daily operations of the group, and organize and certify the quality of the assets they supply.
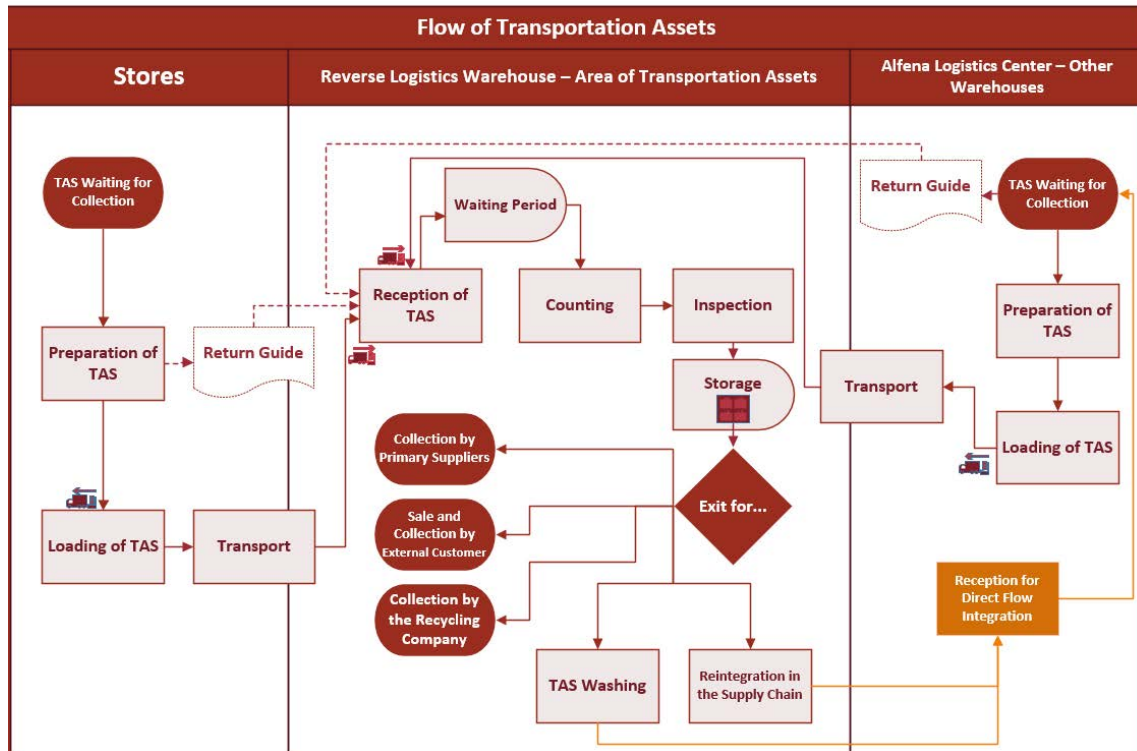

Figure 14 - Map of Operations of the Reverse Flow of Transportation Assets

Similar to the reverse flow of merchandise, this flow can also start in other warehouses in the logistics center, or in stores. The stores gather the TAS to be returned, organize and account for each type and deliver them to the means of transport that supply the stores, as was the case in the previous flow. In the remaining warehouses of the ALC, the goods of each supplier are received in pallets and/or boxes, and not always all of them are necessary to make the transport to the stores, so they are taken to the area of transportation assets.

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[30] All the assets listed in Annex 7, with the exception of three, the skateboarding of frozen foods (in portuguese: "skate dos congelados") and the fresh pasta TAS (in portuguese: "ativos de transporte de massa fresca), which do not exist in the flow of the Alfena Logistics Centre.

[31] Includes only White Pallets (identified in Annex 7 as "*Paletes Brancas*"), those which are considered damaged, not being in the appropriate state for use by the company.

The process continues and the assets are received and counted, based on the return guide that accompanies each type of asset returned. The physical state of each pallet or box is also checked and then stored in the warehouse by type or immediately can take different destinations. In the case of TAS belonging to the supplier based there, it is up to the latter to control, in quantity and quality, its transportation assets. Those coming from other suppliers or owned by JM are the responsibility of RLW employees. These assets, according to their need and owner, can have several destinations. Some of them are sent to the other warehouses within the logistics center, reintroducing themselves into the direct flow. The boxes and pallets dedicated to the transport of fish are sent to the washing and disinfection area, an activity carried out by RLW operators. Another part is collected by its primary suppliers. If extremely damaged, some assets can be destroyed. Finally, another significant part of a specific transportation asset, the *white pallets* is sold. JM has found that there is a market for damaged white pallets, and items that are not of use to the company, are for other companies that pay reasonable amounts for their purchase.

5.3.2.1 Sale of Damaged Transportation Assets

The sale of damaged pallets (See Annex 11) represents the only activity with direct profits for the RL warehouse. It comprises only the *white pallets* that do not belong to any of the companies working there (See Annex 7), and are sold at values between € 0,15 and € 5. In 2018, a total gain of € 379.953,55 (on average € 31.632,80 per month) was achieved, with around 156.199 pallets sold (on average € 13.017 per month). The sale of the most expensive pallet, *Europalete* which costs 5 € per unit, generated a gain of € 188.760,00, representing about 50% of total earnings. Figure 15 shows the distribution of assets sold, according to the gain obtained from each type, with an indication of the unit price of each asset.
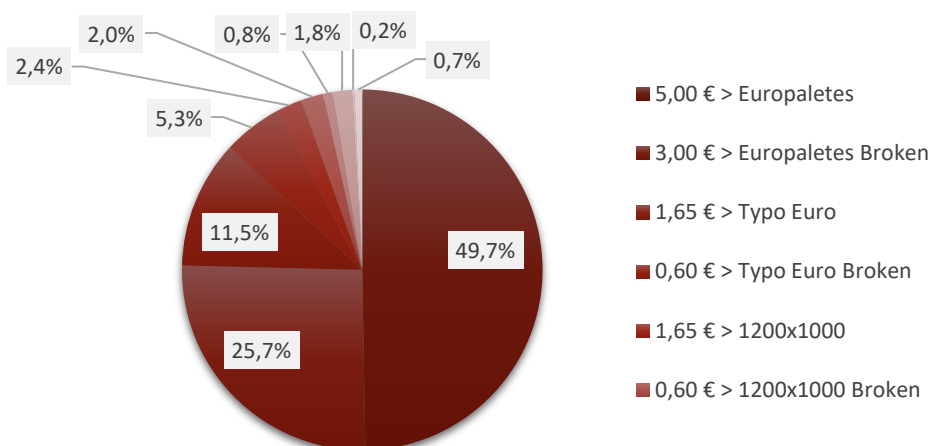

Figure 15 – Distribution of Sales of Transportation Assets by Type

5.3.3 Other Reverse Flows Identified

In addition to the flows already mentioned, there are two other flows which need to be addressed. The first is perishable goods. The ALC has warehouses for perishable goods, fruit and vegetables and fresh fish. As a result of their unique characteristics, these goods are treated differently when damaged in some way, and becoming unfit for sale to the public. If they are still suitable for consumption they can be donated, or otherwise these goods are refrigerated and stored in the warehouses where the damage was detected, while waiting for collection by a recycling company.

Another identified flow is the continuous reuse of cardboard boxes, such as banana boxes, as support for items returned in other flows. These cardboard boxes, in addition to existing in great abundance in the supply chain, because a large number of products are supplied in them, represent an excellent transport aid, being able to support a high weight and being very versatile.

5.3.4 Summary of Types of Returns

For each of the identified flows, a map of operations of the main associated processes was also carried out. With this mapping, the different origins and reasons for returning the different products, materials and assets are highlighted. In terms of goods, the stores are the main source and the end of promotional campaigns (planned) and seasonal the main reasons and with the largest volumes originated. For transportation assets, the main origin is also the stores, and the reason is always the end of use. In addition, the maps clearly identify the various stakeholders, internal and external to the organization, in this RL process.

Planned and seasonal returns and regrouping are treated together, so it is not possible to highlight the individual volumes of each of these types of goods. This distinction is made because the reason for return is different as well as the recovery plans. During 2018, 611 planned and seasonal returns proposals[32] were made (on average 12 per week) with items returned to around 160 suppliers. The analysis of the maps and the description made, allows to highlight two main phases in all the flows of goods:

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[32] Each proposal includes only one product type and one supplier.

- The phase of entrance of goods in RLW, with the reception, counting and verification of all articles. These ate time-consuming processes, mainly due to the non-compliance with delivery procedures by the stores and overload of work on some days of the week. This is the phase that requires the most human resources, time and space.

- The exit phase of goods from the RLW, with various recovery plans taking place. The return to the primary supplier is the destination of most of the returned goods. For contractual reasons, delay in the conference or the supplier's own delay, this pick-up may take longer, increasing the time spent in the warehouse. Even the moment of collection from the supplier is a time-consuming activity, due to the need to check the returns.

Table 5 shows the evolution of volumes managed by the reverse logistics area from 2014 to 2018, based on KPIs[33] prepared annually. From 2014 to 2018, total volumes grew by 73%, from 23.474.546 to 40.529.580 units, with the volume of TAS managed showing the highest volumes managed and with the highest growth.

Types of Volumes	2014	2015	2016	2017	2018
Re-distribution Stocks / Regrouping	322.447	17.651	22.492	20.042	23.146
Entrance - Returns from Stores*	968.514	1.339.468	1.422.165	1.782.218	1.451.919
Exit - Returns to Suppliers	1.105.754	1.708.477	1.418.563	1.685.244	1.234.984
Total Volume Merchandise	2.396.715	3.065.596	2.863.220	3.487.504	2.710.049
Reception - Returns from TAS	10.795.589	11.589.552	13.892.113	18.949.306	23.043.412
Exit - Washing TAS	394.095	497.730	432.695	584.283	578.417
Exit - Returns TAS Suppliers	9.888.147	10.886.349	12.636.196	12.501.330	14.197.702
Total Volumes TAS	21.077.831	22.973.631	26.961.004	32.034.919	37.819.531
Total Volumes Worked	23.474.546	26.039.227	29.824.224	35.522.423	40.529.580

* Includes Planned and Seasonal Returns

Table 5 - Volumes managed according to KPIs from 2014 to 2018 (values in units of product)

The year 2018 was the first full year of operation of RLW, and the data obtained already prove the size and need of this area. Table 6 shows the quantities of articles that circulated through this warehouse throughout 2018. The main entrance and exit processes for both goods and transport assets are highlighted. A total of 1.525.290 units of goods were received and 1.308.355 dispatched, this difference being due to the fact that the goods returned from the stores were received, but the collection by the supplier did not take place during 2018,

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[33] KPIs – Key Performance Indicators. The elaborated KPIs do not take into account all the volumes managed, however, they already reproduce an idea of the size of the largest volumes worked.

but in the following year. In terms of transportation assets, there were 23.043.412 units received and dispatched for different purposes, sale (156.199 - 0.7%), primary suppliers (8.111.094 - 35.2%), washing (578.417 - 2.5%) and head office suppliers (14.197.702 - 61.6%). An average of 390 pallets are shipped daily to the remaining warehouses, being in continuous rotation.

Types of Volumes	Total 2018
Entrance and Exit – Redistribution Stocks / Regrouping*	46.292
Entrance and Exit – Recovered from Storage*	100.000
Entrance – Stores Returns (*Seasonals and Planneds*)	1.451.919
Entrance and Exit – Recall*	450
Exit - Returns to Suppliers (*Seasonals and Planneds*)	1.234.984
Total Volume of Volumes Managed	**2.833.645**
Entrance – Returns of Transportation Assets	23.043.412
Exit - Sale of Damaged Transportation Assets	156.199
Exit – Suppliers of Primary Goods	8.111.094
Exit - Washing TAS	578.417
Exit – TAS Returns to Suppliers (*CHEP,IFCO,LPR*)	14.197.702
Total Volumes of Transport Assets Managed	**46.086.824**
Total Volumes Managed	**48.847.098**

*The displayed volume means the entrance of 23.146/50.000/225 units and exit of the same units for redistribution, donation or recycling and return to the supplier, respectively.

Table 6 - Volumes of Managed Merchandise – 2018 (values in units of product)

5.4 Difficulties Identified

The more efficient all the work is done here, the more and better the results, both monetary and non-monetary, will be. The main difficulties experienced on a daily basis in the warehouse are related to the physical space of the warehouse, the workforce and the required materials/equipment, the fulfilment of the delivery and reception procedures and the mentalities, as described below:

- *Physical Space of the Warehouse*

One of the main difficulties has to do with the physical space. Given the growing size of the group, the 2017 workload is not the 2018 workload, and physical needs increase day by day. When constructing the space, account was taken of the workloads existing at the time, but perhaps it was not taken into account, that new flows would arise and that new storage and support work to other areas would appear. Therefore, the greatest difficulty occurs on

the most crowded days, in this case, Tuesdays are complicated days in terms of time and space management, just as in weeks of the end of larger campaigns or the end of festive and seasonal seasons.

On the other hand, the warehouse is also not close or connected with the other warehouses in the center, which makes it very difficult to communicate with the other warehouses, from the transport of recovered products to the transport of pallets and boxes, as these require a means of transport that are not always available. Initially, a truck would have been allocated to this task, but it is regularly used for other tasks.

- *Procedures and Returns Treatment*

There is a lack of compliance with delivery procedures, both for TAS and goods. Transportation assets do not always come organized by supplier or by type, and they happen to come with returns guides all together or mixed or with no guides at all. These situations hinder and delay the processes of reception, counting and inspection, and in crowded days, human resources become scarce for the work that needs to be done. Sometimes, the lack of manpower to make the conference, and the lack of physical space and time, causes the goods to be stored for weeks or months, until the conditions to continue the work are provided.

Returned products are strictly controlled, not only at the counting level, but especially at the inspection level. Each product and asset is analysed in detail, which depending on its size, can take from seconds to a few minutes. It is estimated that for at least half of the employees in this warehouse, their job is to "*check the work of the stores*" [34]. This happens because in addition to the need to check the physical condition of each unit to determine its destination, this process is also necessary so that the store from which the item/asset comes can be responsible for the damages and losses identified. The volume TAS' losses tends to be too high, between 400 and 500 units per month. The main reasons for these occurrences are the carelessness of those who handle and control the assets and its high value in the secondary market, since each pallet or box can be worth between 0.15 € to 5 €.

On the other hand, when failures are detected in the delivery processes to the RLW, the stores are approached by the RL team, with the aim of identifying what is going wrong and how it can be improved. However, these approaches are not always best seen by the stores.

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[34] Transcribed expression from one of the interviews and information confirmed on the basis of the opinions expressed by employees.

- *Labour and Equipment*

Most of the tasks are performed manually, from counting products and pallets/boxes, to separating and inspecting them, which implies a great expense of human resources, time and space. If, on the one hand, these expenses could be minimized with the existence of more trust between stores and the warehouse (previous point), on the other hand, all the work done in the RLW is still very manual and very dependent on human resources that have proven to be increasingly scarce. There is a need to modernize processes.

- *Information Flow*

The reverse logistics warehouse has little access to information on returns themselves and on relationships with suppliers, namely on which and when goods will be returned, which suppliers are associated, and whether they are associated, and when returns to them will occur, if will in fact[35].

On the other hand, the employees of the stores and warehouses also have little knowledge of the meaning of reverse logistics, of the inherent practices, of the complete return process associated with any goods or transportation asset, and of the importance of each phase of this process, for its success and efficiency. In warehouses, this perception is greater than in stores, the concept is known even though it is not used day by day, and there is an awareness of the contribution of that warehouse to the overall activity of the company.

- **Agreements with Suppliers**

There are goods pending of delivery to suppliers, due to lack of understanding about the destination of these articles. Not always the contracts established with suppliers are clear enough, and takes into account all the possible situations in which goods can return.

- *Institutional Partners*

There are products for weekly donations, and there are institutional partners, who do not always have the capacity to make the collections at the time that would be ideal for JM.

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[35] Contracts with vendors are dynamic, group partners today may not be tomorrow, and planned returns may no longer occur. This information does not always reach the RL team, causing some "confusion" in the management of these flows.

5.4.1 Difficulties at Stores' level

For store employees, the lack of knowledge of the concept of reverse logistics was evident, and the idea that "*returns are a job that has to be done, but that takes work, takes time, we try to dispatch things as quickly as possible, we try to be careful, but we can't always check everything we send. We lack people, we lack time, we lack space. The shops are not prepared with space beyond the sales space, so we can carefully prepare what is to be returned, separating pallets by supplier, or pallets and boxes for each type is very difficult because we don't have the resources*" [36]. On the other hand, the fact that in several stores, the space for receiving, storing and shipping items is too exposed[37] and increases the exposure to robbery and consequently losses.

5.5 Monetary Costs and Gains

Like any logistics department, doing reverse logistics also entails costs. But unlike other warehouses, a RL warehouse represents the only area of logistics that can have direct monetary gains, transversal to the specific business of the company. It should be noted that the RLW has several associated costs, ranging from the cost of its construction (initial investment), to its maintenance costs and other costs and benefits to the employees that are supported by the company's main structure. Table 7 summarises the main total expenses directly associated with the reverse logistics area, as well as the gains generated during 2013 and 2018. The weight of each one in the annual total cost, its monthly average and the variation of each item from 2013 to 2018 are also presented.

In 2018, the first full year of the RLW in operation, the total expenses were € 1.215.145, with an average of € 101.262 per month. The main expenses include *Personnel Costs* of € 580.247, which totalled 47,8% of total annual costs, *Rents and Rentals* of € 188.695,32, around 15,53% and *General Expenses* of € 182.042, around 15,0%. The cost described as *Rents and Rentals* relates to the rental of the warehouse in Vila do Conde and the rent of the service machines in the warehouses. As seen before, the fact that the goods and TAS are transported by the same means of transport that carry out the distribution, makes the costs with *Transports* to be zero. All these costs are abated by the monetary gains associated with the sale of damaged assets, which amounted to € 379.593 in 2018, an average of € 31.921 monthly. This

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[36] Transcribed expression from one of the store' interviews.
[37] Space with cover, but "open" on the sides (with bars).

gain covered warehouse costs by around 31.5%. With the costs remaining at € 832.098. It should be noted that, although the RLW is responsible for the reception and dispatch of waste from 155 stores, the associated monetary returns are not accounted for there[38].

	2013			2018			Δ 13/18
	EUR	Weight	Month	EUR	Weight	Month	
TOTAL PERSONNEL COSTS	573.847 €	28,2%	47.821 €	580.247 €	47,8%	48.354 €	1%
Transports	611.391 €	30,0%	50.949 €	- €	0,0%	- €	-100%
Packaging and Labels	49.996 €	2,5%	4.166 €	4.852 €	0,4%	404 €	-90%
General Expenses*	27.516 €	1,4%	2.293 €	182.042 €	15,0%	15.170 €	562%
Cleaning and Safety	354.768 €	17,4%	29.564 €	74.901 €	6,2%	6.242 €	-79%
Office Supplies - Othes	9.524 €	0,5%	794 €	223 €	0,0%	19 €	-98%
Insurance / Fees / Contributions	2.527 €	0,1%	211 €	3.845 €	0,3%	320 €	52%
Conservation and Repair	29.005 €	1,4%	2.417 €	13.986 €	1,2%	1.165 €	-52%
Other Suppliers Service	15.702 €	0,8%	1.308 €	89.966 €	7,4%	7.497 €	473%
TOTAL OPERATING COSTS	1.100.428 €	54,0%	91.702 €	369.814 €	30,4%	30.818 €	-66%
Computer Support	25.297 €	1,2%	2.108 €	45.363 €	3,7%	3.780 €	79%
Rents and Rentals	314.635 €	15,4%	26.220 €	188.695 €	15,5%	15.725 €	-40%
Equipment Depreciation	23.491 €	1,2%	1.958 €	31.026 €	2,6%	2.585 €	32%
TOTAL OTHER COSTS	363.423 €	17,8%	30.285 €	265.084 €	21,8%	22.090 €	-27%
Total RL Warehouse Costs	2.037.698 €	100,0%	169.808 €	1.215.145 €	100,0%	101.262 €	-40%
Incomes	54.885 €	2,7%	4.574 €	383.047 €	31,5%	31.921 €	598%
Total Gains	54.885 €	2,7%	4.574 €	383.047 €	31,5%	31.921 €	598%
Total Final Costs of the RLW	1.982.813 €	2,7%	165.234 €	832.098 €	68,5%	69.342 €	-58%

* Water, Electricity, Fuel and Communications.

Table 7 - Costs and Gains associated with the Reverse Logistics Warehouse 2013 and 2018

In turn, the oldest data on costs and gains of the RL area that could be accessed date back to 2013, when this area was still managed in three spaces. The analysis of the table allows some significant conclusions:

- Total Costs for 2013 were € 1.982.813, about 58% higher than in 2018.
- *Personnel Costs* remained relatively similar, as the move to Alfena only led to the reintegration of existing human resources.
- The *Transport Costs* of 611.391 € have disappeared completely;
- Several cost items decreased, such as *Cleaning and Security* and *Rents and Rentals*, by -79% and -40% respectively, while others increased, such as *General Expenses* from € 27.516 to

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[38] We can confirm that there is a monetary counterpart for JM associated with the recycling of waste, but it was not possible to access the amounts.

€ 182.042, and *Computer Support*, which increased by 79%, which makes sense given the move to a single larger space, with better conditions and higher technological needs.

- The greatest variation was in the *Income* from the sale of damaged transportation assets, from € 54.885 in 2013 to € 383.047 in 2018, an increase of almost 600%.

The overall reduction in costs is visible as well as the increase in income, that are only possible in this conditions. The costs of this warehouse also represent 2,1% of the total costs of the Alfena Logistics Center.

5.6 Improvement Guidelines

In this last part of the work, concrete improvements will be presented that can be implemented in the company in order to improve the efficiency of the reverse logistics operations identified. At a stage when processes are already defined, such as trained teams and defined work functions, it is first necessary to meet the difficulties identified by those involved in these processes, in what are the real barriers to a more efficient daily work. In general, we can identify several improvements, which depend on at least one of three conditions, the need for monetary investment, the need for implementation time and the need for a superior decision. In this part, I will organize possible improvements in accordance with these restrictions and also their feasibility of implementation, since some improvements were considered, but after analysis they proved to be unfeasible.

5.6.1 Improvements that require Investment and a Superior Decision:

- *Warehouse Automation with possible Acquisition of Equipment for counting and verification of goods and/or TAS*

This reverse logistics warehouse has a relatively recent and updated computer warehouse management system, and makes use of some equipment such as barcode readers that automatically receive the goods in the system, and transport vehicles that assist in various tasks in everyday life. However, the tasks of reception, counting, separation and verification are entirely manual and dependent on labour and physical space to work. Analysing this whole process, the question that arises is: "*whether it is possible to modernize and/or automate this warehouse and in what way?*".

In order to investigate the possibility of modernising this warehouse, a company specialised in warehouses and their equipment was contacted. Some informal meetings were held, where the warehouse and its operations were first presented, then the problem itself and finally, possible solutions and their viability were discussed. Although there is a great variety of equipment and ways of automating different types of warehouses, there is still nothing concrete for managing reverse flows in the retail context. The management of goods and TAS presented, presents unique challenges, namely:

- The diversity of goods and their uncertainty about the quantities and types of goods that will be received. The arbitrary need for article-by-article verification, whatever the recovery plan of the article;

- The diversity of TAS worked, because although there are types of assets with higher volumes, there are 21 types of pallets and boxes received and shipped daily, with crucial need for verification of physical condition;

For the management of goods, automatize this flow would not be feasible due to this diversity, uncertainty and need for verification of each article, which can only be performed manually. Automation of TAS management would also not be an easy task, although relatively more feasible than the previous one. At the moment, existing equipment is defined for a reduced number of pallets and boxes, and even here the equipment is not prepared to make an accurate reading of the physical status of these assets, allowing only the reading of the type of article, based on their weight, measurements and format and counting. In turn, separation, storage and dispatch are operations that already exist, but always for a small, limited and predefined number type of assets. In order to automate this area, a whole new system for managing this flow would have to be designed from scratch, requiring an area of implementation greater than the existing one and costs that could easily exceed one million euros. The opinion of the salesperson who followed the case is that, for the time being, the development of automation in the reverse logistics area is still practically nil, and that, based on the volumes worked, it is still not justified.

We concluded that, at least for now, equipment does not represent a viable solution for improving the efficiency of this warehouse. In the future, with the greater increase in returned volumes, and a greater awareness of the need and benefits of this area properly developed in a company, it will be possible to create more efficient automated solutions.

- *Associate a Vehicle of Transport only for the operations of the RLW*

Although this has been previously defined, there is no compliance and the allocated vehicle is regularly used in other tasks, effectively ending up being removed from the warehouse guard. This decision to remove the truck from the exclusive use of the RLW, was made with the perception that the work, even if regular and sometimes excessive, still did not justify the allocation of a particular mean of transport.

5.6.2 Improvements that require Investment, a Superior Decision and Time

- *More Operators and Qualified ones in Warehouse and Stores*

The need for human resources, and above all, dedicated and committed human resources in the work they do has been proven. Thus, it is up to the company to make new hires, which given the current difficulties will only be possible with fairer and more attractive work proposals. Currently, the working conditions, and in particular the salaries offered to store and warehouse operators, are not perceived as such, so they should be reviewed in order to attract and above all to support the workforce in the long term. Even if higher qualifications are not required for this kind of work, conditions should be offered that encourage good work. Managers should also supervise the needs of stores and warehouses more closely.

- *Training and Awareness of Store and Warehouse' Employees*

The company is responsible for training and raising the awareness of its employees from stores and warehouses about the concept of reverse logistics, about the entire associated return process, and the need for these operations to be as efficient as possible, and the difficulties that regularly arise. Sessions in this sense should be defined in the calendar of activities of the group, because one to two sessions annually, exposing the mentioned, could result in changes in the behaviour of employees.

- *Take into account the Need of more Stores' Space to prepare the Goods and Assets to be Returned*

It was evident the lack of physical space in the store to deal with the normal stock of the store, and with the preparation of articles for return. In the future, it will be necessary to take into consideration when opening new stores, that there is a need for warehouse space in them. A properly closed space that allows the reception, preparation and expedition of goods

and TAS with care. This will allow faster and more efficient processes, and less losses, if this space is less exposed to robbery.

5.6.3 Improvements that do not require Investment, but Time and a Superior Decision

- *Create a Function on Store for Monitoring the Return of Products and TAS*

This measure aims to ensure that all working instructions are complied with, from the organization of goods by supplier, and pallets and boxes by type, and the guarantee that the return guides are correct and properly distributed among the items. On the other hand, this closer monitoring allows for greater control of transportation assets. In this way, the work that follows in the warehouse can be faster and more efficient, and the volume of losses reduced. With all stages of the return process being more organised and efficient, the whole company will benefit. To take a concrete example: if the pallets come from the store properly separated, there is no need for more people just separating pallets/boxes and items, which would make the entire return process faster. If goods and assets are properly organised from stores, it is estimated that at least two people could be saved daily in each of the areas of managing products and assets[39].

- *Distribution of the Losses Equally among the Stores*

One solution that would help save time and resources used to control goods and TAS would be to have less control and more confidence in the work of the stores, and the losses distributed equally across the stores, as both stores and employees from the warehouse belong to the same group and all work towards the same goals. The disadvantage of this measure is that the stores can reduce their concern in preparing the items for return, as they know that the losses will not be directly attributed to them. On the other hand, the items that are returned to the supplier have to be counted and checked in any case. We conclude that this measure is not as viable as one might initially think.

- *More Concrete Information about the RL Practices and Results of the Group*

The work carried out by the company at the level of reverse logistics does not have the exposure it could. Its practices and results are not yet included in any of its public reports,

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[39] Information sustained by employees based on their work experience.

and perhaps because of this, the growth in this area is lower than in others. As this is a relatively recent area, more measures of analysis and especially of evaluation of this area should be created and even disclosed in the group's reports. Measures such as, for example:

· Quantities of goods returned by type (half-yearly or quarterly) and their monetary value;

· Return cost of each article (general or per article group) and storage cost of each article

· Cost of TAS' losses;

· Information such as the main existing reverse flows, their volumes and monetary values could be presented in public. First, in order to make this area known to consumers and institutional partners. And second, since JM is a group with an image of a sustainable company and a reference in retail, it could make use of its position to be an example and incentive for other companies to acquire these practices.

• *Greater Control over Transportation Assets all the way through the chain*

The teams responsible in the warehouses and stores should be constantly aware of the inventory moved and inventory stopped in order to reduce losses (around 500 assets per month). With this greater control, the areas where losses were detected should be held responsible, in order to encourage control and care in their management.

• *Continue to ensure, and clearly, that all Goods Purchased have Return Policy Contracts with the Suppliers*

For an efficient reverse logistics, this is an essential point. Without return agreements with suppliers, the company is restricted in the volumes and respective prices at which it purchases the items. Is subject to losses if it is not able to despatch the entire stock for sale, which also results in an increased need for storage space in the RLW for stock in excess. These agreements/contracts should also include clear procedures/criteria for accepting or rejecting goods, for any non-conformities that arise, or other situations involving the return of goods. This improvement guideline aims to make returns to suppliers quicker and more efficient, and to reduce the length of time items remain in the warehouse. There are specific contracts (D. Simchi-Levi, Kaminsky, & Simchi-Levi, 2008), which among other benefits stimulate the development of RL, such as the *Buy-Back Contract* or the *Quantity-Flexibility Contract*. The fact that it was not possible to access the existing contracts between JM and the suppliers, does not allow knowing if these contracts may already be used by the group, and

if not, only the comparison between both, the existing and the suggested ones, could allow more precise conclusions in this sense.

- **Better Flows Management**

One of the great difficulties in the management of TAS and goods is related to work peaks, namely on Tuesdays. An analysis could be carried out of which stores have more storage capacity, in order to try to dilute the return of these by the other days of the week, making the flows more uniform throughout the week and easier to manage.

On the other hand, the RL team should have right from the reception, concrete information on the destination of each article received, and for those who should return to suppliers, strict dates should be set for the collection. In this way, it would be possible to better manage these flows, allocating and preparing the goods accordingly, and freeing up space for other tasks and storage of other items more quickly.

6 Conclusion

In this sixth and final chapter, the main conclusions resulting from the work developed for the company and the academic field will be presented, as well as the limitations of the research and suggestions for future.

6.1 Main Contributions

This project arises primarily from a need of the Jerónimo Martins Group to know and analyse the processes and operations in one of its most recent areas, Reverse Logistics. However, it was the group's openness to the academic field that enabled the development of this study, with the creation of a partnership between the student and the group, with the aim of working towards this need. The objectives identified at the beginning of this work were adhered to throughout chapters four and five, and supported by real information obtained through access to the company's work area.

The present report began with a review of the relevant literature to the topic, with the aim of understanding the fundamental dimensions to be explored around the implementation of the reverse logistics area in an organisation. The literature concludes that the concept, although increasingly recurrent, still has a low level of real integration in organisations. It was found that the study of the implementation of reverse logistics, although increasing in recent decades, is still limited, and focuses too much on the drivers and associated barriers, and fails to explore in practical terms how the implementation should be done, and how the flows of returns should be managed in a real company. One of the objectives of the work is to meet this gap, describing in detail how reverse logistics happens in a real company, contributing with data that will be both useful for the academic environment and for the industry itself.

The development of the project allowed us to conclude that what happened at Jerónimo Martins is globally in line with what is mentioned in the literature, from the motivations of the company, the real reasons for the return of goods and assets, to the main types of product and key processes for their treatment and recovery. In addition, the growing importance of the topic within academia is accompanied by the growing importance attributed by the group to this logistics area, which is proven by the changes made over the last few years in the management of returns, in 2012 and more recently in 2017. These dates represented decisive

milestones in the history of Reverse Logistics within the group. The key points of the group's reverse logistics chain are presented based on the five dimensions of the framework presented by Brito and Dekker (2003).

Dimensions	Jerónimo Martins
Why to Receive?	*Subchapter 5.2* - The main motivations of the company are the need to be more efficient (reduce losses and provide more support to other areas of the company), reduce costs (the comparison of costs in 2013 and 2018 shows), improve relationships with suppliers and strengthen a responsible company image.
Why to Return?	*Subchapter 5.3* - The main reasons for returns include damage, seasonality and uncertainty of demand, volume of goods purchased, quality issues, existence of supplier return contracts, end of life of the articles.
What?	*Subchapter 5.3* - Identify the flows of non-perishable goods (recovered products, recalls, seasonal and planned and regrouping), the flow of recyclable materials and the flow of TAS, as well as their relevant characteristics.
How?	*Subchapter 5.1 and 5.3* - The space where the main processes take place is presented, as well as the necessary resources. The management of each flow is described and mapped in detail (Reception, Counting, Verification, Storage and Dispatch phases), and the main existing recovery plans include recycling, return to supplier, donation or reintegration into the direct supply chain.
Who?	*Subchapter 5.1* - Those involved in this area are presented, internal to the company: including the warehouse itself and its employees who carry out most of the processes, as well as the other warehouses and stores and employees who return the goods and assets; and external to the company: the customers of Pingo Doce stores, the several suppliers who collect what is assigned them, the recycling companies and the buyers of damaged assets that represent end customers of some of the flows.

Table 8 – Application of the Five Dimensions of Brito and Dekker (2003) to the Jerónimo Martins case

Despite the fact that there have always been returns to manage, only recently Jerónimo Martins has opted to start carrying out most of the processes and operations associated with it internally, and with the appropriate conditions. In turn, a single space for this area in the Alfena Logistics Center, allowed more centralization and proved to be crucial for the proper functioning of the group's entire logistics chain. Firstly, the fact that the RL warehouse is in the same space as the other warehouses, allowing greater proximity with the direct supply chain and aid to other areas, and allowing the direct flow transportation network to be used to collect goods and assets from stores. In addition, allowed suppliers to take advantage of their goods delivery circuit in other warehouses to collect their returned goods. The development of this space was also translated in a drastic cost reduction of around 60%, and

other indirect benefits, which are not all possible to quantify, are visible and perceived by those involved.

With the study, it was verified that the main barrier to the development of RL in this company in recent decades and now even, is not the absence of resources or knowledge/know-how, but the existence of a reactive attitude of employees and managers in doing what is necessary only when it is necessary, and not bet on a more proactive development, and learning from the difficulties and errors present and past. The mentality of those involved, the way in which RL is still seen by those involved as "*one more job*"[40] and "*something that if it is done badly, there is no problem*"[40] is also a major barrier to the increase of the efficiency of this area. There is a need for greater compliance with the stipulated procedures, and for awareness of the importance of this area and the whole process associated with it. In addition to the above, it should be noted that the improvement of reverse logistics operations particularly involves internal changes, which, although requiring more time and a superior decision, require little or no investment.

With the development of this project, Jerónimo Martins has now, a detailed mapping of all the processes and practices associated with reverse logistics. The main flaws/difficulties experienced in daily operations were also identified. These two elements are fundamental inputs for outlining improvement solutions, which are presented at the end of the project. The improvements presented are real and possible to put into practice, although for this purpose, it is necessary to go deeper into them, in order to determine the cost and return ratio, as well as their feasibility.

The fact that the sample is composed of only one company, and with a very specific reality in a very specific sector, does not allow the generalization of its results. A reverse logistic chain must always be implemented based on the characteristics of the organization of the environment where it operates. However, the results of this project provide other companies with information on what is currently being done in the area and how it is being done. Since Jerónimo Martins is a renowned company, this work is also an incentive and a starting point for organisations that are considering implementing these practices.

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[40] Transcribed expressions from the stores' interviews.

6.2 Limitations and Future Work

Although the proposed objectives were achieved, some difficulties arose during the development of this project. We highlight the relatively short time spent in the company, given that the student reconciled the development of the dissertation with a full-time job in another company. With more time spent in the company it would have been possible a more quantitative mapping of all reverse logistics processes, obtaining times of operations, volumes of flows (daily or weekly) of entrance and exit, among others. A more quantitative approach about reverse logistics in a company of this size, is the kind of work necessary on both academic and business fields. Even at the internal level of the company, only more recently, from 2013, began to exist precise indicators that allow to evaluate the growth of this area, which was a limitation in the development of this study. In addition, another major limitation was the quantity, lack of quality and dispersion of information, sometimes outdated or incomplete. In this sense, the creation of more and best well defined performance indicators for RL activities would be fundamental in Jerónimo Martins to begin to exist a basis for comparison and evolution over time, and after the implementation of the improvement proposals.

As relations with suppliers are a fundamental part of the reverse logistics process, access to contractual information associated with returns could have been relevant in the development of the study, in order to address possible ambiguous information regarding returns, and suggest ways of improvement. A detailed analysis of real contracts established between retailers and suppliers with regard to return agreements is a key topic for which there is a lack of academic support, and should therefore be further developed when developing such dissertations.

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8 Annexes

Annex 1 – List of Reverse Logistic drivers, classification, and sources (Govindan & Bouzon, 2018)

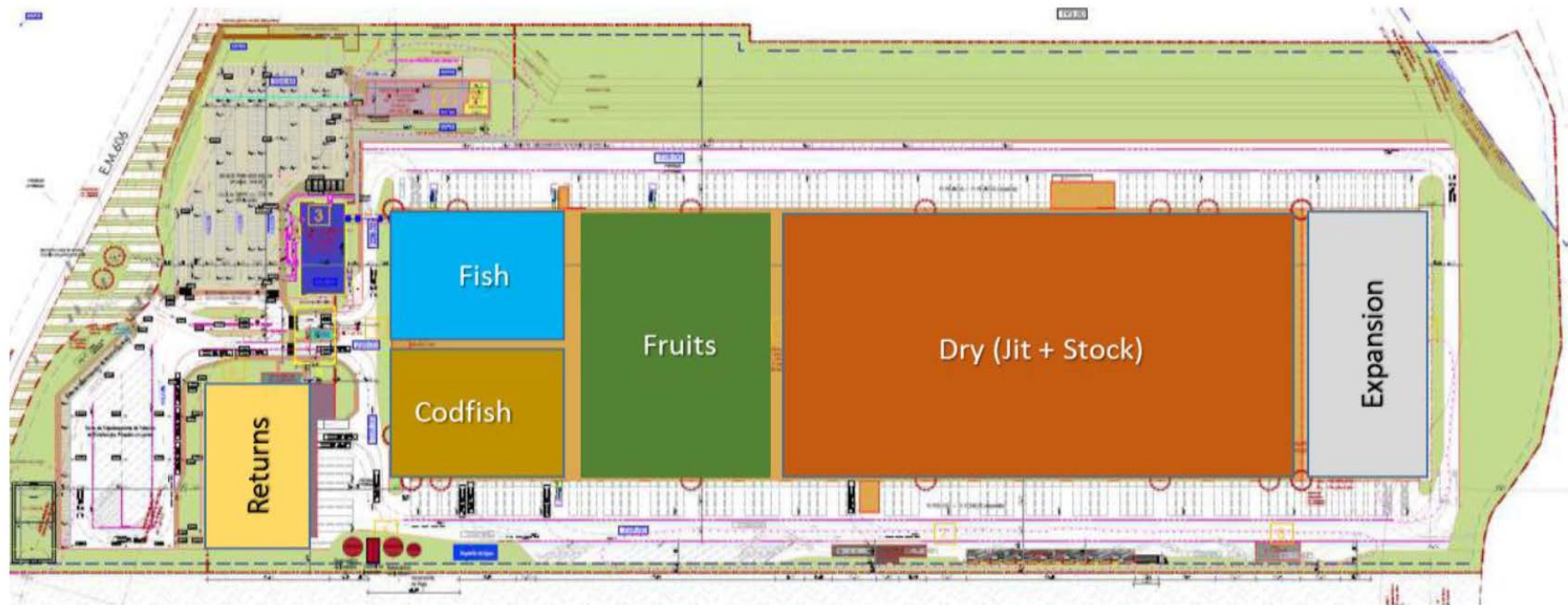| Driver	Description	Internal/ External	Stakeholders involved	Sources
1 - Policy related issues				
D1. Regulatory pressure for product return/ recovery	Many nations have introduced laws to ensure effective disposal of products or may make it obligatory for the firms to recover used products.	External	Government	Agrawal et al., 2015; Aitken and Harrison, 2013; Alvarez-Gil et al., 2007; Andiç et al., 2012; Chan and Chan, 2008; Chan et al., 2012; de Sousa Jabbour et al., 2013; Hsu et al., 2013; Jayaraman and Luo, 2007; Jindal and Sangwan, 2013; Kannan et al., 2014; Kapetanopoulou and Tagaras, 2011; Krikke et al., 2013; Kumar and Putnam, 2008; Lau and Wang, 2009; Mathiyazhagan and Haq, 2013; Saavedra et al., 2013; Shaik and Abdul-Kader, 2013; Shaik and Abdul-Kader, 2014; Srivastava, 2008; Subramanian et al., 2014; Subramoniam et al., 2013; Van Der Wiel et al., 2012; Wang and Sun, 2005)
D2. License to operate	Firms are increasingly adopting RL practices in their business schedule in order to get license to operate.	External	Government	(Andiç et al., 2012)
D3. EOL levies at point of sale for the consumer	Tax revenues at point of sales drive customers to return their EOL products.	Internal	Organization	(Rahimifard et al., 2009)
D4. Motivation laws	Take-back levies from manufacturers drives industries to take back their products. For example: special tax discharge for ISO 14001 certified companies.	External	Government	(Mathiyazhagan and Haq, 2013; Rahimifard et al., 2009)
2–Governance and SC process related issues				
D5. Qualification and support of business partners	Well-trained SC partners may assist RL implementation and management.	External	Suppliers, Customers	(Aitken and Harrison, 2013; Ho et al., 2012)
D6. Cooperation and integration with partners in the SC	Cooperation with business partners in the SC can help the RL implementation.	External	Suppliers, Customers	(Ho et al., 2012; Janse et al., 2010; Saavedra et al., 2013; Shaik and Abdul-Kader, 2013; Subramoniam et al., 2009, 2013; Xie and Breen, 2012)
3 - Management related issues				
D7. Employee satisfaction	Feel-good factors, employee morale, individual satisfaction obtained by environmental practices in the company.	Internal	Employees	(Andiç et al., 2012)
D8. Number of staff	Number of employees is positively related to RL implementation.	Internal	Employees	(Ho et al., 2012)
D9. Human resources support	Company's human resources support boosts RL activities.	Internal	Employees	(Ho et al., 2012)
D10. Top management awareness and commitment	RL implementation is facilitated when top managers are conscious about its relevance and committed to RL implementation.	Internal	Employees	(Agrawal et al., 2015; Janse et al., 2010; Xie and Breen, 2012)
D11. Department integration	An integrated organizational structure (physical and non-physical) with the manufacturing divisions has a positive influence on the decision to perform RL.	Internal	Organization	(Subramoniam et al., 2009)
4–Market and Competitors related issues				
D12. Customer satisfaction	Customer satisfaction and customer trust/loyalty can be increased by better after sales services.	External	Customers	(Andiç et al., 2012; Jayaraman and Luo, 2007; Jindal and Sangwan, 2013; Kapetanopoulou and Tagaras, 2011; Mathiyazhagan and Haq, 2013; Shaik and Abdul-Kader, 2013)
D13. Competitive advantage	Firms might get competitive advantage from RL implementation, e.g. higher profits or lower costs, larger market share, differentiation, etc.	External	Market/ Competitors	(Andiç et al., 2012; Chan and Chan, 2008; Jayaraman and Luo, 2007; Kapetanopoulou and Tagaras, 2011; Lau and Wang, 2009; Mathiyazhagan and Haq, 2013)
D14. Green consumerism/ consumers' environmental awareness	Customer pressure is an increasing concern for green protection among consumers.	External	Customers	(Andiç et al., 2012; Chan et al., 2012; Hsu et al., 2013; Jindal and Sangwan, 2013; Kapetanopoulou and Tagaras, 2011; Lau and Wang, 2009; Mathiyazhagan and Haq, 2013; Shaik and Abdul-Kader, 2013, 2014; Srivastava, 2008; Subramanian et al., 2014; Subramoniam et al., 2013)
D15. Green marketing	Industries are progressively concerned about providing a green image. Additionally, firms do not want to get negative media attention by environmental action groups.	External	Society, Media	(Jindal and Sangwan, 2013; Kapetanopoulou and Tagaras, 2011; Lau and Wang, 2009; Mathiyazhagan and Haq, 2013; Shaik and Abdul-Kader, 2013; Van Der Wiel et al., 2012; Wang and Sun, 2005)
D16. Long-term sustainability	Firms are concerned about their long term survival in the market, considering, for example, the increasing shortage of raw materials and the green consumerism.	Internal	Organization	(Andiç et al., 2012; Jindal and Sangwan, 2013; Kannan et al., 2014; Kumar and Putnam, 2008; Mathiyazhagan and Haq, 2013)
D17. Competitors' pressures to adopt green initiatives	Many companies face pressures from competitors inducing them to adopt environmental initiatives.	External	Market/ Competitors	(Hsu et al., 2013; Mathiyazhagan and Haq, 2013; Shaik and Abdul-Kader, 2014)
D18. Brand protection	The outside RL competition and the consequential brand erosion may pressure the decision to perform RL.	Internal	Organization	(Jindal and Sangwan, 2013; Subramoniam et al., 2013)
5–Technology and infrastructure related issues				
D19. RL management information system	The availability of specific IT for RL is a success factor for RL development.	Internal	Organization	(Subramanian et al., 2014)
D20. Recycling management system	The availability of good recycling management system and recycling service drives RL practice.	Internal	Organization	(Lau and Wang, 2009)
D21. Technological innovations	Rapid innovations, quicker obsolescence and shortening product lifecycle propel RL activities.	Internal	Organization	(Lau and Wang, 2009; Shaik and Abdul-Kader, 2014)
D22. Eco-design and Design for X techniques	Design for remanufacturing, recycle, or disassemble are techniques that can enhance the chance of getting an EOL product back because RL costs are reduced.	Internal	Organization	(Kannan et al., 2014; Subramoniam et al., 2009, 2013; Xie and Breen, 2012)
D23. Recycling and remanufacturing technologies	Many recycling and remanufacturing strategies are evolving towards continuous improvement by the researchers.	Internal	Organization	(Kannan et al., 2014; Shaik and Abdul-Kader, 2013)

Barrier Name	Description	Internal/ External	Stakeholders Involved	Sources
6 - Economic related issues				
D24. Benefits of recycling	Economic benefits of recycling places more pressure on companies to develop a better RL strategy.	Internal	Organization	(Chan et al., 2012)
D25. Reduction on raw material consumption and waste disposal cost	Decreasing the use of raw materials by replacing them by recovered ones as well as reduction of final disposal costs.	Internal	Organization	(Mathiyazhagan and Haq, 2013; Rahimifard et al., 2009; Subramanian et al., 2014; Subramoniam et al., 2013)
D26. Value recovery	RL enables recapturing value from spare parts, recovering assets.	Internal	Organization	(Chan and Chan, 2008; Chan et al., 2012; Janse et al., 2010; Kannan et al., 2014; Kapetanopoulou and Tagaras, 2011; Mathiyazhagan and Haq, 2013; Rahimifard et al., 2009; Subramanian et al., 2014; Subramoniam et al., 2013)
D27. Second hand market	Other financial opportunities are realized from entering the second hand market.	Internal	Organization	(Chan et al., 2012)
D28. Reduction of cost risks	Companies implement RL in order to avoid fines and penalties and to lessen risks. Example: Carbon tax forces fuel cost reduction.	Internal	Organization	(Andiç et al., 2012; Mathiyazhagan and Haq, 2013)
D29. Economic viability	RL can improve economic efficiency.	Internal	Organization	(Agrawal et al., 2015; Chan et al., 2012; Jindal and Sangwan, 2013; Kannan et al., 2014; Krikke et al., 2013; Lau and Wang, 2009; Ravi et al., 2015; Shaik and Abdul-Kader, 2013, 2014; Srivastava, 2008; Subramoniam et al., 2013; Wang and Sun, 2005)
D30. Financial support	Availability of initial capital for investment in RL operations.	Internal	Organization	(Ho et al., 2012)
7 - Knowledge related issues				
D31. Knowledge on sustainable issues and perception of RL benefits	Awareness of manager and industries in general on environmental issues, sustainable development, corporate citizenship.	Internal	Organization, Employees	(Ho et al., 2012)
D32. Cost and performance knowledge	Full insight in cost and performance of RL operations.	Internal	Organization, Employees	(Janse et al., 2010; Mathiyazhagan and Haq, 2013)
D33. Intellectual property (IP)	The need to protect the IP of the product affects the decision to perform RL.	Internal	Organization	(Subramoniam et al., 2013)
7 - Knowledge related issues				
D31. Knowledge on sustainable issues and perception of RL benefits	Awareness of manager and industries in general on environmental issues, sustainable development, corporate citizenship.	Internal	Organization, Employees	(Ho et al., 2012)
D32. Cost and performance knowledge	Full insight in cost and performance of RL operations.	Internal	Organization, Employees	(Janse et al., 2010; Mathiyazhagan and Haq, 2013)
D33. Intellectual property (IP)	The need to protect the IP of the product affects the decision to perform RL.	Internal	Organization	(Subramoniam et al., 2013)
8 – Social related issues				
D34. Higher public awareness	Greater concern of environment by the population drives RL operations and claim for environmental behavior by NGOs.	External	Society, Customers	(Alvarez-Gil et al., 2007; Lau and Wang, 2009)
D35. Corporate citizenship pressure	Firms are under pressure to act in a socially responsible way, by meeting ethical, legal, and economic responsibilities.	External	Society, Media	(Chan and Chan, 2008; Hsu et al., 2013; Jayaraman and Luo, 2007; Shaik and Abdul-Kader, 2014; Van Der Wiel et al., 2012); (Aitken and Harrison, 2013; Chan et al., 2012; Jindal and Sangwan, 2013; Mathiyazhagan and Haq, 2013; Shaik and Abdul-Kader, 2013)
D36. Increasing landfill	Illegal landfills became a major threat and RL is a solution to give a proper disposal to EOL products. Scarcity of landfill.	External	Society	(Jindal and Sangwan, 2013; Kannan et al., 2014)
D37. Environmental conservations	Hazardous substances can be released from EOL goods that are dangerous for the environment.	External	Society	(Kannan et al., 2014)

Annex 2 – List of Reverse Logistics barriers, classification, and sources (Govindan & Bouzon, 2018)

Barrier Name	Description	Internal/ External	Stakeholders Involved	Sources
1 - Technology and infrastructure (T&I)				
B1. Lack of technical skills	There is a lack of skilled manpower and lack of capabilities to perform RL activities.	Internal	Employees, Organization	(Abdulrahman et al., 2014; Aitken and Harrison, 2013; Bouzon et al., 2015; Chan and Chan, 2008; Daily and Huang, 2001; Ganjali et al., 2014; González-Torre et al., 2010; Govindan et al., 2013; Hillary, 2004; Kapetanopoulou and Tagaras, 2011; Perron and Student, 2005; Prakash and Barua, 2015; Pumpinyo and Nitivattananon, 2014; Ravi and Shankar, 2005; Rogers and Tibben-Lembke, 2001; Sarkis et al., 2010; Shaharudin et al., 2014; Sharma et al., 2011; Škapa, 2011; Van Der Wiel et al., 2012; Walker et al., 2008; Wang and Sun, 2005; Yusuf and Raouf, 2013)
B2. Lack of IT systems standards	IT connectivity issues, including: lack of information and technological systems, incompatibility of IT systems and inadequate information technology support.	Internal	Organization	(Abdulrahman et al., 2014; Aitken and Harrison, 2013; Bernon et al., 2013; Bouzon et al., 2015; Chan and Chan, 2008; Chileshe et al., 2015; González-Torre et al., 2010; Janse et al., 2010; Ravi and Shankar, 2005; Rogers et al., 1999; Sharma et al., 2011; Škapa, 2011; Wang and Sun, 2005; Yusuf and Raouf, 2013)
B3. Lack of most recent technologies	Lack of latest available technologies for performing product/material recycling.	External	Organization	(Abdulrahman et al., 2014; Bouzon et al., 2015; Chan et al., 2012; Ganjali et al., 2014; Lau and Wang, 2009; Pumpinyo and Nitivattananon, 2014; Shaharudin et al., 2014)
B4. Lack of facilities	Deficient industrial infrastructure for reverse operations in terms of handling equipment, storage, and vehicles.	Internal	Organization	(Abdulrahman et al., 2014; Bouzon et al., 2015; Chileshe et al., 2015; González-Torre et al., 2010; Shaharudin et al., 2014)
B5. Technology and Research and Development issues related to product recuperation	There is a complexity of design to recycle/reuse used products and manufacturers resist improving design for EOL recovery. Recycling technologies or design for 'X' techniques are mostly not in practice, especially in developing countries.	Internal	Organization	(Andiç et al., 2012; Beamon, 1999; Bouzon et al., 2015; Ganjali et al., 2014; Govindan et al., 2013; Rahimifard et al., 2009; Shaharudin et al., 2014)
B6. Complexity in operation	RL systems are more uncertain and complex when compared to forward distribution because the recovery options and processes vary in view of characteristics of products and life cycles, capacity of facilities, and resources required.	Internal/ External	Organization	(Kapetanopoulou and Tagaras, 2011; Wang and Sun, 2005)
2 – Governance and SC process (G&SC)				
B7. Difficulties with supply chain members	Lack of support and poor coordination in the SC for RL implementation and management.	External	Suppliers, Customers	(Abdulrahman et al., 2014; Agrawal et al., 2015; Bernon et al., 2013; Bouzon et al., 2015; Chileshe et al., 2015; González-Torre et al., 2010; Mangla et al., 2012; Ravi and Shankar, 2005; Sharma et al., 2011; Walker et al., 2008; Wang and Sun, 2005)
B8. Limited forecasting and planning	Many firms face difficulties in forecasting and planning RL as a result of the degree of assortment of products and flows (i.e. stochastic return and demand, variable product mix).	Internal	Customers, Organization	(Abdulrahman et al., 2014; Abraham, 2011; Bouzon et al., 2015; Chan et al., 2012; Janse et al., 2010; Lau and Wang, 2009; Shaharudin et al., 2014; Sharma et al., 2011; Yusuf and Raouf, 2013)
B9. Inconsistent quality	When compared to forward logistics, the product quality is not consistent.	External	Organization	(Abraham, 2011; Bouzon et al., 2015; Ravi and Shankar, 2005; Shaharudin et al., 2014; Sharma et al., 2011; Yusuf and Raouf, 2013)
B10. Complexity for finding third party for RL	Finding third parties to collect used goods is not easy. Additionally, there are few consultancy companies for the field of RL.	External	Organization	(Ganjali et al., 2014; Govindan et al., 2013; Shaharudin et al., 2014; Škapa, 2011)
B11. Lack of suitable performance management system	Lack of appropriate performance metrics and a performance management system for RL.	Internal	Organization	(Abdulrahman et al., 2014; Janse et al., 2010; Ravi and Shankar, 2005; Shaharudin et al., 2014; Sharma et al., 2011; Yusuf and Raouf, 2013)
B12. Inappropriate organizational co-operation	Lack of co-operation between departments for communication, causing restrictions in the information flow.	Internal	Organization	(González-Torre et al., 2010; Govindan et al., 2013; Ravi and Shankar, 2005; Shaharudin et al., 2014)
3 - Economic related issues (E)				
B13. Lack of initial capital	RL is a restructuring process that demands investment.	Internal	Organization	(Abdulrahman et al., 2014; AlKhidir and Zailani, 2009; Andiç et al., 2012; Bouzon et al., 2015; Carter and Ellram, 1998; Chan and Chan, 2008; Ganjali et al., 2014; González-Torre et al., 2010; Govindan et al., 2013; Hervani et al., 2005; Lau and Wang, 2009; Mangla et al., 2012; Mudgal et al., 2010; Pumpinyo and Nitivattananon, 2014; Ravi and Shankar, 2005; Rogers and Tibben-Lembke, 2001; Sharma et al., 2011; Škapa, 2011; Van Der Wiel et al., 2012; Wang and Sun, 2005; Yusuf and Raouf, 2013)
B14. Funds for training	Lack of funding for training human resources for RL operations.	Internal	Organization	(Abdulrahman et al., 2014; Ganjali et al., 2014)
B15. Return monitoring system/storage and handling	Lack of support for investments in monitoring systems for RL, storage and handling operations. Investing in product recovery activities is not justifiable in economic terms.	Internal	Organization	(Abdulrahman et al., 2014; Bouzon et al., 2015; Ganjali et al., 2014; Kapetanopoulou and Tagaras, 2011)
B16. Financial burden of tax	Complex flows of products and the varied bought-in services embedded in RL create an elevated degree of tax difficulty and lead to unpredicted tax and costs.	Internal	Organization	(Abdulrahman et al., 2014; Lau and Wang, 2009; Sharma et al., 2011)
B17. Uncertainty related to economic issues	There is a demand for profit from shareholders and the establishment of product recovery activities constitutes a highly uncertain investment, one in which it is hard to see the economic benefits.	Internal	Organization	(Alvarez-Gil et al., 2007; González-Torre et al., 2010; Kapetanopoulou and Tagaras, 2011; Shaharudin et al., 2014)
B18. Lack of economy of scale	Compared to forward flows, RL might be uncertain regarding the volume of returned products, creating a difficulty on attaining economy of scale.	Internal	Organization	(Bouzon et al., 2015; Prakash and Barua, 2015)

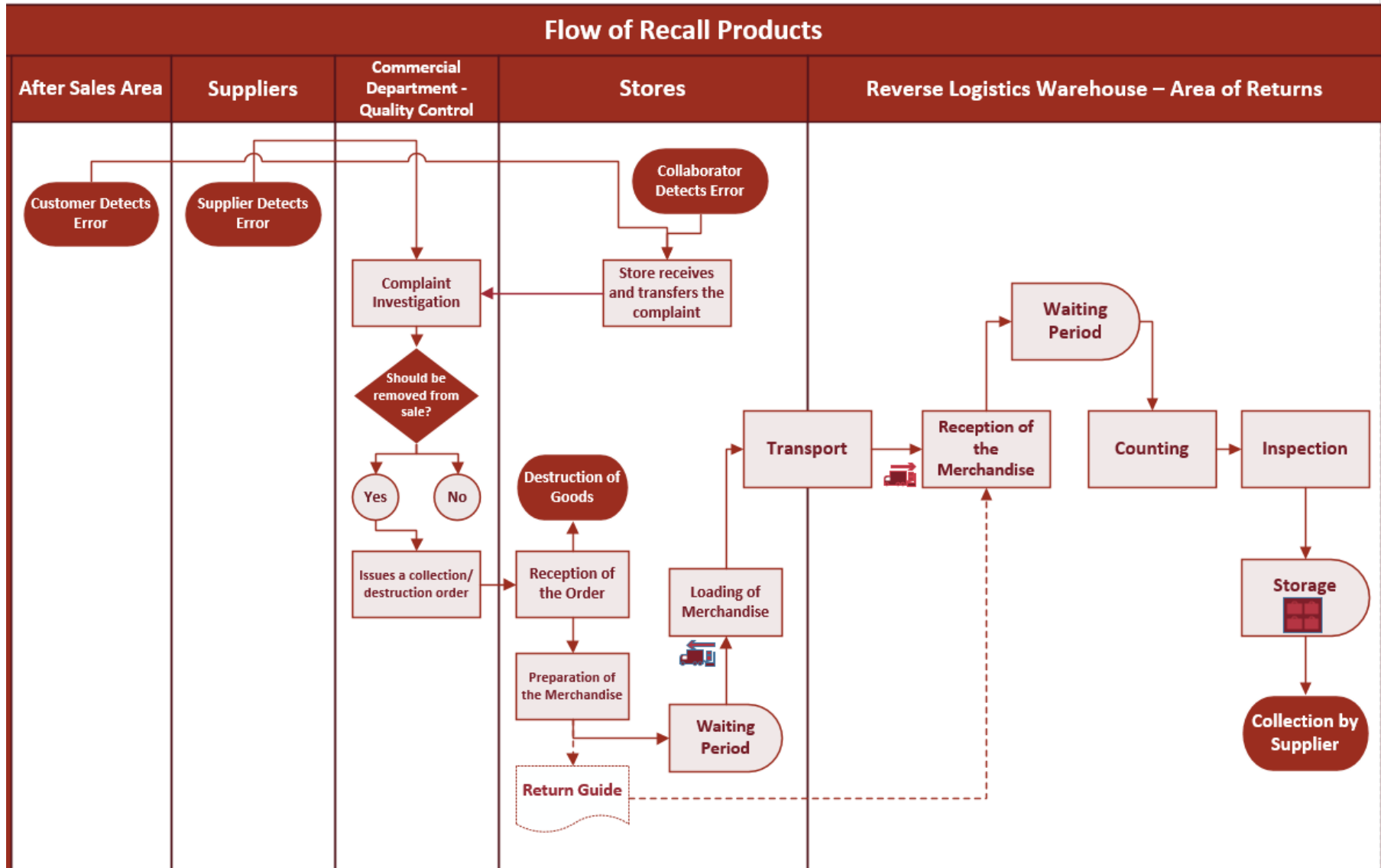| Barrier Name	Description	Internal/ External	Stakeholders Involved	Sources
4–Knowledge related issues (K)				
B19. Lack of knowledge on RL practices	Difficulty in obtaining information about the best practices in RL.	Internal	Organization	(Abdulrahman et al., 2014; Agrawal et al., 2015; Bouzon et al., 2015; Prakash and Barua, 2015)
B20. Lack of information on take back channels	No proper dissemination of information regarding take back channels available for customers to return their products.	External	Organization	(Abdulrahman et al., 2014; Bouzon et al., 2015; Govindan et al., 2013; Shen and Tam, 2002)
B21. Lack of awareness concerning RL and its benefits	Lack of publicity and knowledge of RL benefits.	Internal	Organization, Employees	(Abdulrahman et al., 2014; Agrawal et al., 2015; Aitken and Harrison, 2013; Bouzon et al., 2015; Shaharudin et al., 2014)
B22. Lack of taxation knowledge on returned products	Companies can face a cost burden due to lack of knowledge of customs procedures, and financial support for value-added tax payments.	Internal	Organization, Employees	(Bouzon et al., 2015; González-Torre et al., 2010; Govindan et al., 2013; Lau and Wang, 2009; Meade et al., 2007; Mudgal et al., 2010; Rahimifard et al., 2009; Ravi and Shankar, 2005; Rogers and Tibben-Lembke, 2001; Sharma et al., 2011; Van Der Wiel et al., 2012; Yusuf and Raouf, 2013)
B23. Lack of environmental regulations awareness	Lack of knowledge on environmental laws and unawareness of environmental impact on the firm's activities and benefits of implementing RL.	Internal	Organization, Employees	(Janse et al., 2010)
5–Policy related issues				
B24. Lack of specific laws	Lack of supportive policies: a lack of legislation or appropriate laws is seen as a major barrier for companies to be involved in EOL returns.	External	Government	(Abdulrahman et al., 2014; Agrawal et al., 2015; Bouzon et al., 2015; Carter and Ellram, 1998; Chan and Chan, 2008; Ganjali et al., 2014; Krikke et al., 2013; Lau and Wang, 2009; Mangla et al., 2012; Shaharudin et al., 2014; Sharma et al., 2011; Walker et al., 2008)
B25. Lack of waste management practices	In many countries, waste management practices are not implemented due to a lack of clear return policies or not fully regulated waste management.	External	Government	(Abdulrahman et al., 2014; Bouzon et al., 2015; Ganjali et al., 2014; Janse et al., 2010)
B26. Lack of inter-ministerial communication	Lack of inter-ministerial communication could provide conflicting laws.	External	Government	(Abdulrahman et al., 2014; Bouzon et al., 2015)
B27. Lack of motivation laws	Lack of regulations or directives to motivate manufacturers to perform RL and maintain a green environment and also motivate customers to buy green products	External	Government	(Abdulrahman et al., 2014; AlKhidir and Zailani, 2009; Bouzon et al., 2015; Ganjali et al., 2014; Govindan et al., 2013; Perron and Student, 2005; Pumpinyo and Nitivattananon, 2014; Shaharudin et al., 2014; Zhu et al., 2012)
B28. Misuse of environmental regulations	Some environmental laws are not well implemented: for example, non-deterrent penal sanctions and loopholes in WEEE regulations.	External	Government	(Abdulrahman et al., 2014; Andiç et al., 2012; González-Torre et al., 2010)
B29. Difficulties in extended producer responsibility across countries	Complexity created by the globalization of the supply chains, hindering the implementation of the extended producer responsibility.	External	Government	(Abdulrahman et al., 2014)
B30. Company polices against RL	Many firms fear cannibalization of their first quality products by remanufactured ones, making policies against product recovery operations.	Internal	Organization	(Abdulrahman et al., 2014; Aitken and Harrison, 2013; Chan and Chan, 2008; Ravi and Shankar, 2005; Rogers et al., 1999; Sharma et al., 2011; Škapa, 2011)
6 - Market and competitors related issues (M&C)				
B31. Perception of a poorer quality product	Customers might think recovered products or the use of recycled material as a lower quality standard.	External	Customer	(Bouzon et al., 2015; Carter and Ellram, 1998; González-Torre et al., 2010; Rahimifard et al., 2009; Shaharudin et al., 2014)
B32. Undeveloped recovery marketplaces	Difficulty on establishing end-of-life recycled material markets and on establishing remanufactured products markets.	External	Market/ Competitors	(Abraham, 2011; Bouzon et al., 2015; Rahimifard et al., 2009; Shaharudin et al., 2014)
B33. Little recognition of competitive advantage	Many companies do not recognize RL as a factor for creating competitive advantages.	Internal	Organization	(Abdulrahman et al., 2014; Bouzon et al., 2015; Janse et al., 2010; Rogers et al., 1999; Shaharudin et al., 2014; Škapa, 2011)
7 - Management related issues				
B34. Low importance of RL relative to other issues	Product recovery activities are perceived as inconsistent with the firm's main operations (low priority when compared to other duties).	Internal	Organization	(Abdulrahman et al., 2014; Bouzon et al., 2015; Chan and Chan, 2008; Ganjali et al., 2014; Kapetanopoulou and Tagaras, 2011; Rogers et al., 1999; Shaharudin et al., 2014; Škapa, 2011; Walker et al., 2008; Wang and Sun, 2005)
B35. Low involvement of top management and strategic planning	Resistance of top management to change to RL due to organizational culture. Resistance to change existing investments, information systems and habits. Lack of strategic planning and structure for RL.	Internal	Organization	(Abdulrahman et al., 2014; Bernon et al., 2013; Bouzon et al., 2015; González-Torre et al., 2010; Govindan et al., 2013; Hillary, 2004; Lin and Ho, 2008; Perron et al., 2006; Prakash and Barua, 2015; Ravi and Shankar, 2005; Rogers et al., 1999; Rogers and Tibben-Lembke, 2001; Sarkis et al., 2010; Shaharudin et al., 2014; Sharma et al., 2011; Škapa, 2011; Van Der Wiel et al., 2012; Walker et al., 2008; Yusuf and Raouf, 2013; Zhu et al., 2007)
B36. Limited approval of disposal licenses	A system does not permit one firm to hold many products' disposal permissions at the same time.	Internal	Organization	(Andiç et al., 2012)

Annex 3 – Alfena Logistics Center Plant

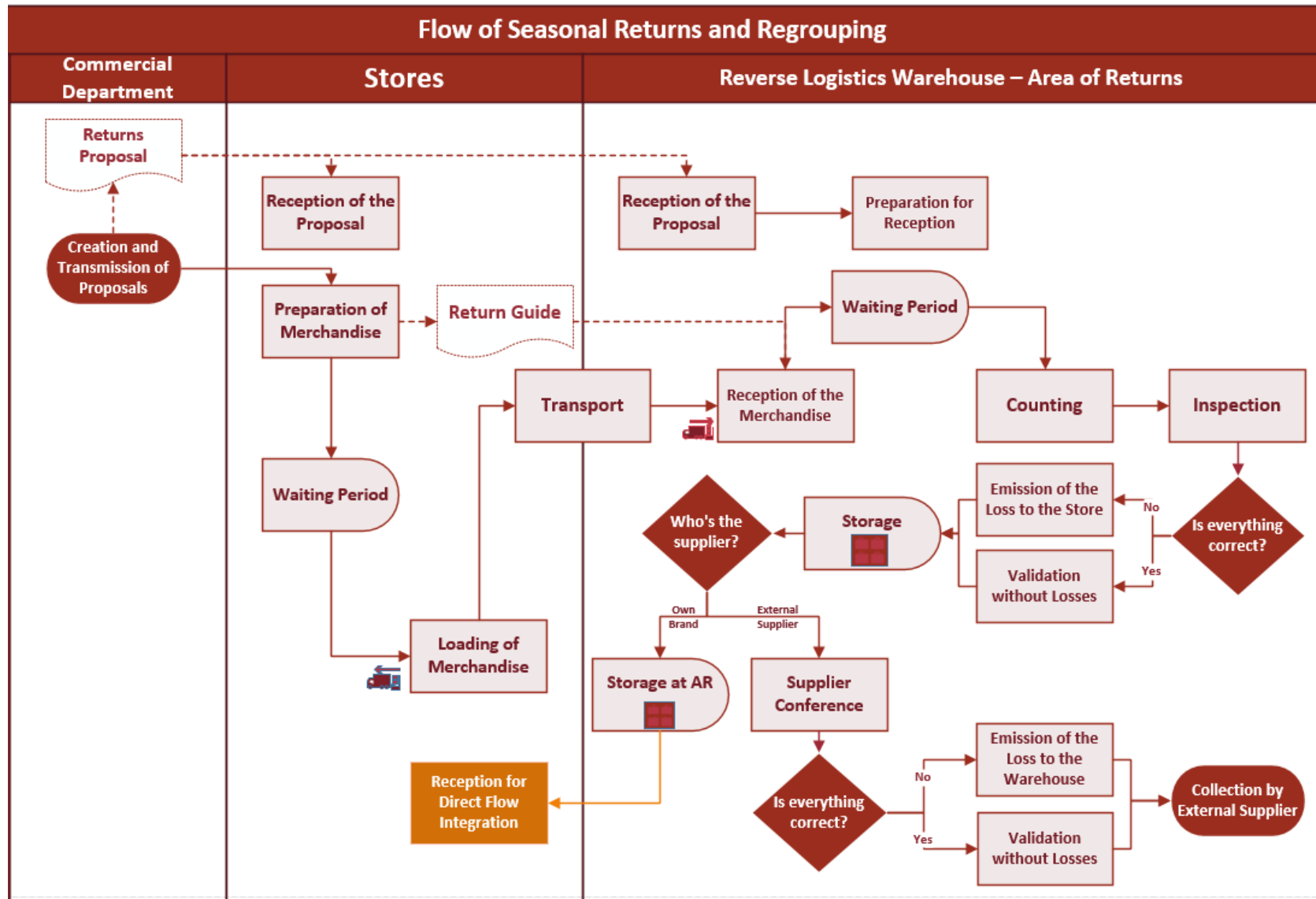**Annex 4 –** Map of Operations of the Reverse Flow of Recovered Products

Flow of Recovered Products	
Stock and JIT Warehouses	**Reverse Logistics Warehouse – Area of Returns**

Detection of the Damaged Product → Preparation of the Merchandise → Waiting Period → Loading of Merchandise → Transport → Reception of the Merchandise

Return Guide

Waiting Period → Counting → Inspection → Storage → What to do?

What to do? → Donation → Collection by the Institution

What to do? → Recycling → Collection by the Recycling Company

Annex 5 – Map of Operations of the Reverse Flow of Recall Products

Annex 6 – Map of Operations of the Reverse Flow of Planned Returns
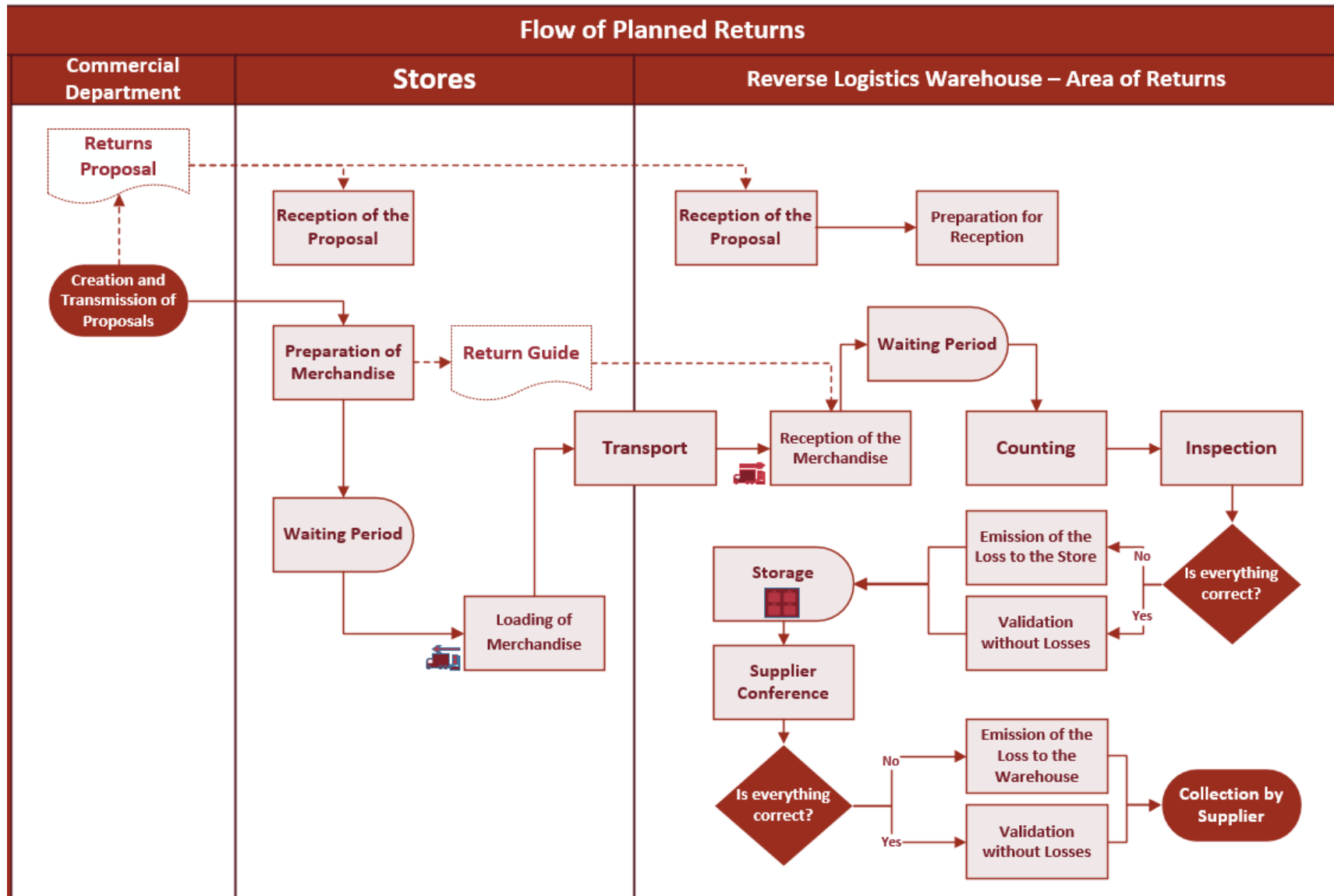
Annex 7 – Map of Operations of the Reverse Flow of Seasonal Returns and Regrouping
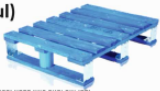
Annex 8 – Map of Operations of the Reverse Flow of Recyclable Waste
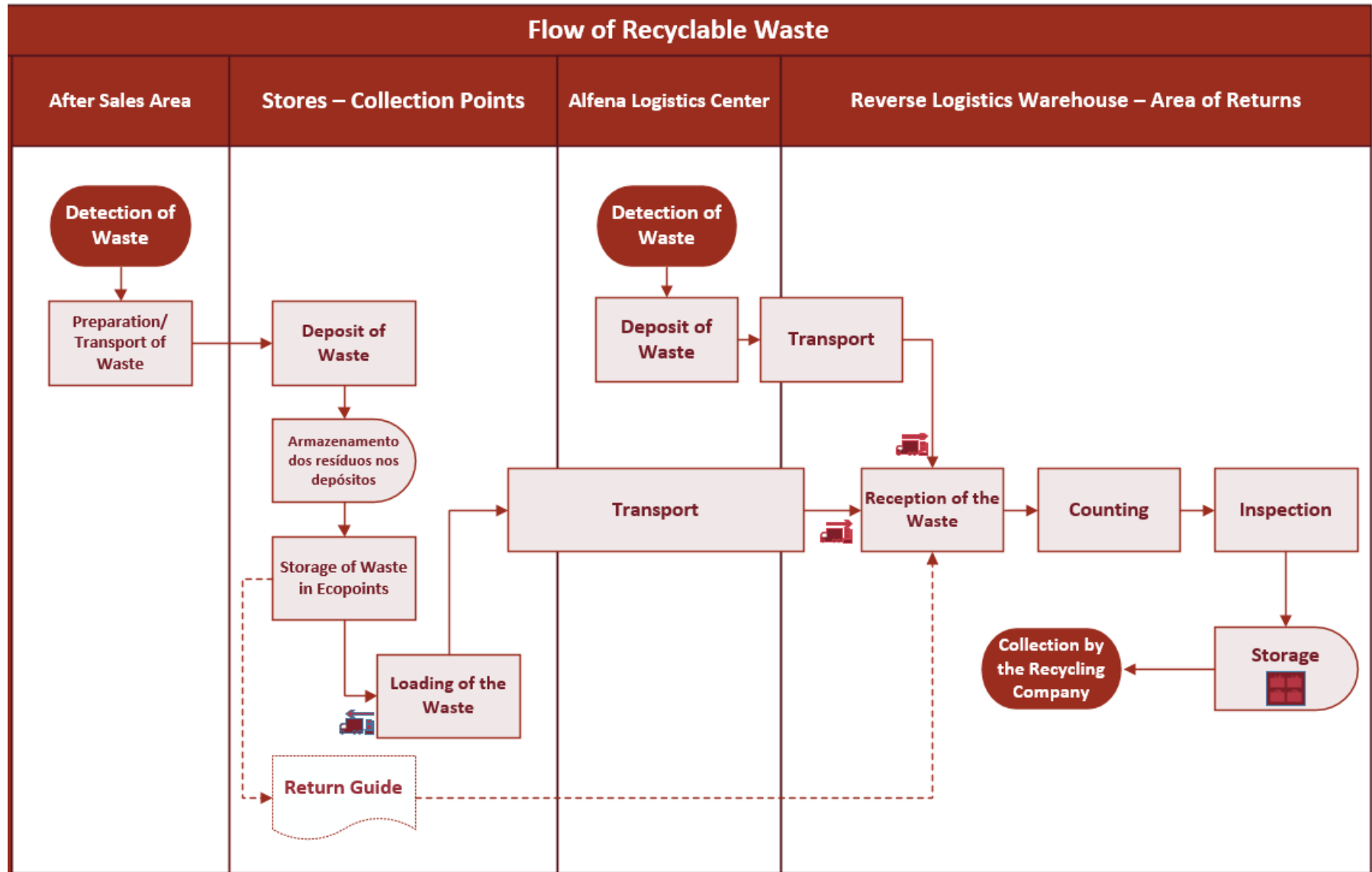
Annex 9 – Map of Operations of the Reverse Flow of Transportation Assets
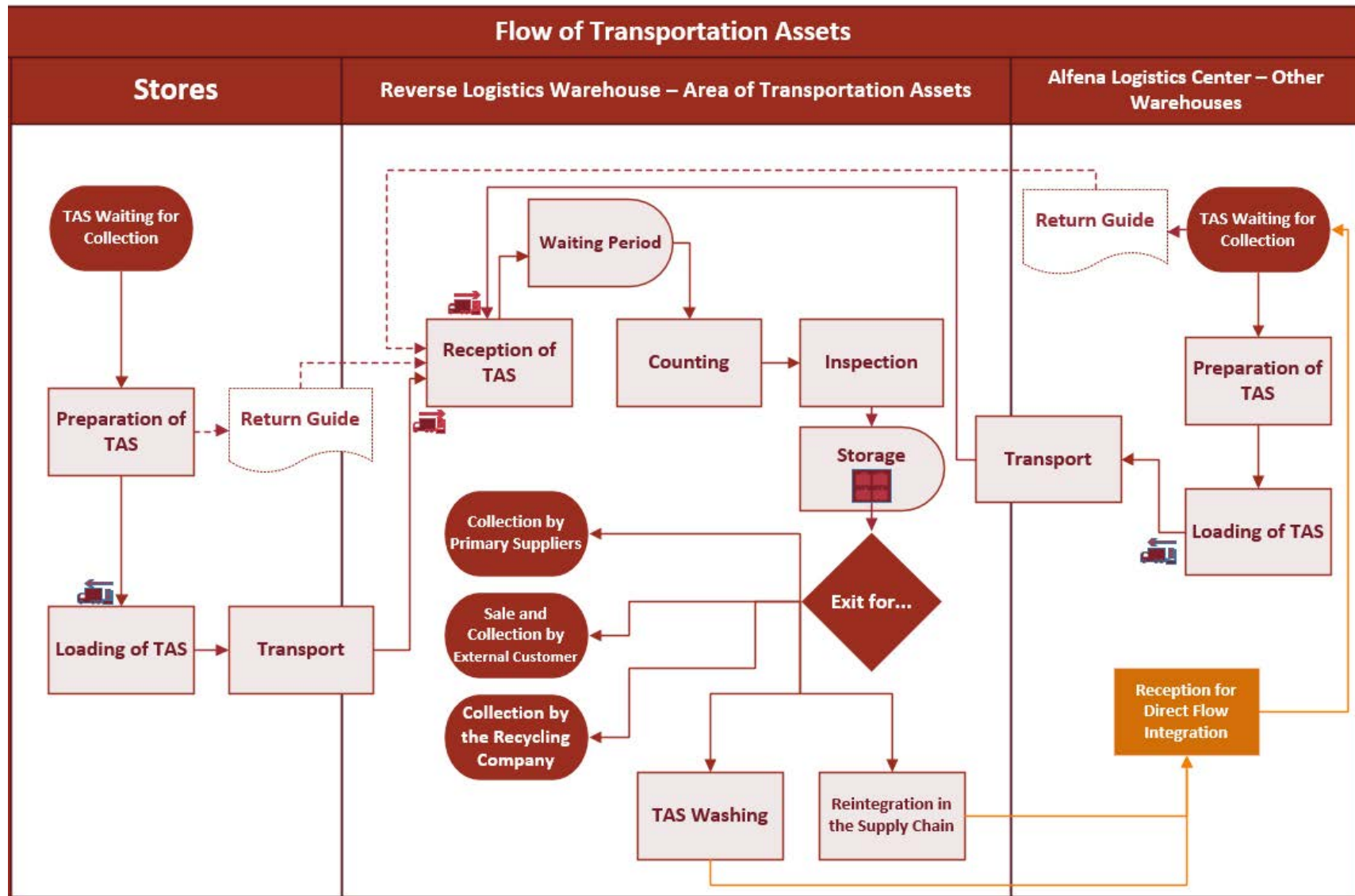
Annex 10 – List of managed Transport Assets (Document provided directly by Jerónimo Martins)

Acessórios Transporte   JERÓNIMO MARTINS

Palete CHEP (Azul)
SAP: 748438

EAN: 200 0002 5213 34

Palete LPR (Vermelha)
SAP: 748439
EAN: 200 0002 5213 41

Palete Normal (Branca)
SAP: 230497

EAN: 210 0000 1695 28

Meia Palete CHEP (Azul)
SAP: 748441

EAN: 200 0002 5213 65

Meia Palete LPR (Vermelha)
SAP: 748442
EAN: 200 0002 5213 72

Meia Palete Normal (Branca)
SAP: 659569

EAN: 200 0001 9126 21

Palete Industrial
SAP: 748440

EAN: 200 0002 5213 58

Palete Plástico
SAP: 264155
EAN: 200 0000 0061 78

Roll Congelados YATN
SAP: 745036

EAN: 200 0002 4915 38

Skate Encaixe
SAP: 634499

EAN: 200 0001 8662 14

Grelha
SAP: 634500
EAN: 200 0001 8672 35

Carro Pendurados
SAP: 578262

EAN: 200 0001 8006 38

Carro Pendurados Pequeno
SAP: 597154

EAN: 200 0001 8198 21

Caixa Pool Pequena Fruta
SAP: 374888
EAN: 200 0000 1421 28

Caixa Pool Fruta
SAP: 45439

EAN: 200 0001 0737 28

Caixa Pool C01
SAP: 496964

EAN: 200 0001 0655 25

Caixa Pool C02
SAP: 374953
EAN: 200 0000 1424 49

Caixa Pool C03
SAP: 496965

EAN: 200 0001 0655 32

Caixa Pool C04
SAP: 496966

EAN: 200 0001 0655 49

Caixa Pool Nº10 Peixe Pequena
SAP: 498390
EAN: 200 0001 0732 47

Caixa Pool Nº11 Peixe Média
SAP: 498394

EAN: 200 0001 0732 54

Caixa Pool JMR
SAP: 620675

EAN: 200 0001 8505 41

Caixa Plástica Sapateira
SAP: 551560
EAN: 200 0001 6340 42

Caixa Artigos de Risco
SAP: 588250

EAN: 200 0001 8050 39

Caixa Panrico
SAP: 526227

EAN: 200 0001 3466 86

Tabuleiro Massa Fresca
SAP: 623069
EAN: 200 0001 8536 34

Skate Massa Fresca
SAP: 623070

EAN: 200 0001 8536 41

Annex 11 – Example of Damaged Pallets For Sale (*Paletes Brancas*)

Annex 12 – Interviews for collaborators at Warehouse and Stores

During the data collection period, interviews were conducted with warehouse employees, including 8 operatives, 2 administrative and 1 operational manager. At store level, interviews were conducted with 3 assistant store managers.

Questions for Warehouse' collaborators:

- What do you think reverse logistics is, and does it include, what processes and types of products?
- What are the difficulties you encounter when doing reverse logistics, in your day-to-day life, but also in the way this area is still seen?
- Which do you consider that for the company were the main motivations to have this reverse logistics' structure?
- In what way and what are the main advantages associated with it, both monetary and non-monetary? And in terms of disadvantages, do you think there are any?
- What do you think JM can still do to improve in this area? And in general, in other companies?
- What are the next steps in your opinion?
- As a consumer, in your opinion, do you think the work that is done in this area is important?

Questions for Stores' collaborators:

- What do you think reverse logistics is, and does it include, what processes and types of products?
- What do you think were the main motivations for the company to have this RL structure? These processes, make all this investment, ...
- Regarding the returns operations, that have been created, how do you think they help or contribute (advantages) to a better and more efficient management of the store and its operations? Or do you think it is of no use to the efficiency of your store operations?
- What costs do you associate with carrying out these reverse logistics operations here in the store?

- What are the difficulties you encounter when making reverse logistics, in the preparation of products for return to the warehouse, in the return rules, but also in the way this area is still seen (by employees included)?

- Was it pointed out as one of the main problems of returns, the fact that the returned products/materials are not delivered according to the recommended rules? Why does this happen?

- Is there someone (employee) responsible for the return processes? Who handles these processes?

- What do you think can be improved in return processes? Having someone in charge of "watching over" these operations could help and make everything else better.