Survey of Reverse Logistics Practices
The Case of Portugal

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Abstract: Reverse Logistics (RL) has gained substantial relevance in the field of supply chain management, mainly because RL combines environmental, economic and social factors. Although there are studies on RL practices, none of these studies are related to the Portuguese case. Therefore, a survey was conducted in Portugal to fill this gap. This study was applied to a group of Portuguese companies of four industrial sectors. These four sectors are highly diversified, regarding the way RL is managed. The results demonstrate that companies consider the management of RL important. The most common practice used is the proper disposal of returned products. The companies mainly adopt RL due to the benefits associated with the improvement of customer satisfaction and the reduction in logistics costs. The biggest barrier to the implementation of RL is a lack of strategic planning by the companies on handling returned products. The main reason affecting the performance of RL activities is the lack of quality of the returned product. The study also allowed to estimate the volume of returned products and the costs of RL.

1 INTRODUCTION

Currently, the world faces growing uncertainty on the demand of consumers. Adding to that, the national economic situation represents an aggravating factor for the Portuguese market. Furthermore, the seasonality of the sales and the implementation of various campaigns and promotions throughout the year are also responsible for an increased difficulty in making accurate forecasts for the consumer demand. On other hand, the operations of Reverse Logistics (RL) decisively contribute to the value and competitiveness of enterprises, where margins and profitability are increasingly lower, therefore the challenge is to transform costs in added value to the supply chain management. Hence, it is increasingly important to consider RL essential and stop labelling it as "the forgotten child of the supply chain" (Morrel, 2001).

The poor implementation of RL systems have disastrous effects for businesses and cause high costs in transportation and storage, increase processing times and accumulation of products with no destination, conflicts with customers/suppliers, legal and environmental issues. This lack of planning and implementation of RL systems is a reality in Portugal, making the costs of RL relatively high (Logistica Moderna, 2013). One of the major difficulties for companies is how to effectively and economically collect all the products from the place where they are no longer desired and transfer them to a place where they can be processed, reused or recovered. There are several studies on RL practices, but none contemplates the Portuguese context. This work, "survey of RL practices in Portugal", intends to contribute and fill this gap.

2 LITERATURE REVIEW

In the past, RL was only seen as a cost for the companies, however the perspective on RL is shifting markedly whether by its economic value gained in reusing used products, or by using used components in the manufacture of new products (Savaskan and Van Wassenhove, 2006). With concerns about product returns and proper implementation of RL systems, the academic community has been studying this area and as a result, in recent years, increasingly more scientific articles on this subject have been published (Rubio et al., 2008).

In the early nineties, the first definition of RL emerges. Stock (1992) emphasised the recovery aspects of RL, defining as: "... the term often used to refer to the role of logistics in recycling, waste disposal, and management of hazardous materials; a broader perspective that includes all logistics activities such as recycling, substitution, reuse of materials and disposal of products". Furthermore, Rogers and Tibben-Lembke (1998) summarize RL as the process of moving goods from the final destination to another point in the supply chain, in order to capture unavailable value. More recently, Pokharel and Muha (2009) stated that the focus of RL refers to the waste management, recycling of materials, recovery of components or product recovery. According to the authors RL involves a paradigm shift in terms of product life-cycle. Traditionally the life cycle of a product was between the period of its manufacture and its disposal ("cradle-to-grave"). Currently RL allows a change of the product life cycle, from the period of manufacture to its recovery ("cradle-to-cradle").

Companies have been using more liberal return policies in order to reduce the risk of the final customers and thus increase sales volume (Smith, 2005). In the United States, the estimates are even more significant with the annual costs about $ 100 billion for the manufacturers and retailers corresponding to a reduction in the yield at about 3.8% (Blanchard, 2007), while Greve and Davis (2012) state that the electronics industry is over 14 billion dollars, as well as the rates of returns of the end customers ranging from 5% to 9% of sales for most retailers.

Implementing an effective system generate multiple benefits for businesses, including increased customer satisfaction level, reducing the level of investment in resources, and reduce storage and distribution costs (Andel, 1997). Thus, the integration of RL in supply chains is increasingly used as a strategy to increase profits or to promote sustainability and customer satisfaction (Du and Evans, 2008). That said, Brito and Dekker (2003) identify the main reasons that lead companies to adopt RL operations:

- Economics − RL programs can bring direct gains through lesser use of raw materials, reduction in disposal cost, etc. Companies also have indirect gains due to competition, environmental image, improve customer-supplier relations, etc;
- Legislation - refers to any jurisdiction that indicates that a company should recover all the products produced by them or own

responsibility for end-of-life products. With the growing concern for the environment, laws have been emerging in European, that forced companies to develop their RL processes with the introduction of quotas for the recovery, recycling and packaging;
- Corporate citizenship - concerns a set of values and principles that motivate an organization to become involved responsibly in RL activities. This motivation arises from the need to hold a responsible and conscientious stand towards environmental issues.

The activities of a RL network in supply chains may differ, such as, type of products returned, the desired recovery and the logistics network implemented. We can essentially identify 5 groups of recurrent activities in various supply chains with RL (Prahinski and Kocabasoglu 2006; Barker and Zabinsky 2008; Silva et al. 2013). These groups are: acquisition of products, collection of products, inspection and disposal, recovery and distribution and resale.

Ravi and Shankar (2005) studied the main barriers to the implementation of RL operations in the automotive industry. They concluded that there are five main barriers, lack of knowledge of RL, lack of commitment by managers, problems with product quality, lack of strategic planning and financial constraints. However, the lack of knowledge regarding RL practices is the most significant barrier. Therefore, managers should focus on the development of their awareness on the use of RL.

Aberdeen Group (2006) conducted a study on RL based on a survey of 175 companies from various continents. The aim of this study was to analyze the best management practices on RL. From the companies surveyed, 61% mentioned that effective management of RL is very important. The authors also found that companies spend about 9% of sales in costs related with RL.

According to a study by Chan and Chan (2008), successful RL systems may result in greater customer loyalty and reduced operating costs due to the reuse or replacement of products. Their study consisted of a total of 73 companies of the mobile industry in Hong Kong and 34 interviews. This research showed that companies in this sector consider RL important, but compared to other issues RL importance is smaller and this is the biggest barrier to the implementation of RL.

Finally, Ravi and Shankar (2015) developed a study, based on a survey of 105 companies in India, where they investigated RL practices in four sectors of the Indian industry: automotive, paper, food and

electronics. They concluded that the adoption of RL practices is crucial and RL should be integrated at a strategic level and also found that the volume of returned products is a critical factor to RL implementation. Nevertheless, the most important factor to RL implementation is the economic benefit associated.

The main objective of this work is to assess the perception of RL practices in the Portuguese context. In order to achieve this goal, the following research questions (RQ) were addressed: RQ1 - What are the most common RL practices in the Portuguese industry?; RQ2 - What are the main reasons that lead companies to the adoption of RL practices?; RQ3 - What are the main barriers experienced by companies in implementing RL practices?; RQ4 - What are the main reasons affecting RL performance? Accordingly, the work presented herein contributes to expanding the knowledge on RL, in Portugal.

3 RESEARCH METHOD

For this work, a questionnaire survey methodology was used to determine the perception on RL practices in the Portuguese context. The questionnaire was designed to obtain answers to all research questions previously presented. The questions were based on other published works (Andel, 1997; Daugherty, Richey, Genchev, & Chen, 2005; Ravi & Shankar, 2005; Ravi V & Shankar, 2015; Rogers & Tibben-Lembke, 1998; Tibben-Lembke, 2002; Tibben-Lembke & Rogers, 2002), and addresses issues such as the RL practices, reasons to adopt, barriers and performance difficulties. The five point Likert scale was considered appropriate for the evaluation of this type of issues.

The initial questionnaire that resulted from the literature review was validated by a group composed of one teacher, two researchers and two senior consultants specialists in SCM. Later the corrected and improved questionnaire was used in a pilot test envolving five companies. After the pilot, some of the questions were modified to convey their intended meaning and a few other questions were deleted.

In this work, four sectors of Portugal industries dealing with RL operations were selected for this survey: Food Industry (FI), Automotive Industry (AI), ConsumersElectronics (CE) and Manufacturing (Mf) (metallurgical, energy, textile, paper and wood). In the FI, RL has a unique role with regard to food safety. With return policies for food products, companies allow the return of defective or out of date products, preventing infection or intoxication

problems. AI is one of the most dynamic and important sectors in Portugal economy. RL is very important, due to the type of returns (defective product, etc.), as well as the reuse of the main components and subsequent resale. In the CE, the kind of product commercialized has short life cycle due to software updates, among others, that originates a high rate of replacement or removal. The very nature of the products makes them obsolete because of the introduction of new equipment and this is the major challenge (Chan and Chan, 2008). Currently, the Mf is losing importance and it is necessary to achieve its revitalization by modernizing their production processes. This is where RL enters since it allows for the reduction of costs and less use of raw materials.These four sectors are highly diversified in nature with respect to how they operate their RL programs.

Most of the companies selected to compose the sample were identified by Logistema, a consultant partner in this study. In total, 225 companies operating in Portugal were identified for the survey. The survey was conducted in May-September 2016. Questionnaires were sent via email to logistics directors and, in some case, to general email addresses, with information about the study, identifying the objectives and scope of the work, and with a link to the questionnaire. Reminders were sent to all the non-respondents. In addition, phone calls were made in order to increase the number of responses to the questionnaire.

4 RESULTS AND DISCUSSION

The analysis was carried out using a statistical software (SPSS) and consisted essentially of ranking the variables based on mean values and frequency distributions. The objective was to test if the mean values of the dependent variables (assumed as normally distributed) differ among the categories. The following procedure was adopted:

- Test the reliability and internal consistency of responses, Cronbach's coefficient (α), for questions on a Likert scale. In this research a Cronbach's $\alpha > 0.6$ was considered as acceptable, as it is an exploratory study (Hair et al., 2010);
- The T-test was used to test the "indifferent" value of the overall means, which is the value in the measuring scale that represents a shift in the perception;
- The Levene F homogeneity test was used to verify that the variances of the dependent

variables are similar; If the Levene F statistic has a significance value greater than 0.05 then ANOVA is performed; If the Levene F statistic had a significance value lower than 0.05, which means the variances of the dependent variables are not similar, then the Welch test is used, because is a more robust test for equality of means;

- Finally, when the average values of the dependent variable differ between the categories considered, the post-hoc Tukey test is applied to determine which categories differ.

4.1 Sample

Of a total of 225 questionnaires sent, 43 questionnaires were received (Table 1). This gives an overall response rate of 19.2%. This situation is common in surveys via email and can lead to non-response bias (Kypri et al, 2004; Sax et al, 2003). To test for non-response bias, we compared the sectors distribution of potential respondents (those whom the survey was sent electronically) with the distribution of sectors that effectively answered the questionnaires. Using the χ2 test, it was determined that there is no statistically significant difference between the sectors, which might indicate a low non-response bias.

Out of 43 usable responses, the food industry accounts for 51.2% of the answers, manufacturing industry and automotive industry accounts for 18.6%, electronic sector 11.6%. In terms of employees, 28 companies had more than 250 employees, 12 in the range of 51-250 and 3 companies had fewer than 50 employees. In relation to the companies' sales volume in the last year, 35% of companies had a turnover between 50 and 250 million euros, 30% had sales of over 500 million euros, 21% between 250-500 million euros, and 14% shows sales lower than 50 million euros. The distribution of firms by the different sectors show that 73.9% of respondents are positioned as producers, 10.9% are positioned as retailers, and 8.7% are wholesalers.

Table 1: Survey respondent distribution.

Industrial Sector	Potential Respondents		Respondents	
	Frequency	%	Frequency	%
Food	94	41.8	22	51.2
Electronics	51	22.7	5	11.6
Automotive	49	21.7	8	18.6
Manufacturing	31	13.8	8	18.6
Total	225	100	43	100

4.2 General Issues

The importance that companies give to RL management is revealed by 33% of the responses, that sees RL with the utmost importance, but for 26% of respondents RL is "indifferent", and only 5% of the companies surveyed claim to RL as "Not Important". With the results we can say that RL in Portugal is important and aligned with previously studies such as the study by the Aberdeen Group (2006), which stated that the majority of companies surveyed (60%) considered that effective management of RL it is extremely important to the overall performance. Also, there is no significant difference between sectors.

RL offers many benefits (Table 2), including: improve logistics efficiency and reduction of logistics cost. With 53.5% of the replies (23 responses each option). The less observed benefits are "Improved employee productivity" with only 2.3% of respondents and "Increase on turnover " with 9.3% of the answers. These results meet expectations of the literature review.

Table 2: Observed benefits.

Benefit	N. of responses
Improve logistics efficiency	23
Reduction of logistics costs	23
Improve relations/satisfaction with partners	22
Improved company image	21
Lower costs resulting from better planning	19
Minimising waste (eco-friendly)	16
Improvement on asset recovery	11
Lower costs in processing of returned products	8
Increase of net sales	4
Improve employee productivity	1

The volume of returned products that are recovered was measured in this work (Table 3). With 26% of companies stated that they recover more than 50% of returned products, this reveals a growing trend of RL practices and awareness of entities to minimize the costs on raw materials. Unfortunately, 30% of the managers could not estimate a value, this shows difficulties for companies to observe the value recovered from returned products.

Table 3: Estimate of the value recovered.

Value (%of the returned product)	Frequency (%)
Not aware	30
More than 50%	26
Less than 5%	21
Between 26% - 50%	14
Between 6% - 25%	9

The respondents were enquired to estimate the costs of RL according to the volume of sales (Table 4). Most companies (about 70%), stated costs lower than 2% of total sales volume. While 19% of respondents indicate that they have no knowledge on this subject and can´t estimate a value, which reveals a lack of visibility of total costs. However, 5% of the companies surveyed say that RL costs are more than 10% of total sales volume. The values obtained in general support the values presented in the literature review. Logistica Moderna (2013) stated that 23% of companies in Portugal had an RL cost of less than 3% of the sales volume, while Greve and Davis (2012) reported values close to 4%. These values are aligned and even exceed the values of previous studies, this allows us to assume that companies have greater knowledge on this topic and have an optimized system that manages the reverse flow, but on the other hand, may show a lack of visibility by managers on the real cost.

Table 4: Costs of reverse logistics.

Costs (% sales volume)	Frequency (%)
Less than 2%	70
Not aware	19
More than 10%	5
Between 2% - 5%	5
Between 5% - 10%	2

The vast majority of respondents already have RL software implemented and operational. On the negative side, investment in new infrastructures specialized in RL management and R&D on new techniques, companies have no plans to invest in the short term.

4.3 Adoption of RL Practices

RL encompasses all the activities in managing and controlling the reverse flow of products from the customer to the manufacturer, for product recovery or proper disposal. Regarding to the frequency which companies execute these practices, the option with the highest score is "Proper disposal of returned products" with 4.05, followed by "Training of

employees" with 3.81 points, on other hand the least common practice is "Product collection" with 3.02 points, as can be seen in Table 5. The item "Resale of returned products" was eliminated by the Cronbach's alpha (α). The results show that there is no statistical difference at a significance level of 5% between the most common practices and sectors. However, analyzing the table the most used practice in FI, CE and AI is the "Proper disposal of returned products" while for the Mf sector is the "Training of employees". These results can be explained because not all products can be easily recycled. At this stage, the products are destroyed for lack of knowledge of new value recovery methods and lack of training of employees who send the product for destruction without trying to recapture value from it.

4.4 Reason to Adopt RL

The most important reason for RL adoption perceived by the respondents was to "Improve customer satisfaction", with a score of 4.23, the second most important reason was to "Reduce logistics costs" with 4 points (Table 6). The reason perceived with least importance to companies is the "Lifecycle of products" with a score of 2.86. Most of the implementation factors to RL differ from the score 3 ("indifferent" in a scale of importance), except "Reduce stocks" and "Lifecycles of Product". The results show no significant difference (at the 5% significance level) between the reasons to adopt RL and sectors. By observing the values obtained, is clear that the main reason for companies to implement RL operations is the need to improve customer satisfaction.

4.5 Barriers to RL Adoption

The practice of RL is not free from barriers, so efficient management of these barriers can result in successful RL systems. Table 7 presents the barriers to RL adoption by sector.

The biggest barrier identified by respondents is the "lack of strategic planning related to reverse logistics" with 3.58. The option with the lowest score,

Table 5: Adoption of reverse logistics practices by sector.

Practices	Type of sector (Cronbach's α = 0.62)*				Global	ANOVA Sig.	Welch Sig.
	FI	CE	AI	Mf			
Proper disposal of returned products	4.00	4.00	4.38	3.88	4.05	0.815	
Training of employees	3.73	3.40	3.88	4.25	3.81	0.313	
Recapturing value from returned products	3.45	3.00	3.75	3.00	3.37	0.511	
Product collection	3.00	3.20	3.50	2.50	3.02		0.184

* Values on a Likert scale of 5 points (1 - Never; 5 – Always).

with 3.02 points, is the "lack of technological systems" which reveals that for companies, technological systems are not the reason for a non-implementation of RL.

Most of the barriers identified differ from the score 3 ("indifferent" in a scale of importance), except "financial constraints" and "lack of technological systems" with significance values less than 5%, as can be observed by T-test. Also, the results show no significant difference at a significance level of 5% between the barriers and the sectors. Is possible to see, that among the sectors studied, CE ranks with a bigger degree of importance in the barriers "lack strategic planning related to reverse logistics" and "lack of training". FI identifies the lack of training of its employees as the biggest barrier. On the other hand, the Mf ranks budget constraints and lack of strategic planning as most significant barriers. As for AI the greatest barriers to RL is lack of training, lack of interest by managers and importance of reverse logistics in relation to other matters"

4.6 Causes Affecting Rl Performance

Measuring the performance of any system is essential to enable improvements in management processes. This is especially important in the management of RL, since it is characterized by high uncertainty in the quality, quantity and timing of the returned products, making the performance measurement a tricky task. The results are shown in Table 8, where we can see that the "uneven returned product" and "difficulty in predicting returns" have the higher scores with 3.88 and 3.83 points, respectively. On the other hand the "marketing difficulty of products used" with 2.81, is identified as a reason that least affects RL. "uneven returned product", "difficulty in predicting returns", "visibility/viability of costs" and "transportation from many sites to one/few places" obtained a different score of 3 ("indifferent"), as can be observed by the T-test.

The results also reveal that there is no statistically significant difference between the reasons and sectors. CE sector, ranks higher on the importance scale for the factor "uneven returned product", but the difference in scores between this sector and the remaining are not significant in order to extrapolate conclusions, but it is important to note this difference.

5 CONCLUSION

This research examines the perceptions of Reverse Logistics (RL) in Portuguese companies through a questionnaire-based survey. The results show that Portuguese companies considered implementing RL

Table 6: Reasons to reverse logistics adoption.

Reasons	Type of sector (Cronbach's α = 0.83)*				Global	T-Student Sig.**	ANOVA Sig.
	FI	CE	AI	Mf			
Improve customer satisfaction	4.23	4.40	4.13	4.25	4.23	0.000	0.947
Reduce logistics costs	4.14	3.80	3.75	4.00	4.00	0.000	0.727
Legal requirements	4.14	4.40	3.75	3.25	3.93	0.000	0.250
Recapturing value of returned products	3.73	4.00	3.50	3.88	3.74	0.000	0.803
Increasing competitiveness	3.73	4.20	3.50	3.50	3.70	0.000	0.598
Reduce stocks	3.32	3.60	3.25	3.38	3.35	0.058	0.962
Lifecycles of Product	3.09	2.40	2.88	2.50	2.86	0.421	0.474

* Values on a Likert scale of 5 points (score of 1 indicates a low importance and 5 a higher one).

** T-Student test for overall means (test value = 3 "indifference").

Table 7: Barriers to RL adoption by sector.

Barrier	Type of sector(Cronbach's α = 0.85)*				Global	T-Student Sig.**	ANOVA Sig.
	FI	CE	AI	Mf			
Lack of strategic planning related to RL	3.50	3.80	3.50	3.75	3.58	0.002	0.926
Lack of training	3.64	3.80	3.63	2.88	3.51	0.002	0.197
Lack of interest by decision makers	3.41	3.60	3.63	3.63	3.51	0.012	0.956
Relations with partners	3.45	3.60	3.50	3.38	3.47	0.012	0.990
Importance of RL in relation to other issues	3.41	3.20	3.63	3.50	3.44	0.007	0.909
Financial constraints	3.05	3.60	3.38	3.75	3.30	0.108	0.501
Lack of technological systems	3.05	2.60	3.50	2.75	3.02	0.898	0.514

* Values on a Likert scale of 5 points (score of 1 indicates a low importance and 5 a higher one), α=0.85

** T-Student test for overall means (test value = 3 "Indifferent")

Table 8: Causes that affect the realization of reverse logistics by sector.

Causes	Type of sector(Cronbach's α = 0.82)*				Global	T-Student Sig.**	ANOVA Sig.
	FI	CE	AI	Mf			
Uneven returned product	3.86	4.60	3.63	3.75	3.88	0.000	0.323
Difficulty in predicting returns	4.00	4.00	3.25	3.88	3.83	0.000	0.389
Visibility/Viability of costs	3.86	3.80	3.38	3.63	3.72	0.000	0.606
Transportation from many places to one/few places	3.36	3.80	3.25	3.88	3.49	0.002	0.574
Poor inventory management	3.32	3.20	3.25	3.38	3.30	0.079	0.955
Product lifecycle issues	3.32	2.80	2.75	2.75	3.05	0.789	0.364
Lack of clarity in relation to the disposal options	3.36	3.20	2.63	2.38	3.02	0.901	0.161
Difficulties in marketing used products	2.82	3.40	2.38	2.88	2.81	0.263	0.416

 * Values on a Likert scale of 5 points (score of 1 indicates a low importance and 5 a higher), α=0.82

 ** T-Student test for overall means (test value = 3 "Indifferent")

programs in their organization as a strategic-level decision, as RL programs involve significant allocation of capital and resources.

The findings show that organizations with higher volume of returned products tend to develop expertise in operating their RL programs, which is well aligned with the literature. Although, the literature indicates that economic, ecological and legislative are the drivers that initiate RL activities, in the case of the Portuguese companies, the adoption of RL is mainly perceived as associated to economic benefits .

Interestingly, the findings indicated that Portuguese companies have already invested in terms of EDI, RL softwares, new logistic resources, etc., which is a good step in the right direction to adopt RL. These findings are aligned with the literature that consider the technologies for tracking and tracing of products essential for successful RL programs. On the other hand, companies do not have plans to invest in the short term.

The main implications of this work are as follows:

- Managers need to consider integration of collection, inspection and consolidation of used products with forward logistics in RL programs:
- Managers should reinforce the training of their staff on new recovery methods in order to reduce the destruction of returned products without trying to recapture the value associated;
- Enhancing customer satisfaction and reducing logistics costs should be considered key in improving the level of RL adoption;
- The strategic planning of RL should not be neglected by managers;
- Companies should support RL on extended information systems that allow the effective exchange of information between forward flow and reverse flow in the supply chain to ensure good RL management.

For further work/research, it is recommended to repeat this study, but considering a bigger sample size. Also, it would be useful to hold interviews with the entities and their partners in order to understand the motivation factors and the vision that each party provides for the implementation of RL strategies.

The present work has some limitations, mainly the small sample size, which reduces the generalization of the findings. However, it is believed that the work presented expands the knowledge in the RL field by addressing this topic in the Portuguese context thus adding a relevant and empirical study to the literature.

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