

Systematic literature review on the ways of measuring the of reverse logistics performance

Revisão sistemática da literatura sobre as formas de mensuração do desempenho da logística reversa

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Abstract: Reverse logistics can provide a sustainable competitive advantage for the company. However, to benefit from it, companies must monitor their reverse logistics based on a performance measurement system composed of financial and non-financial indicators. Thus, this study investigated, through a systematic literature review, the ways of measuring the of reverse logistics performance. The results of this study showed that the most used indicators were the financial and/or economic performance, together with the indicators related to the clients, followed by the indicators related to the improvement of internal, environmental, innovation and growth, social and, finally, supplier processes. It should be emphasized that there is no single justification on the best measures of performance evaluation of an activity. Therefore, each company must establish the measures appropriate to its characteristics, in order to meet the company goals.

Keywords: Systematic review; Performance measurement; Indicators; Reverse logistics.

Resumo: *A logística reversa pode proporcionar uma vantagem competitiva sustentável para a empresa. No entanto, para obter benefícios, as empresas devem monitorar sua logística reversa com base em um sistema de medição de desempenho composto por indicadores financeiros e não financeiros. Desse modo, este estudo investigou, por meio de uma análise sistemática da literatura, as formas de mensuração do desempenho da logística reversa. Os resultados deste estudo evidenciaram que os indicadores mais utilizados foram a performance financeira e/ou econômica, juntamente com os indicadores relacionados aos clientes, seguido dos indicadores relacionados com a melhoria dos processos internos, ambiental, inovação e crescimento, social e, por último, fornecedor. Ressalta-se que não há uma justificativa singular sobre as melhores medidas de avaliação do desempenho de uma atividade, portanto cada empresa deve estabelecer as medidas apropriadas às suas características, para que possam atender as metas da empresa.*

Palavras-chave: *Revisão sistemática; Mensuração do desempenho; Indicadores; Logística reversa.*

1 Introduction

The driving forces behind the reverse logistics boom are the scarcity of natural resources, green legislation, reverse flow value recognition, e-business, good image, customer relationship and information system (Jayaraman & Luo, 2007). As a result, reverse logistics is an important process, since it makes it possible to add value to the company. Its effective

management enables the leverage of a sustainable competitive advantage, increase profits, cut costs, increase customer satisfaction, and improve internal processes (Tibben-Lembke, 2002; Smith, 2005).

However, to be effective, the reverse supply chain must be measured. This is in line with the understanding of Song & Hong (2008), for which

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performance measurement is fundamental to business success. The first condition to improve and achieve business excellence is to develop and implement a performance measurement system to quantify the efficiency and effectiveness of actions (Neely, 2002).

Although reverse logistics plays an important role in logistics, the literature rarely discusses its performance. According to Shaik & Abdul-Kader (2012), the concept of reverse logistics is relatively new and, therefore, few structures and measures have been developed to evaluate its performance.

Thus, this study aims to investigate, through a systematic analysis of the literature, the ways of measuring the performance of reverse logistics.

The research is justified by the scarcity of literature on methods of measuring the performance of reverse logistics, corroborating the need to identify opportunities for research in this topic.

The article is presented in four sections, the first being the introduction. The second section presents the theoretical reference; the third, presents the methodology and results of the systematic review, highlighting the indicators adopted to measure the performance of reverse logistics. Finally, there are the conclusions of this study, ending with the references used.

2 Reverse logistics

The terminology of reverse flows arose in the literature in the 1970s (Adlmaier & Sellitto, 2007). However, it was only in the 1990s that reverse logistics began to be debated and used by companies (Dias et al., 2012).

Reverse logistics is a series of activities required to recover a used or unused product, from the time a customer wants to dispose of it, reuse it or resell it (Guide & Wassenhove, 2002). Or, as the process of planning, implementing and controlling the flow of raw materials, production and finished product (and its

flow of information), from point of consumption to origin, in order to recapture value or offer an ecologically appropriate destination (Gonçalves & Marins, 2006).

In a more “[...] broad definition, reverse logistics are all operations related to the reuse of products and materials” (Gonçalves-Dias & Teodósio, 2006, p. 430).

For Rogers & Tibben-Lembke (2001), reverse logistics can be classified in two ways: Product and Packaging, and the main activities are described in Chart 1:

Return of product to origin = Reverse channel, that is, with little or no use, the products return to the productive cycle, and this return occurs from “[...] customer to retailer or to manufacturer, from retailer to manufacturer” (Acosta et al., 2008, p. 4);

Product Resale = The returned products are brought back to the market (Leite & Brito, 2005);

Sale of the product via outlet = The returned products can be sold via *outlet*, that is, in retail (Krumwiede & Sheu, 2002);

Refurbishment = The returned products need some repair and can be sold at a lower market value (Bouzon et al., 2010);

Re-manufacture = “[...] when the returned product or its components are able to be partially repaired or re-manufactured in order to acquire conditions of sale on secondary markets” (Leite & Brito, 2005, p. 218);

Recycling = The products or part of the products are processed into raw materials (Acosta et al., 2008);

Chart 1. Main activities of reverse logistics.

Materials	Reverse Logistics Activities
Products	Return of product to origin Product Resale Sale of the product via outlet Refurbishment Remanufacturing Recycling Donation Discarding
Packing	Reuse Recycling Discarding

Source: Rogers & Tibben-Lembke (2001, p. 133).

Donation = This process occurs when the returned products are donated to any interested entity (Acosta et al., 2008);

Disposal = The products are destined for landfills or incineration when the possibility of adding value to the product is exhausted (Leite & Brito, 2005);

Reuse = It occurs when the company seeks to intensify the use of the product before being discarded or used as raw material in the production process (Krumwiede & Sheu, 2002).

According to Leite (2006), reverse logistics seeks to add value to the return of after-sales and post-consumption goods. Figure 1 shows these two stages of operation of reverse flows.

The reverse distribution channels for post-consumption are the return of end-of-life products and that must be properly recycled, reused, disassembled or disposed; for example: incineration or landfill (Acosta et al., 2008).

Reverse after-sales distribution channels consist of products that, for some reason, return to the production cycle (Acosta et al., 2008; Guarnieri et al., 2006). In this case, the “[...] strategic objective is to add value to the returned product” (Leite, 2006, p.17).

For Moraes et al. (2014) the economic issue is the main justification for the realization of reverse after-sales logistics. In relation to post-consumption reverse logistics, the main justifications are legal and environmental issues.

According to Ravi & Shankar (2005); Nikolaou et al. (2013), economic factors, environmental issues, legislation requirements and competitiveness are some factors responsible for the growing interest of

the business community in the implementation of reverse logistics.

Economic factors = Reverse logistics can provide gains for the company due to the reuse of products, the reduction of materials used, the sale of waste, the reduction of costs, the adoption of returnable packaging, besides the possibility of emerging new market niches (Akdogan & Coskun, 2012);

Environmental issues = The activities of reverse logistics provide solutions for the disposal of solid waste, reducing environmental pollution and favoring the image of the company (Ravi et al., 2005);

Legislation = The rigor of environmental legislation is forcing companies to be responsible for the entire product life cycle (Akdogan & Coskun, 2012). Creating laws that pressure companies to accept the return of products and restricting the use of certain harmful substances (Acosta et al., 2008);

Corporate Citizenship = It refers to the values and principles of the company in relation to the environment. The company teaches customers the right way to use the products without degrading the environment. (Akdogan & Coskun, 2012). Another view of corporate citizenship is related to competitiveness, since the company needs to satisfy the interests of different *stakeholders* (Ravi et al., 2005).

According to Nikolaou et al. (2013), these factors can be classified into two categories:

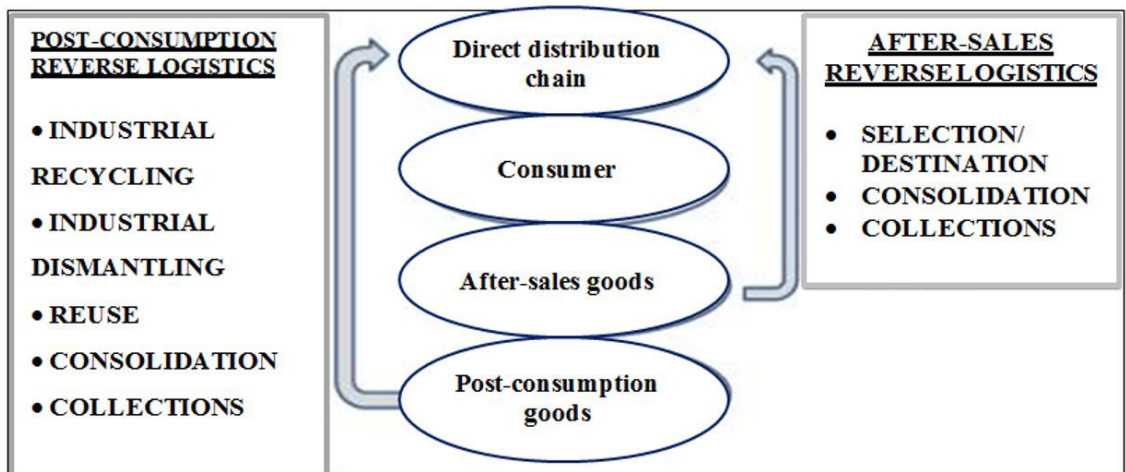


Figure 1. Areas and stages of reverse logistics. Source: Leite (2006, p. 17).

- a) Proactive: these are related to expected benefits, such as improved environmental performance, cost reduction, competitive advantage, among others;
- b) Reactive: aims to comply with legislation.

2.1 Benefits provided by reverse logistics

Reverse logistics has become a competitive strategy for modern companies (Gonçalves & Marins, 2006). And the global demands for environmental protection have made reverse logistics so important as product quality, sales price and brand (Amaral, 2003).

In addition to providing environmental benefits, the implementation of reverse logistics may entail a competitive differential for the company (Epelbaum, 2004; Gonçalves & Marins, 2006). And the various benefits generated by reverse logistics are expressed in Figure 2.

It can be seen in Figure 2 that reverse logistics can provide economic, social and environmental benefits, positively influencing the corporate image. Araújo et al. (2013) also emphasize the competitive advantage associated with reverse logistics, but focus this study on the e-commerce environment.

Brito & Dekker (2002) confirm the study of Epelbaum (2004) and Araújo et al. (2013), because they claim that investment in reverse logistics can provide the company with competitive and economic advantages, improve the company’s image and also contribute to customer satisfaction.

Adlmaier & Sellitto (2007) highlight that the use of reverse logistics provides the following benefits for the company studied: (1) economic, due to reduced packaging costs and reduced logistical costs; (2) ecological, because it provided the mitigation of waste generated; (3) flexibility to make changes in packaging due to legal requirements; (4) recycling of packaging carried out by the packaging supplier itself.

In this context, Chaves & Batalha (2006) point out that the lack of knowledge of the entrepreneurs regarding these benefits hinders the efficiency and effectiveness of reverse logistics. But specifically Araújo et al. (2013) argue that the lack of knowledge of the reverse logistics process in electronic commerce generates a variety of problems, such as: reverse logistics processes that are deficient, little information exchange between different sectors, lack of knowledge diffusion, and little participation of the academic community.

Bei & Linyan (2005) present three distinct characteristics of reverse logistics:

- (1) **Uncertainty about quantity and quality** = The recovery process involves imprecision on the quantity and quality of the product that will be recovered, as well as whether there will be market for the recovered product (Thierry et al., 1995);
- (2) **Complexity in operations due to recovery options** = The processes and options of the reverse logistics system for product recovery are uncertain and complex, as they consider the characteristics of the products, the life cycle, the resources required to carry out the process and also the capacity of the company premises (Bei & Linyan, 2005). In addition, reverse logistics activities are affected by the interests of customers, suppliers, government, competitors and shareholders, which have multiple conflicting objectives (Ravi & Shankar, 2005; Nikolaou et al., 2013). Thus, it is difficult for the company to decide which recovery option will be adopted and, consequently, to manage the reverse logistics system efficiently and effectively (Bei & Linyan, 2005). Leite (2006) further states that the company must ensure a sustainable recovery of the product;

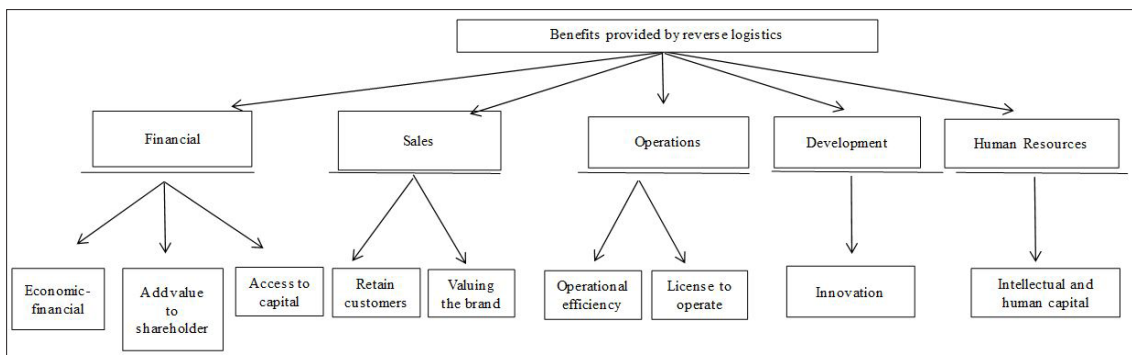


Figure 2. Benefits of reverse logistics. Source: Adapted from Epelbaum (2004).

(3) **Barriers in deployment** = Rogers & Tibben-Lembke (1998) carried out a study to verify the difficulties of the implementation of reverse logistics and reached the following requirements: reverse logistics is less important than other company issues (39.2%), company policy (35%), lack of information systems (34.3%), competitive activity (33.7%), lack of managers' interest (26.8%), lack of financial resources (19%), unprepared employees (19%), legal issues (14.1%).

Other barriers that companies have in implementing reverse logistics are: lack of strategic planning and quality problems (Ravi & Shankar, 2005), weak performance measurement system (Janse et al., 2010), organizational resources and competitiveness (Mittal & Sangwan, 2013), lack of reverse logistics specialists (Abdulrahman & Subramanian 2012).

The effective reverse logistics management can result in savings in the areas of inventory maintenance, transportation and costs, as well as providing customer satisfaction.

According to the literature, reverse logistics has a great potential for improving the financial performance of organizations, but to exploit this potential, firstly, managers must consider reverse logistics as an important strategic planning item and, secondly, must use a performance measurement system composed of a set of financial and non-financial indicators capable of measuring the efficiency and effectiveness of the action (Neely et al., 2005; Smith, 2005).

2.2 Measurement of the performance of reverse logistics

Performance measurement is often discussed but rarely defined. There are many reasons for companies to measure their performance, such as increasing understanding, collaboration, and integration among the supply chain members. Performance measurement also helps the company to achieve profitable market segments or to identify an appropriate service definition (Cuthbertson & Piotrowicz, 2008). In addition, it is an activity to achieve predefined objectives, derived from the strategic objectives of the company (Lohman et al., 2004).

The performance measurement is a way for the company to evaluate the efficiency and effectiveness of reverse logistics, that is, the measurement allows a better understanding of a dynamic system, helping managers to improve the company's reverse logistics (Neely, 2002; Saisana & Tarantola, 2002).

For Pun & White (2005) and Shaik & Abdul-Kader (2014) the following factors influence the performance measurement of reverse logistics:

- a) Support for decision-making;
- b) Integrate reverse logistics into the company's logistics policy;
- c) Communication;
- d) Align actions with strategic objectives;
- e) Achieve goals;
- f) Feedback.

Performance measurement is traditionally the process of quantifying the effectiveness and efficiency of action (Nukala & Gupta, 2007). Developing a system for such a purpose tends to be a complex task because the performance metrics and assessment techniques used in the traditional supply chain cannot be extended to reverse logistics (Nukala & Gupta, 2007). The use of appropriate strategies and metrics enables a reverse supply chain to play a strategic role in the product lifecycle, serving as a basis for identifying customer loyalty and also for increasing market share (Pochampally & Gupta, 2004).

Chaves et al. (2008) suggest the measurement of the performance of reverse logistics through financial and non-financial performance indicators, which should be developed based on several drivers, but with a single purpose: to serve shareholders, government, community, customers, employees and other agents in order to add value to the company (Hernández, Marins, & Castro, 2012).

Inadequate performance measurement becomes an obstacle to successful cooperation among members of the supply chain, as well as being an obstacle to the improvement of reverse logistics. However, although reverse logistics play an important role in the logistics system, the literature rarely discusses its performance and analyzes in an incipient way the factors that influence its operation (Griffis et al., 2007).

3 Method

In this work, the method of systematic literature review was used. According to Fink (2005, p. 3), "[...] literature review is a systematic, explicit and reproducible method that makes it possible to identify, evaluate, interpret and extract data from the work of scholars and researchers." It must follow a scientific, transparent and reproducible method (Tranfield et al., 2003) and must be elaborated with methodological rigor (Rother, 2007).

For Vosgerau & Romanowski (2014) the emergence of the internet facilitated the systematization of the literature review, since currently the databases have electronic access and enable the use of conference articles, theses and scientific journals (Dresch et al., 2015).

The systematic review explores a specific issue and provides solid and reliable evidence, as well as identifying gaps to be filled (Dresch et al., 2015). It is used to map primary studies on a particular topic (Dresch et al., 2015), to critically evaluate the literature and to consolidate the results of relevant studies (Seuring & Gold, 2012; Dresch et al., 2015).

A literature review can contribute to theoretical development, help in understanding terminologies (Cherrafi et al., 2016), and facilitate the construction of a bibliography on a particular topic (Rowley & Slack 2004).

This research adopted the following work process: collection and analysis of the articles, synthesis of the results, as shown in Figure 3.

For the collection of the articles, *Ebsco*, *Scopus* and *Web of Science* databases were used, and for the search of articles aligned with the theme of this research, the following keywords were adopted: “performance evaluation” AND “reverse logistics”; “reverse logistics” AND “management” AND “systems” AND “performance evaluation”; “reverse logistics systems” AND “performance evaluation”; “performance measure” AND “reverse logistics”.

The “reverse logistics” keyword was also used in the *Production* and *Gestão & Produção* journal databases, being found 6 articles in each journal. After reading them, 5 articles published in the *Production* journal and 4 articles published in the *Gestão & Produção* journal were used in the theoretical framework.

These words were used in all the databases defined, and the filters used to include articles in the bibliographic portfolio were: language (English, Portuguese and Spanish), research area (engineering, administration, *decision science*), and the articles should present some of the keywords used in the title, or in the abstract, or in the course of the text. In this study, only the articles available in full text, in the database to which they were linked, were selected. The articles were managed through the *EndNote X7.2.1* software.

One hundred seventeen (117) articles were obtained, of which 60 were duplicates, 21 were not available and 36 were available to carry out the study. After reading the articles, 25 were not aligned with the topic and were discarded from the research, resulting in 11 relevant articles.

The references of these 11 articles were analyzed as a secondary source, adding 13 articles to the bibliographic portfolio.

The content of the documents was evaluated by means of a descriptive analysis, extracting: (1) How is the distribution of publications in the course of time?; (2) How many authors per institution?;

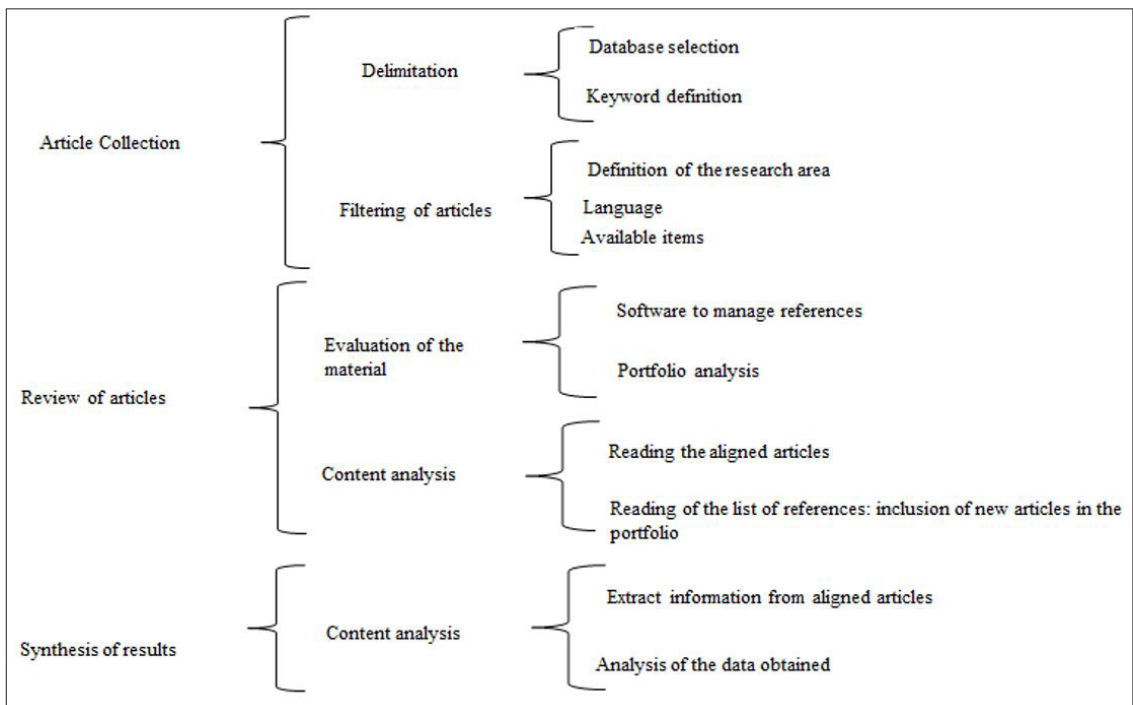


Figure 3. Work process. Source: Authors.

- (3) What methodologies are applied?;
- (4) What keywords were adopted by the studies?;
- (5) What are the expected benefits of implementing reverse logistics?;
- (6) What is the origin of reverse flow?;
- (7) What are the activities of Reverse Logistics?;
- (8) Which reverse logistics assessment indicators were adopted?

4 Results

Initially, a descriptive analysis of the portfolio articles is done. Thus, the distribution of published articles in time is shown in Figure 4.

The first publication found was developed in 2004 and, as of 2008, there was a small increase in publications, reducing in 2009. However, in the years 2010, 2011 and 2012, the publications started to grow again and were maintained until 2013. In 2014, it declined again. Therefore, Figure 3 confirms the research gap found in most of the documents analyzed, which report the lack of studies that address the methods adopted to evaluate the performance of reverse logistics.

The authors with the highest number of publications were Olugu & Wong (2011) and Olugu et al. (2011), of the Malaysian Technological University; Li & Olorunniwo (2008) and Olorunniwo & Li (2011) of the University of Tennessee; And Shaik and Abdul-Kader (2012, 2014) of the University of Windsor. The other authors presented a single publication. Thus, the institutions with the highest number of authors with publications are presented in Figure 5.

Figure 5 shows that the institutions with the largest number of authors with publications are concentrated in China and the USA, with 3 institutions each.

It is noteworthy that the largest number of articles comes from China with 8 registers, followed by the United States, with 4 registers. India, for its part, presented 3 articles; Malaysia, Canada and United Kingdom, each presented 2 articles. And finally, Brazil, Cuba, Czech Republic, Romania and Turkey, each of these countries, presented 1 article published.

China is the publishing leader, a developing country, which has serious environmental problems. However, the demands of society and strong business competition are pressing the government and companies to invest in green politics, with the aim of reducing pollution. Therefore, the adoption of reverse logistics and, consequently, its study, can help companies to achieve sustainable development, reduce costs, improve customer satisfaction and establish competitive advantages (Changli & Lili, 2008; Xin, 2010).

In Figure 6, it is possible to observe that, among the research methodologies used, 9 articles are

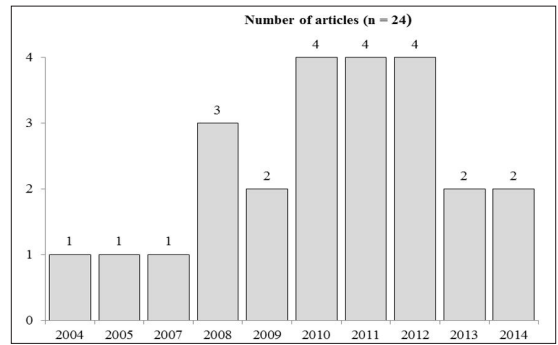


Figure 4. Distribution of publications per year. Source: Authors.

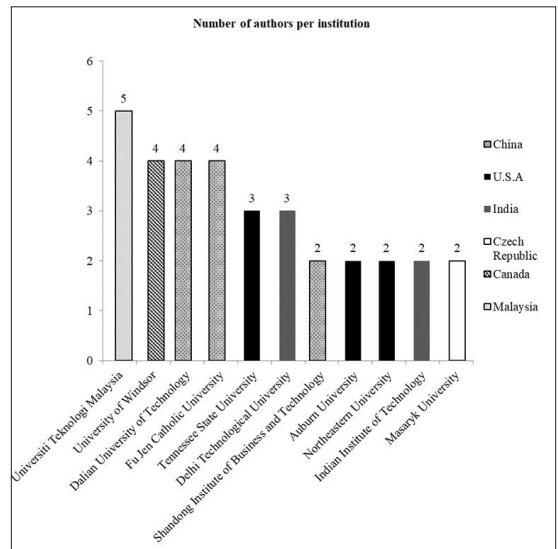


Figure 5. Number of authors per institution. Source: Authors.

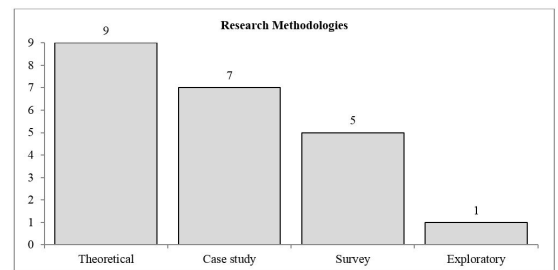


Figure 6. Research methodologies. Source: Authors.

theoretical in nature, 7 articles adopted the case study, 5 articles are survey-type and, in 1 study adopted the exploratory research. In 2 articles, it was not possible to identify the methodology used for the development of the study.

Among the adopted methods, there are: *Fuzzy and Analytical Hierarchy Process (AHP)* methods, addressed in 8 articles; *Analytic Network Process*

(ANP), addressed in 4 articles; interview, *likert* scale and questionnaire, in 6 registers; *Business Intelligence, Dematel, Linear Physical Programming (LPP)*, 1 article each; And in three articles analyzed, it was not possible to identify the method adopted.

The number of occurrences of the 10 most used keywords is shown in Figure 7. As expected, *reverse logistics* is the most common term; and the second most used keyword is *performance measurement*, indicating a strong link between these words.

Figure 8 demonstrates the expected benefits from the adoption of reverse logistics. The financial / economic benefits, along with improved customer satisfaction, were the most cited, being highlighted in 7 articles. Competitive advantage, company image and waste reduction were benefits mentioned in 3 articles.

Next, the protection of the environment was cited in 2 articles. Soon after, other benefits were indicated once, such as: low carbon economy, reuse of materials, sustainable development, corporate citizenship, compliance with legislation, expense reduction, asset efficiency, feedback process and more efficient operations. These results corroborate with the study by Epelbaum (2004) on the advantages that reverse logistics can cause for the company.

It should be noted that in the articles of Li & Olorunniwo (2008), Olorunniwo & Li (2011) and Skapa & Klupalova (2012), the managers interviewed mentioned that reverse logistics does not generate significant revenues and does not substantially reduce operating costs. In fact, reverse logistics is seen by managers as adding unwanted costs to the company's operations. This set of responses is quite surprising, because they are contrary to the observations found in the literature. For example, Adlmaier & Sellitto (2007) argue that the financial issue was the main factor that drove the company studied to invest in reverse logistics.

Brito & Dekker (2002) ratify that reverse logistics can lead to cost reductions, decreased use of materials, and other benefits that positively impact the company's financial perspectives.

The lack of interest and / or the difficulty of installing and managing reverse logistics, such as the difficulty in measuring its performance and the lack of studies about it, favors the idea that reverse flow does not generate benefits for the company, but rather, generates costs (Rogers & Tibben-Lembke, 1998).

In relation to the origin of the reverse flow, 4 articles analyzed highlighted the return of aftermarket products, and two articles mentioned computers as returned goods. Vehicles and electronics were also addressed as objects of reverse logistics, but each one in 1 article. It should be noted that in the research carried out by Li & Olorunniwo (2008), the type of electronic product mentioned was not found, as shown in Figure 9.

According to Li & Olorunniwo (2008) and Olorunniwo and Li (2011), after-sales reverse logistics is comprised of 75% of products, without use or with little use, that for some reason return to the production cycle through reverse channels (Leite, 2006).

Regarding the return of post-consumption products, Leite (2006) states that they comprise used or end-of-life products that return to the reverse channel.

Figure 10 shows that the return of post-consumption goods was reported in seven articles, and in two of

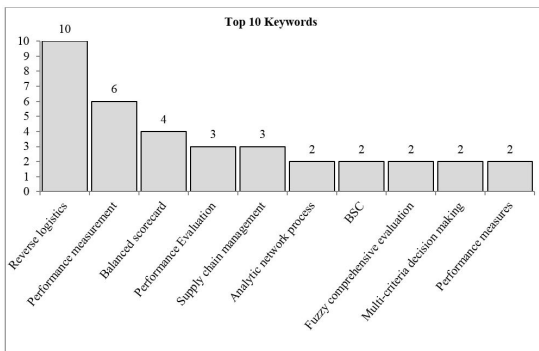


Figure 7. Top 10 keywords. Source: Authors.

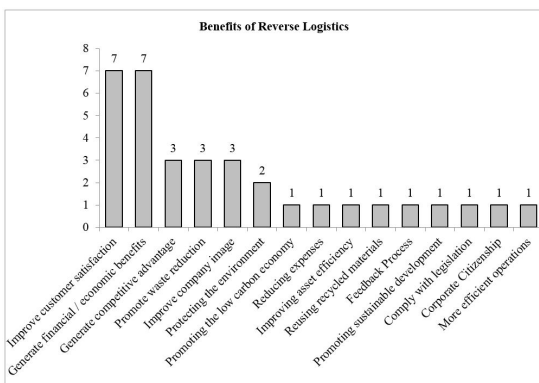


Figure 8. Benefits of reverse logistics. Source: Authors.

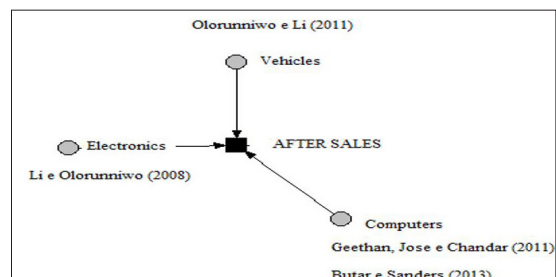


Figure 9. Return on after-sales goods. Source: Authors.

them vehicles were addressed. Computers, cell phones, batteries, electronics and tires were mentioned as objects of reverse logistics, each in 1 article. The type of electronic product reported was not found in the study of Xiao-Le et al. (2010).

It is noteworthy that the origin of the reverse flow was not found in 13 articles analyzed.

In relation to the activities of reverse logistics, Figure 11 shows that recycling was mentioned in 7 articles, and the reverse logistics activity was more evidenced by the articles analyzed. In 3 articles, remanufacturing was mentioned; In 2 articles, the return of the product to the supplier was found; and in 2 articles, the recovery of materials was mentioned.

Remarketing, landfills and product return to the distribution center, are reverse logistics activities that have been mentioned, each one, in one article.

In order to highlight the measures used to measure the performance of reverse logistics, the articles were separated into four categories, being:

1. Articles that adopted the indicators established by the *Balance Scorecard* (BSC);
2. Articles that adopted the BSC premises, but made modifications according to the needs of the company;

3. Articles in which the studies were based on the indicators mentioned by the managers interviewed;
4. Articles in which the indicators were consolidated based on the literature.

It should be noted that most of the articles that adopted indicators mentioned by managers and based on the literature, presented several measures of performance evaluation, and most of these indicators fit the perspectives established by the BSC. Then, to consolidate the information presented, these indicators were grouped in the following perspectives: Financial, Customers, Internal Operations, Learning and Growth.

The other measures found were based on the proposals established by the *Performance Prism* (PP). The *Performance Prism* was adopted for presenting a broader vision than the BSC, since it seeks to satisfy the key stakeholders of the company, such as supplier, society, government, environment, among others (Neely et al., 2001).

Financial / economic = focuses on achieving the company's financial success (Shaik & Abdul-Kader 2012). This perspective shows whether reverse logistics operations serve the interests of shareholders (Ravi et al., 2005). According to Rogers & Tibben-Lembke (1998), the implementation of reverse logistics programs can generate tangible and intangible value for the company, such as increasing revenue, reducing costs and expenses, among other benefits.

Customers = this perspective shows how the company wants to be seen by its customers (Kaplan & Norton, 1997). Its proposal is to improve customer satisfaction through reverse logistics operations, taking into account the issues of cost reduction, improvement of product quality, deadlines, among others (Ravi et al., 2005; Kaplan & Norton, 1997). This perspective can be evaluated through market share, retention, satisfaction and profitability of customers (Kaplan & Norton, 1997).

Internal Operations = Focus on improving the productivity and efficiency of workflows, satisfying the company's shareholders and customers, which may include short- and long-term goals (Shaik & Abdul-Kader, 2012). From this perspective, managers must find critical internal processes that must be improved in order to generate value for clients and achieve the organization's financial objectives (Kaplan & Norton, 1997).

Learning and growth = This perspective focuses on the continuous improvement of the infrastructure (Kaplan & Norton, 1997). Through innovation,

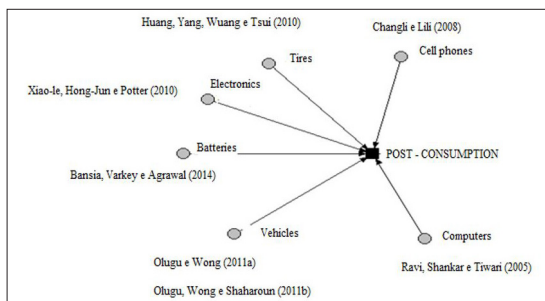


Figure 10. Return on post-consumption goods. Source: Authors.

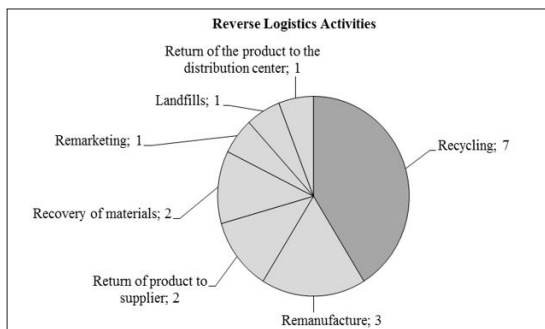


Figure 11. Reverse logistics activities. Source: Authors.

motivation, employee learning and also the capacity of the information system (Shaik & Abdul-Kader 2012).

Social = Focuses on motivating “[...] ethical conduct, improving the image by fulfilling the obligations and expectations of communities and societies” (Shaik & Abdul-Kader 2012, p. 26).

Environmental = Focuses on compliance with regulations and increasing the company’s environmental awareness (Shaik & Abdul-Kader, 2012).

Suppliers = The objectives and targets of the suppliers must be congruent with those established by the focal company (Silva et al., 2013).

The following examples demonstrate how the measures of performance found in the systematic review were classified according to the perspectives of BSC and PP.

- (1) **Financial / economic** = increase profit, add value to stakeholders, increase revenue, reduce costs and expenses (Kaplan & Norton, 1997; Shaik & Abdul-Kader, 2012);
- (2) **Customers** = percentage of customer complaints (Kaplan & Norton, 1997; Norreklit, 2000; Mooraj et al., 1999, p. 482), effectiveness in delivery time customer retention (Epelbaum, 2004), market share (Norreklit, 2000; Mooraj et al., 1999, p. 482; Kaplan & Norton, 1997), service quality (Kaplan & Norton, 1997);
- (3) **Internal Operations** = production time (Kaplan & Norton 1997), cycle time of each machine (Bansia, Varkey & Agrawal 2014), storage capacity, transport capacity management (Jianhua, Lidong & Zhangang 2009), after-sales services (Kaplan & Norton 1992), inventory control capability (Xiangru 2008);
- (4) **Learning and Growth** = employees training (Hernández et al., 2012), interested managers (Kaplan & Norton, 1997), information technology (Shaik & Abdul-Kader, 2012);
- (5) **Social** = corporate citizenship; employee safety, relationship with reverse logistics partners (Shaik & Abdul-Kader, 2012);
- (6) **Environmental** = comply with legislation, use of recycled materials, use of renewable energy (Shaik & Abdul-Kader 2012), use of clean fuel, reduction of operational pollution, waste disposal capacity;
- (7) **Supplier** = supplier environmental certifications (Olugu & Wong, 2011), supplier commitment to the environment and reverse logistics practices

(Olugu & Wong, 2011; Olugu et al., 2011), quality of the product provided (Lugoboni et al., 2013; Careta & Musetti, 2008).

In Chart 2 there are the forms used to measure the performance of reverse logistics.

Chart 2 shows that reverse logistics is developed to meet different drivers (government, shareholders, customers, employees, community, among others), confirming the research of Garengo et al. (2005) because, according to these authors, the approaches developed in the last decades are more horizontal, focused on the process, and focus on stakeholder needs.

It is noteworthy that 21 articles adopted both the Financial / Economic factors and the perspectives related to the Customers. Financial and / or economic performance demonstrates whether the reverse logistics strategy implemented in the company has (and does not have) achieve the expected success and return. In the factors related to customers, the company evaluates their satisfaction with the strategies adopted.

The other perspectives shown are presented in parentheses, which shows the number of times they are mentioned in the articles analyzed, being: Internal Operation (19), Environmental (16), Innovation and Growth (13), Social (5) and Supplier (3). It is noticed that the incorporation of environmental, social and supplier measures is an integration of the BSC’s perspective with the Performance Prism vision, providing the creation of scorecards appropriate to the reality of the company.

For Shaik & Abdul-Kader (2014), all companies must have six perspectives: financial; processes (internal and external); interested parts; innovation and growth; environment and social. However, Hernández et al. (2012, p. 454) point out that “[...] even though a model may be applicable to companies in any industry, it will always be necessary to make specific adjustments to the characteristics of each company”, because the performance measures adopted are subject to the difficulty of the process to be measured and its relevance in relation to the objectives set by the company, as well as the use of this information by managers (Hernández et al., 2012).

According to Chaves et al. (2008), there are several variables to measure and evaluate the performance of an activity. However, there is no single explanation on which is the best way to measure an activity’s performance, since companies have different realities and are contained in different industries.

Chart 2. Ways of measuring the performance of reverse logistics.

Indicators adopted	Author(s)	Measures of performance measurement of reverse logistics						
		Financial / Economic	Customers	Innovation and Growth	Internal Operation	Environmental	Social	Supplier
BSC	Ravi et al. (2005)	✓	✓	✓	✓	x	x	x
	Changli & Lili (2008)	✓	✓	✓	✓	x	x	x
	Bansia et al. (2014)	✓	✓	✓	✓	x	x	x
BSC adapted	Kongar (2004)	✓	✓	✓	✓	✓	x	x
	Jianhua et al. (2009)	✓	✓	✓	✓	✓	x	x
	Xin (2010)	✓	✓	✓	✓	✓	x	x
	Shaik & Abdul-Kader (2012)	✓	✓	✓	✓	✓	✓	x
	Shaik & Abdul-Kader (2014)	✓	✓	✓	✓	✓	✓	x
	Nukala & Gupta (2007)	x	✓	✓	✓	✓	x	x
	Jun (2009)	✓	x	x	x	✓	✓	x
	Huang et al. (2010)	✓	x	✓	✓	x	x	x
	Xiong & Li (2010)	✓	✓	✓	✓	✓	✓	x
	Xiao-Le et al. (2010)	✓	✓	x	x	✓	x	x
Consolidated indicators based on literature	Geethan et al. (2011)	✓	x	x	✓	✓	x	x
	Olugu & Wong (2011)	✓	✓	x	x	✓	x	✓
	Olugu et al. (2011)	x	✓	x	✓	✓	x	✓
	Fota et al. (2012)	✓	✓	x	✓	✓	x	x
	Skapa & Klupalova (2012)	✓	✓	x	✓	✓	x	x
	Butar & Sanders (2013)	x	✓	✓	✓	x	x	x
	Li & Olorunniwo (2008)	✓	✓	x	✓	x	x	x
	Xiangru (2008)	✓	✓	✓	✓	x	x	x
	Olorunniwo & Li (2011)	✓	✓	x	✓	x	x	x
	Hall et al. (2013)	✓	✓	x	x	✓	x	✓
Indicators mentioned by managers	Hernández et al. (2012)	✓	✓	x	x	✓	✓	x

Source: Authors.

5 Conclusions

Reverse logistics has become an important process, contributing to sustainable competitive advantage. However, for this process to be effective, companies must monitor it through a performance measurement system. Thus, this study had as objective to investigate, through a systematic analysis of the literature, the ways of measuring the performance of reverse logistics.

Results showed that financial and / or economic performance, together with the indicators related to Customers, were the most used forms for the measurement of the performance of reverse logistics.

It can be inferred that the financial and / or economic perspectives are aimed at measuring whether reverse logistics actions lead to increased revenues and reduced costs. That is, companies must meet their financial goals and, at the same time, offer value to their customer, their main source of revenue.

The other forms of performance measurement adopted were: Improvement of Internal Processes, Environment, Innovation and Growth, Social and, finally, Supplier.

It is known that, in order to generate value for customers, it is necessary to optimize company's Internal Processes, being possible to reduce costs and make the company more competitive.

The measure related to environmental factors includes government satisfaction, reduction of environmental impacts, control of energy consumption, clean fuel, company image, that is, the efficiency of environmental management.

The Innovation and Growth perspective identifies the investments that must be made for the company to achieve financial success in the long term. In this study, strategic alliances, employee satisfaction, employee training, investment in research and development, team of interested managers, information technology, reward and motivation, educational activities and competitiveness stand out.

In relation to social factors, the company aims to measure the level of corporate citizenship. Regarding indicators related to Suppliers, the objective is to know if suppliers have environmental certifications, and also the supplier's commitment to other environmental practices, such as the number of suppliers that have recycling practices.

In view of this, the importance of reverse logistics for the company's future is evident, because due to fierce competition, environmental legislation and other stakeholders' demands, investments in this area are essential, seeking sustainable development and adding various benefits to the company.

In recent times, reverse logistics practices have gained importance, but there are few academic papers

regarding the measurement of its performance. Thus, firstly, this article is limited by the paucity of relevant studies that address the ways of measuring the performance of reverse logistics. The search criteria used are linked to the choices defined by the authors of this article - the databases, the defined keywords and the keywords combination - and they can be considered another limitation of the work. However, the literature review included other studies that were initially not found by the search. And the results indicate that, in fact, there are few studies discussing the measurement of the performance of reverse logistics, which becomes an opportunity for future research in the area.

As future research, it is suggested to investigate the methods adopted by Brazilian companies to measure the performance of reverse logistics, as well as innovative processes applied to it. Another research opportunity is related to the process to identify criteria for measuring the performance of reverse logistics (indexes and indicators) and the search for customized models, considering the specificities of each context.

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