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Impact Of Reverse Logistics On Organizations

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Abstract

This article describes a descriptive investigation of models for reverse logistics (RL) application and exploration. For this purpose, databases such as ScienceDirect, Redalyc, Springer Link, and Scielo were consulted, from which fifty references were chosen. Furthermore, the article discusses the studies of various authors in different countries, identifying their results and the advantages or achievements of the models applied. It also presents the relationship between reverse logistics, corporate social responsibility and sustainable development, which are concepts to which reverse logistics has been linked.

Keywords: Competitiveness, Sustainable development, Waste management, Environmental impact, Reverse logistics, Corporate social responsibility, Recycling

1. Introduction

Studies focused on the various business management practices have been growing, as they allow for improving business results by making the company integral, taking into account the social and environmental impact of its productive activities. In addition, these practices have been considered a source of competitiveness, differentiating the company in the market and generating sustainable business opportunities.

According to this, one of the techniques that have had more recognition in this context is reverse logistics, which allows taking advantage of product waste or products out of use for their reuse and generating new values with them [1] [2] [3]. The main reverse logistics processes or techniques include remanufacturing, recycling and reuse. Remanufacturing allows the collection of a used product to evaluate its condition and replace the affected parts with new or repaired parts; recycling allows the

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recovery and new use of obsolete products or materials from industrial by-products; and, finally, reuse is based on collecting used materials and distributing or selling them after a minor repair [4].

Thus, the specific purpose of reverse logistics is the management given to the return of business products or part of them, thus having a differentiation strategy in the market, as it serves to obtain competitiveness and develop a good corporate image, since companies that are participants in the care of the environment are the favorites in dynamic markets [5] [6].

Likewise, business competitive advantages can be seen in their costs and differentiation leadership. In many aspects, the benefits that allow entering into a concept of competitiveness through reverse logistics are reflected in how value is obtained by deciding to reuse returned, discarded or out-of-use products [7] [8]. Each reverse logistics activity affects the return costs; which could increase or decrease these costs depending on the decision made. This is why strategic choices must be defined to save costs and obtain profits from returned products [9].

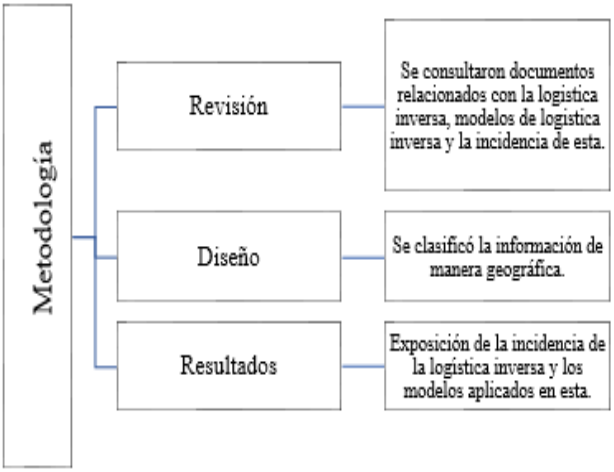
In addition, reverse logistics is related to corporate social responsibility since companies, in addition to recovering values associated with the production process, demonstrate their commitment to environmental, ecological and social responsibility. Therefore, it is essential to see in the company's practices that lead them to position themselves in the concept of being socially responsible and also to be responsible with the environment due to the demands of the current market and some legal regulations that have arisen on the subject. Nevertheless, reverse logistics and Corporate Social Responsibility (CSR) can be considered some excellent strategies to impact the growth and sustainability of companies [10] [11] [12].

This article presents a documentary review of reverse logistics, its importance and models for its development in companies or productive sectors. The scientific articles were searched in four high-impact bibliographic databases, and the topics to be covered in 50 articles were identified after filtering.

2. Method

Figure 1 shows the proposed methodology based on three stages: Research, Design and Results.

Figure 1. Methodological process.



The documents were selected through a manual search of files found in databases such as ScienceDirect, Springer Link, Redalyc, Scielo and Google Scholar. The choice of articles was made through search

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filters, which were keywords and year; the keywords used were: "Reverse Logistics" and "Reverse Logistic", the filter by year was determined in a window of 10 years, from 2012 to 2022. About 70 articles were consulted, from which purification was made according to those mentioned above and 50 articles were selected for the research development.

The articles were classified geographically, seeking to expose in a more compact way the models used in each of the countries of the selected papers. First, the information on each article in the geographically segmented review is showed. Next, the selected data is presented and analyzed to determine the results of the incidence of reverse logistics in companies, products or production processes, together with the most commonly used models for the study of reverse logistics. Finally, the information is disaggregated by country.

3. Results

Incidence of reverse logistics in companies, products or production processes

Argentina

Amato conducted a case study in Córdoba on the relationship between reverse logistics and performance for six companies from different productive sectors, including the automotive, auto parts, publishing, food, and alcoholic beverages sectors. The question to be answered in this study is whether the reverse logistics function can be considered a factor for the achievement of better work related to sustainability. The study was conducted through semi-structured interviews with managers in charge of sustainability or social responsibility in the organizations. The variables analyzed were: strategic planning, competitiveness, performance measurement, sustainability programs, social responsibility and 3R. The research showed that the companies studied that incorporated reverse logistics concepts in their strategic planning, which are related to sustainability or social responsibility actions, achieved superior social, economic, and environmental performance [13].

Brazil

In a company located in Joinville (Santa Catarina, Brazil), López Silva et al. carried out a case study of reverse logistics for disposable containers used for packaging the export of engine heads, developing a returnable packaging model to replace the model used by the company, which was a disposable container, seeking to minimize the formation of waste and increase the competitiveness of this company, taking into account cost reduction and minimization of environmental impacts [14].

The study was conducted through interviews with company representatives and an analysis of the company's documents and standards. Technical analysis was carried out to determine the performance and shelf life of the new returnable model, and the evaluation technique (LCA), ISO 14040 standard series, was applied, considering the life cycle of the materials used in the designed packaging model.

As a result, the designed returnable packaging model consumed 18% less material than the disposable model used by the company. Furthermore, in the context of the reverse flow of these packages, the volume and their weight were reduced, which meant that for every seven containers of products sent for export, only one container would return with empty containers, thus minimizing costs and environmental impacts.

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In addition, Guarnieri et al. described in their research the implementation of the sectoral agreement on reverse logistics of packaging in Brazil towards a transition to the circular economy. The study was conducted through documentary analysis of the technical report of the Brazilian packaging sectoral agreement, published in November 2017 and interviews with members of the packaging industries. The results of the study allowed concluding that although there is an absence of revaluation of packaging under the concept of circular economy, Brazil has approximately 858 recycling industries. After the enactment of law 12305, many supply chains have implemented the concept of reverse logistics, which allows the return and revaluation of their products, thus aligning with the principles of circular economy, so that of the 858 companies 809 are plastic industries and implemented the recycling of their plastic packaging, observing environmental and economic gains [15].

Likewise, Marques et al. conducted a study to analyze farmers' behavior in Sao Paulo concerning pesticide containers. The study was conducted with 48 farmers through interviews, and then they used SPSS 22.0 software to classify the cases and culminated with a multidimensional scaling to synthesize the data. The results allowed concluding that reverse logistics, in the framework of farmers, do not have the expected performance; approximately 83% of farmers do not perform the return of the packaging or do not comply with the legal obligations present in the state [16].

For the plastic artefacts industry, Mendes et al. conducted a case study showing how the company GAMA establishes reverse logistics as an alternative for its industrial waste. Through interviews with the industrial manager and the organization's controller, a documentary analysis of the organization’s internal records related to waste management and reprocesses was conducted, without leaving behind the data concerning the volumes generated and their costs. The main result after adopting reverse logistics was the increase in operational efficiency, competitiveness and cost reduction, obtaining a positive economic flow in the use of waste [17].

This industry study of the expanded polystyrene supply chain in Brazil, conducted by Oliveira et al., aims to discuss the main challenges of this industry towards the circular economy. It was achieved through mapping the supply chain, stakeholder analysis and logistics activities in the reverse channels. In addition, the Brazilian legislation was reviewed to understand the impact it would have on the activities developed in the reverse channels. With the data collected, they established the barriers to implementing the reverse supply chain in the expanded polystyrene industry. It was concluded that despite the existing obstacles, it is essential to plan how to carry out reverse logistics because there is high environmental pollution. Therefore, it is necessary to find ways to comply with Brazilian legislation by reducing pollution [18].

Addressing other contexts, Rocha and Santos conducted a study to evaluate the benefits and environmental effects of a reverse logistics system for a large variety of waste electrical and electronic equipment (WEEE). This study was conducted using a life cycle assessment (LCA) according to ISO 14040 and 14044 guidelines, data were collected from two dismantling companies constituting a sample of about 3000 tons of WEEE. The results indicated that reverse logistics generates a positive impact due to the saving of mineral resources and metals, mainly resulting from recycling printed circuit boards. In addition, it reduces the environmental impact [19].

Similarly, Oliveira et al. evaluated the environmental advantages of reverse logistics of portable batteries carried out by the Brazilian Association of Electrical and Electronic Industry (ABINEE). The study was conducted through interviews and documentary analysis of ABINEE. An analysis of the amount of batteries collected was carried out through a mass balance, where it was determined that 4,304,465

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batteries were collected, representing in 176,422 kg of solid and chemical waste that were effectively disposed of. It was concluded that the implementation of the reverse logistics concept for batteries minimized the environmental impact [20].

In addition, reverse logistics has been implemented in supermarkets. Pagán et al. analyzed the reverse logistics practices implemented in retail supermarkets. They sought to measure the volume of waste that would no longer be disposed of and the negative environmental impacts. The study was carried out in three supermarkets, based on observation for one semester, to quantify the reduction of pollution, an analysis of the data was carried out using the Material Input Per Service (MIPS) method. As a result, during the study period, the supermarkets reduced the generation of a large amount of waste that affects the environment; for each kilogram of cardboard and plastic that was recycled, 107.68 kilograms of water and 0.56 kilograms of air are no longer polluted [21].

Chile

Valenzuela et al. designed a reverse logistics model for a company that sells used plastic containers that are being used to store Diesel, these containers once they finish their use, are discarded in the municipal landfill, the aim was to recover these plastic containers contaminated with oil to transform them by giving them a second use, the model also seeks to minimize recycling costs, which would be minimized through the location of facilities for the reprocessing of containers. The model was designed using linear programming and was also solved with evolutionary algorithms. As a result, the design was successful since it allowed determining the location of the recycling and manufacturing centers, thus minimizing costs and increasing profits [22].

China

Chiou et al. in their study explored the factors to be considered for the implementation of the reverse logistics concept, and this study was conducted through interviews with members of the electronics industry sectors, the Fuzzy Analogical Hierarchy Process (FAHP) was applied to choose the essential criteria that highlighted the expert staff of each company. With the study, the priorities and performance ranking of the factors stipulated to implement reverse logistics were obtained. It was determined that reverse logistics is a strategically important issue for companies and should be considered in the processes where decisions are made [23].

Abdulrahman et al. conducted a study in the Chinese manufacturing sectors seeking to propose a theoretical model of reverse logistics implementation and to identify the significant barriers to reverse logistics for finance, policies, and infrastructure. The study was conducted by surveying some managers of manufacturing industries. The results obtained show that the barriers with the greatest impact on the management and implementation of reverse logistics are a low commitment and lack of experts regarding reverse logistics in the companies, as well as the lack of financial resources, such as the lack of money and funds for systems to monitor returns [24].

The steel industry is one of the largest flow industries in China, so Gua W et al. conducted a study where they sought to establish a decision framework to help companies choose the best reverse logistics methods and effectively utilize scrap steel. First, they identified the key factors, which are economic, social, environmental, and governmental policy, and then applied a multi-criteria decision-making method to analyze the dependence of these factors, seeking to suggest the most appropriate strategy

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according to the alternatives. The results showed that the formulation of governmental policies greatly impacts companies by encouraging them to invest in reverse logistics systems [25].

Colombia

The most relevant case studies in Colombia are related to the plastics industry. Silva Rodríguez proposed a configuration and operation of a reverse logistics network for the collection, hoarding and planning of empty pesticide containers and packaging in Usochicamocha in Boyacá, for which a mixed integer linear programming model was developed to establish the quantities to be collected and transferred. The main result was that out of 5 kg of waste collected from farms in this sector, 1106.58 kg were disposed of without environmental impacts, and 1292.31 kg were recycled, improving the recycling of containers and packaging by 36% [26].

Similarly, Silva and Contreras developed a study of the process of collection and stockpiling of pesticide waste in the Pantano de Vargas irrigation unit, which is located in the city of Boyacá. A diagnosis was made of the current development of the process, observation of the collection days carried out, and then a model for the development of reverse logistics was assembled in the FlexSim software. A feasible configuration was proposed with results of improvement of 46% in the time of the collection process, and waste or residue hoarding was achieved [27].

Jimenez et al. conducted a study to identify trends and good practices of reverse logistics in the context of manufacturing plastic products. The study was conducted through surveys taking into account the technique of analytical hierarchy process (AHP). Good practices are summarized in prioritization of risks, planning of sustainable reverse logistics operations, reprocessing procedures, recycling and reuse. The results led to the conclusion that leadership, planning and improvement can help determine the success of plastics companies [28].

Additionally, Peña et al. identified the most important facilitators and barriers that present or impacted SMEs in the Colombian plastics subsector when seeking to implement reverse logistics programs. The study was carried out using evaluations made by the entrepreneurs of the recognized facilitators and barriers. As a result, it was found that it is necessary to have personnel trained to support reverse logistics activities, this is the most important facilitator; on the other hand, the absence of secondary markets for the recovered materials is the barrier to the greatest impact [29].

De la Hoz et al. presented a multi-objective linear programming model to be applied to reverse logistics in the polypropylene plastic sector. The model concentrates on the variables and measures detailed in the design of the reverse logistics process. The results illustrate a 12.6% improvement towards the costs of reverse logistics and production planning programs [30].

For the paper sector, Jarrín et al. described the reversible practices and methodologies applied when products ended their useful life and verified the international laws governing this issue. The research was developed through a survey on eight employees of four companies in the paper and commercial sectors. As a result, it was found that the two companies do not execute reverse logistics processes for paper because the process is not defined or due to a lack of knowledge [31].

In addition, Peña et al. presented a model of a supply chain with a focus on reverse logistics in the paper manufacturing sector located in Valle del Cauca, seeking to find how many warehouses and what

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capacity should be developed, minimizing logistics costs focused mainly on transportation. The programming model resulted in locating the recovery centers in the cities of Guacarí and Buga [32].

Calpa Oliva validated a reverse logistics model for recovering waste electrical and electronic equipment (WEEE) based on continuous simulation. The validation of the model allowed identifying cultural behaviors as one of the elements that influence pollution due to the bad practices exercised by society when disposing of WEEE [33].

Reverse logistics is related to the integrated management of solid waste. According to Peña et al., in their study, they present this relationship which would allow giving value to materials that will be recovered and try to incorporate them into the production cycle. The study was carried out utilizing an exploratory analysis. The results show that reverse logistics has an incipient application in Colombia, although the concept is not alien to the industrial sector; the relationship between reverse logistics and integrated solid waste management strengthens the use of waste [34].

Cuba

Suárez et al, sought to implement the application of models in reverse supply chains (ISC) in the soft drink industry, proposing an analysis of compliance and the identification of risks faced by the ISC through the use of new software that would allow knowing the results to detect new opportunities for improvement based on economic and environmental factors. The research was based on data collection, document analysis, bibliographic searches, surveys, expert consultations and a Pareto diagram. By means of these tools and adding the comments, it was concluded that the model used as a reference identifies the inconsistencies and strengths of the organization, emphasizing process management and constant training [35].

Similarly, Feitó et al. initiated an investigation due to the low influence of supply chains in plastics recycling in Cuba, aiming to identify a strategic management plan that includes economic and environmental activities. To achieve this objective, they used developed thought processes, which are consolidated with the study of the life cycle, statistical techniques and discrete multicriteria methods. The results showed shortcomings and concluded that decision making should be redesigned to include economic and environmental factors to obtain better performance in the supply chain [36].

Santana et al.'s research led to the design and application of a process to optimize the reverse supply chain (RSC) under the Six Sigma methodology, with the aim of reducing existing waste, managing it efficiently, favorably influencing the environment and reducing costs. The collection of aluminum containers was identified as the main drawback because it generates significant waste. The theory proposed in the stages is confirmed, where economic improvements, customer satisfaction, and efficiency in the supply chain are reported [37].

Ecuador

Muñoz and Ledón investigated the reverse supply chain to evaluate the recycling process of refrigeration equipment in Ecuador. The evaluation was based on environmental factors such as pollutants, water and consumption of natural resources. It also measures the economic impact of the actions taken and the benefits generated socially. Where negative results were identified in the social factor, showed favorability in terms of the environment and stability in the economic dimension [38].

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Spain

Monterrey et al. brought with them research where an analysis is made on the new business development opportunities from reverse logistics. The main proposal is the realization of a Reverse Logistics (LI) business park where all kinds of activities that benefit the economy, the valuation of waste and the integration of various sectors that improve access to information are included. It was concluded that the proposal is a business opportunity, in addition to demonstrating an interesting profitability [39].

France

Alamerew and Brissaud developed a model to represent the reverse logistics system seeking to recover products after their end-of-life stage. The study was conducted using a system dynamics approach to create the dynamics of costs, revenues and strategic decisions, and the interaction of the circular economy was exposed through a case of electric vehicle battery collection. As a result, the strategies of reuse, remanufacturing and repurposing present a huge market potential for recovering electric vehicle batteries [40].

Greece

Nikolaou et al. proposed an integrated model to annex corporate social responsibility (CSR) and sustainability issues in reverse logistics processes to develop a complete performance model. The study was conducted by developing performance indicators to measure this for the social responsibility of reverse logistics, and this study was under the Triple Bottom Line approach. The results were good since an indicator was developed to evaluate Corporate Social Responsibility (CSR) and reverse logistics (RL), which will help to design strategic and decision support [41].

India

Reverse logistics in India has been growing, so Mangla et al. decided to investigate the critical success factors of reverse logistics, for which the authors proposed to conduct the study using a structural model and evaluated using the Analytical Hierarchical Process (AHP) and decision-making (DEMATEL). The results show that the main factor of the 25 critical success factors is competitiveness, followed by globalization, green image building, benchmarking, and sustainability [42].

Similarly, Agrawal et al. investigated these critical success factors. They sought to prioritize them for reverse logistics (RL) execution in the Indian electronics industry. They identified twelve factors through a review of studies on the subject and discussion with electronics industry experts. The results showed that resource management, economic factors and terms and conditions of contracts in companies are the priority factors [43].

Govindann et al. based their study on an integrated decision-making model for selecting sustainable reverse logistics suppliers. The evaluation was performed using an AHP process fuzzy analytic hierarchy; this model was performed with bi-objective mixed integer programming to maximise the manufacturer's profit and the sustainable score of reverse logistics suppliers. Among the results was found the novelty of the study, which is the classification of reverse logistics suppliers in economic, social and environmental aspects of sustainability, integrating them into procurement decisions for the reverse flow of products. This allows for improving the value of the sustainable performance of the supply chain and ensuring reasonable profits [44].

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Considering transportation's role in reverse logistics, Upadhyay et al. sought to suggest crowd shipping measures through an analytical framework that leads to emission reduction. The results show that with the help of a Crowdshipping platform, time, effort, cost and emission reduction are saved since the shortest route for product delivery is selected [45].

Agrawal et al. explored the different disposal options for returned products and developed an approach for selecting the best alternative. The approach was developed using graph theory and the matrix approach, the study was conducted in a mobile manufacturing company, and the alternatives for returned products included repair, reuse, resell, remanufacture or recycle. The results showed that recycling should be preferred [46].

Indonesia

Maheswari et al. proposed sustainable reverse logistics scorecards to identify the performance of informal e-waste companies. The research was conducted through interviews with the companies above and the snowball sampling procedure. In addition, a descriptive statistical analysis such as mean, geometric mean, mode and median were used. The results made it possible to identify that performance measurement in informal e-waste businesses is necessary due to the growth of environmental pollution caused by not planning reverse logistics [47].

Irán

Ramezani et al. performed forward and backward logistic network design by means of a stochastic multi-objective model. It was performed utilizing a set of Pareto optimal solutions and the financial risk was calculated. The results showed that this process made profit maximisation possible [48].

México

Arroyo et al. investigated how products are delivered from the manufacturer to the consumers and how the reversion of these products works. The study was applied to computer recycling using system dynamics to see how the return of computers varies under different scenarios. The results allowed to identify which factors should be worked on to increase the volume of recycled computers, seeking to make the recycling activity profitable and attractive for companies [49].

Venezuela

Bustos Flores investigated the uncertainty in a company when performing and implementing a reverse logistics model. The study was carried out using the theory of restrictions, a survey of customer relations and the company's information. The problem found was that the company had not located the bottleneck in the reverse logistics process. Nevertheless, it contributed to planning the reverse logistics program and managing a better return of products [50].

4. Discussion

Through the research that was carried out to fifty articles on the incidence of reverse logistics and its different models applied in companies, productive sectors and even certain products, it was detailed the importance that this concept has acquired and how it has become a relevant process that leads to establish

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a sustainable competitive advantage; Since reverse logistics is related to the reduction of environmental impacts, this concept gives rise to environmental responsibility or corporate social responsibility, and therefore, it is concluded that companies should begin to include in their concept, the way to be responsible for the products they manufacture even after their useful life.

In short, it can be stated that reverse logistics can be summarized as how a product or part of its materials are returned, and the process that is given to them after their collection, which can be their reuse, recycling, repair or renovation, to recover a certain value and also contribute to minimize the impact on the environment.

Taking into account what was mentioned in the previous paragraph, this would give a competitive advantage to the business management of a company, generating a greener image and complying with laws that governments have implemented precisely so that companies become responsible for their waste and contribute to improving the environment.

5. Conclusions

Analyzing the field of application that reverse logistics has had, it was found that most of the case studies, analyses and models carried out for this concept were in Asian countries. In Latin America, there is little experimentation or scientific support in this field that provides relevant results. However, the studies carried out in Brazil have had positive results. Although, there are approaches to reverse logistics carried out in Argentina, Colombia, Cuba and Venezuela, these studies are more focused on the design of routes for the reverse logistics chain.

It was found that a large part of the community conducting studies on reverse logistics uses mathematical models to validate factors such as costs and risks. In addition, most researchers observed that financial or economic performance was one of the most common ways to measure the advantage of adopting a reverse logistics model, since reverse logistics activities are intended to take advantage of certain resources, generating income and reducing costs.

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Appendix A. An example appendix

Authors including an appendix section should do so after References section. Multiple appendices should all have headings in the style used above. They will automatically be ordered A, B, C etc.

A.1. Example of a sub-heading within an appendix
There is also the option to include a subheading within the Appendix if you wish.

Makalenin Türkçe başlığı buraya yazılır…

Özet

Türkçe özet.

Anahtar sözcükler: anahtar sözcükler1; anahtar sözcükler2; anahtar sözcükler3

AUTHOR BIODATA

Insert here author biodata**.**

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