CIRCULAR ECONOMY AND REVERSE LOGISTICS: A SYSTEMATIC REVIEW

Iasmim Taísle Gomes Vanderlei de Almeida 1  
Ana Regina Bezerra Ribeiro 2  
Leila Lopes Ramalho 3  
Leandro de Sousa Floriano 4  
Ruan Samuel Chaves de Araújo 5

ABSTRACT

Introduction: The circular economy and reverse logistics have as main objective to look for means for the final disposal of waste, that is, the waste that at first is no longer useful undergoes a new evaluation within the process of reverse logistics and consequently of circular economy for how it, identify whether this waste will be reused in another segment or destined for a specific location for that material.

Objective: The main objective of the study was to analyze, through a Systematic Literature Review (SLR), the relationship between Reverse Logistics and Circular Economy.

Method: The research is characterized as a qualitative, descriptive approach, in addition, the research was carried out through the Systematic Literature Review (SLR) taking into account the PRISMA guidelines. For data management, StArt - State of the Art through Systematic Review was used.

Results and discussion: A total of 1,351 studies were surveyed, after applying the study analysis strategies, 20 articles were selected, which were consistent with the inclusion criteria. It was possible to show that Brazil is the country that most contributed with studies focused on the Circular Economy and Reverse Logistics, mainly in the year 2021, which corresponds to 50% of the total analyzed in the period under study. In this way, it is noted that this relationship is increasingly on the rise, considering that they are methods that are related and that contribute significantly to the society and economy of a country.

Conclusion: It is considered that the process of Reverse Logistics and Circular Economy, when carried out correctly, contributes to the products at the end of the life cycle, being rescued for a new production process, being a viable reuse, aiming at the recovery of the product. Finally, this whole process depends on the joint work of end users, government, industries/companies and collectors' cooperatives.

Keywords: Circular Economy, Reverse Logistics, Sustainability, Systematic Review.

ECONOMIA CIRCULAR E LOGÍSTICA REVERSA: UMA REVISÃO SISTEMÁTICA

RESUMO

Introdução: A economia circular e a Logística Reversa tem como principal objetivo procurar meios para destinação final dos resíduos, isto é, o resíduo que a princípio não tem mais utilidade passa por uma nova avaliação
INTRODUCTION

The Circular Economy - EC is a concept that emerged as a solution to global challenges such as climate change, waste management, pollution and biodiversity loss (Ellen Macarthur, 2021). For Ghisellini et al (2016), the EC comprises multidisciplinary concepts (ecological, environmental and industrial economics), being a counterpoint to linear economics. From this point of view, the intention of circularity is observed in the continuous use of productive resources, following repair, reuse, reconditioning and recycling strategies during the process of manufacture and use of the product. In this way, it leads society to greater resource efficiency, aligned with the search for balance between economy, environment, and transforming agents in the process, responsible for managing innovative projects and processes (Ritzén; Sandström, 2017).

Reverse logistics (RL) is part of the proposed closed loop in the circular economy. She is responsible for the return of after-consumption and after-sales goods to the business and production cycle, through the reuse of materials (Araújo; Macêdo, 2021). This concept has been widely considered to deal with environmental, economic, financial and social problems (Corrêa, 2013). In this context, reverse logistics provides companies with the opportunity to manage waste and increase environmental efficiency through: reducing raw material resource consumption; creating value; improving customer satisfaction; energy savings; reducing landfills; and reducing gas emissions.

To investigate what is the relationship between the concepts of Circular Economy and Reverse Logistics, is the research issue of this work. Thus, the proposal of this article is to analyze, through a Systematic Literature Review (RSL), the relationship between Reverse Logistics and Circular Economy. It is important to identify how the two terms complement each other, i.e. the relationship between the two terms and, above all, to highlight the importance of...
this union for society and the environment, highlighting the roles of the agents and the implementation of the two concepts.

2 METHODOLOGY

The research is configured as a qualitative approach, of a descriptive nature, using the systematic review of the literature as a way of collecting the precise information. The Systematic Review of Literature is essential to help unleash new ideas and innovations in research and at the same time one has a greater understanding on a topic (Cronin et al., 2008).

In order to carry out a systematic review of literature, it is necessary to follow a few steps, namely: i) select a topic from the review; ii) do literature research; iii) Gather, perform reading and analyze literature; iv) write the text; v) references (Cronin et al., 2008). This work followed the 2020 PRISMA - Preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist.

The first step towards the realization of the RSL was the elaboration of the research question: what is the relationship between the concepts of Circular Economy and Reverse Logistics? The present study used the following academic bases: Science Direct, Web of Science and Scopus. The main keywords, ("Logistics Reverse" / "Circular Economy"), as well as ("Reverse Logistics" / "Circular Economy") with this, were searched considering only the scientific articles, as far as the type of document is concerned, without considering any other type of scientific work.

For the selection of the articles, the following inclusion criteria were used: a) studies published between 2011 and September 2021; b) written in English or Portuguese; c) scientific article format; d) that answer the research question; e) have free electronic access (open access). The access to the databases was carried out by the Portal of Periodicals of CAPES, by the access CAFé - Federated Academic Community.

The selection of articles took place in three stages: 1) the reading of the title, abstract and keywords; 2) the introduction and conclusion of the articles were analyzed; 3) the complete reading of the articles accepted in the second selection. After the conclusion of the third stage, the selected articles were seen in the light of the quality criteria, these being: clarity, objectivity and construction of the methodology, relevance and timeliness of the references, contribution to research, impact factor of the researches. To assist in the organization (selection, eligibility and extraction of quotas) of the RSL was used the StArt - State of the Art through Systematic Review software and the Google Sheets tool.

The selection of the articles was carried out by three of the authors to avoid interpretation bias during the review, the results collected by each researcher were compared by two of them, and in case of different interpretations, the third author went in to decide on the inclusion of the article in the review.

3 RESULTS

The identification of the studies in the databases resulted in 20 articles. Explaining the applications of the filters better, we have: a) identification stage - 1,351 articles were selected from the selected databases; b) selection stage - the reading of the introduction and conclusion resulted in 20 articles; c) third stage - characterized by the complete reading of the articles, did not generate modifications in the total quantity of articles from the previous stage. Thus, from the accepted articles, the quotas were extracted. The quotas consist of excerpts from the text of these 20 articles that are considered important for the authors. Figure 1 illustrates how this screening process occurred in RSL.
Therefore, 20 articles were selected from the 1,351 articles raised, that is, they were those that were adhering to the theme, to the research problem and the intention of the research itself. These 20 works were read in depth, so as to build the results and be analyzed with the discussion, extracting as much information as possible. The type of analysis was based on the Bardin concept (2011) which follows the following order of analysis: i) organization of analysis; ii) coding; iii) categorization; iv) treatment of results, inference and interpretation of results.

In order to highlight the publications selected for the study, in Figure 2, one can observe the list of articles organized, according to the author(s), year of publication, title and number of citations. In addition, with the help of the Google Scholar tool, the number of citations of each publication was analyzed in order to measure their respective level of influence.

Graph 1 relates the number of respective publications to the theme examined for each year within the time horizon of the study. It is noticeable that, although the years 2011 to 2016 were considered, only from 2017 onwards, the surveys began to be accounted for. This fact, however, can be explained by means of the selection criteria, in the stage of the data selection, since the articles selected should present, obligatorily, some context about the relationship between the Circular Economy and Reverse Logistics. Overall, Graph 1 shows a growth in the number of studies bringing information about the connections between reverse logistics and the circular economy, highlighting the period 2021, which covered 50% of the articles analyzed.
Concerning the magazines that published the articles, Table 1 shows a predominance between the Journal of Cleaner Production and the Resources, Conservation & Recycling, which together correspond to 35% of the material examined. Then, two periodicals, 'Thunderbird International Business Review' and 'Business Strategy and the Environment', have 2 articles each, adding up to a percentage of 20%. In addition, the term 'others' corresponds to journals that had only 1 article, totaling a frequency of 45%.

**Table 1 - Distribution of articles by journal**

<table>
<thead>
<tr>
<th>Periodic</th>
<th>Total Articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal of Cleaner Production</td>
<td>4.</td>
</tr>
<tr>
<td>Resources, Conservation &amp; Recycling</td>
<td>3.</td>
</tr>
<tr>
<td>Thunderbird International Business Review</td>
<td>2.</td>
</tr>
<tr>
<td>Other</td>
<td>9.</td>
</tr>
<tr>
<td>Total Articles</td>
<td>20</td>
</tr>
</tbody>
</table>

**Source:** Prepared by the authors (2022).

When looking at graph 2, in which it presents an analysis of affiliation about the first authors of the studies examined, one can see the predominance of Brazil as the country that concentrated the largest number of publications (5 articles). Then India had 3 articles, while China and England had the same amount of publications (2 articles), and the rest of the countries being: Germany, USA, France, Iran, Ireland, Italy, Norway and Russia registered respectively only 1.
In order to analyze the main topics covered by the research and their respective areas of activity, a word cloud was prepared with the keywords registered in each study, as can be seen in Figure 3.

The word cloud is a graphical visual representation tool that displays the frequency of words in the text. The more the word is used, the more visible the expression becomes in the image.

It is relevant to realize that from keywords such as: analysis, logistics, management, supply chain, sustainability, sustainable, industry and business show that there is a search for the benefits that the concepts cited bring, show real environmental and cost improvements, in the economic scope leading to lower costs and lower environmental impacts.

4 DISCUSSION

Noticing the growing demand on the studies and applications of sustainable processes, it can be noted that such articles are divided into 2 categories, being: *Agents of EC and LR*; and *Implementation of EC and LR*. 
4.1 Circular economy actors and reverse logistics

The agents identified by the articles are characterized by the level of influence, both in the implementation process, as well as in the deliberation, execution and efficiency of the actions of the Circular Economy and Reverse Logistics. In addition, it is also worth noting, the existing interconnection and the importance of collaborative practice between these actors who, according to Van Langen et al. (2021), play an essential role in the transition to a circular economy.

4.1.1 End User

Customers, consumers or end users play a crucial role not only in relation to the motivators of the circular economy, but mainly in the initial and final processes of Reverse Logistics. Being characterized as generators or suppliers of waste production. The end user is the first group to initiate the circular flow, performing the fundamental task of returning end-of-life products, so that they are handled by LR (A7) processes. In this perspective, (A10) addressed the importance of the end customer and the issues involving the waste recovery aspects of the Circular Economy.

According to the authors above, the final consumer is responsible for controlling the destination of a product. Thus, the discussions related to product management and extended producer responsibility, end up not taking into consideration that, although a good is planned and developed to be reused, in the end, it is the final consumer who will decide what will be, in fact, its destination: the contribution with the circular model and environmentally sound disposal or, seeking convenience, the disposal of waste in landfills.

According to the aforementioned authors, when it comes to recycling, Flygansvær, Samuelsen and Støyle (2021) mention that although end customers are positive to recycling, they still do not act according to what they say. This promotes dysfunctions in LR processes, since products and resources end up destined in unplanned locations and, in view of this, cannot be used in their potential in the circular economy.

On the other hand, (A5) they showed that the role of the final consumer materializes in three major ways: 1) through consumption in a conscious and responsible manner; 2) through the demands imposed on companies to improve their production processes; and 3) through the reuse of packaging and the correct disposal of waste.

4.1.2 Industries/enterprises

When it comes to the implementation or even efficiency of LR and CE processes, industries and other companies can play decisive roles, whether negative or positive. The perception of high management, for example, is a worrying factor, according to the study of (A9), since the market for remanufacturing/reconditioning can be considered a potential threat to the current business.

In this way, the authors show that these companies develop a connotative vision of sustainable markets because they fear that their business will be cannibalized, given that customers may prefer to buy a remanufactured product than a new product, minimizing the generation of profit for the company. However, the study counters this negative perception by pointing out that the cost of updating and reselling a product ends up being lower than the cost of manufacturing a new product from new materials.

Another negative point is associated with the internal perspective of the companies, evidenced by (A13), which portray the lack of support and/or interest of management, as well as the lack of knowledge, qualification and support in the process of implementation of LR.
The above authors indicate that companies generally target their competencies to meet the most advanced parts of the supply chain and neglect reverse logistics activities, which can be explained by the negative perception that this area of logistics, in addition to adding costs, ends up becoming a burden for companies by generating value on a smaller scale.

On the other hand, innovations in the form of collection and intermediation between users and manufacturers, through delivery companies and logistics, have been a very positive factor in the processes of LR and CE. According to (A10), the services offered to end users range from uninstalling used goods, managing, sorting, and checking returns, as well as providing data on the amount of returns.

The authors also add that these strategies, based on the postal service's door-to-door collection and delivery system, bring benefits such as optimizing waste collection rates in a large geographical area, promoting greater ease of access and convenience to consumers in a more economical way.

4.1.3 Government

The governmental scope is represented by the rules, legislations and regulations, which generate influences on the implementation or efficiency of the CE and LR processes. Compliant (A8), the government has an important role to play when it comes to the transition to a circular economy, since starting with appropriate legislation and government incentives, the scenario for this transition becomes much more plausible, in addition to facilitating cooperative processes among actors.

In Brazil, the National Policy on Solid Waste (PNRS) ascribes to the duty of the environmentally correct management and destination of end-of-life products to their proper generators, being "natural or legal persons, public or private law, responsible, directly or indirectly, for the generation of solid waste and those that develop actions related to integrated management or solid waste management" (Brazil, 2010).

In addition, (A18) complement that the Brazilian legislative context, which covers PNRS, sectoral agreements and other regulations, is guided by the principle of shared responsibility. According to the authors, this precept establishes that the management of end-of-life products is promoted through LR actions made feasible by a cooperative process between various segments of society, such as government, manufacturers, consumers, etc.

It is also worth pointing out that, although Brazilian legislation does not mention the Circular Economy, which can be explained by the current aspect of this theme and the period in which the PNRS was sanctioned, there are common principles and objectives between the two aspects mentioned, as an example: 1) the non-generation of waste, reuse and recycling of solid waste; 2) the incentive for consumption and standards of sustainable production processes; and 3) the stimulation, development and improvements aimed at the adoption of clean technologies that minimize environmental impacts (A5).

However, the absence or inefficiencies of government legislation, enforcement and incentives can also prevent the existence and practicability of new sustainable business models, as well as create implementation barriers for LR and CE. For example, the study of (A6), which aims to present a model representing the LR system in vehicle batteries, shows that due to the lack of regulations providing guarantees related to recovered vehicle batteries, companies encounter difficulties in operationalizing in this type of market.
4.1.4 Waste pickers

Waste pickers are professionals that act independently or can be formally organized into cooperatives (A5). According to Zanin et al. (2018), cooperatives can be characterized as supportive economic enterprises that aim to offer strategies to humanize and formalize the work of these professionals through the management of municipal solid waste. Considered the basis of the recycling production chain, waste pickers perform functions aimed at waste collection and sorting, playing important roles for the efficiency of Reverse Logistics and Circular Economy, as their actions promote the minimization of the environmental impact and costs generated by the dumping of municipal solid waste in landfills and landfills (Magno et al., 2021).

In turn, the screening is carried out according to the type and characteristics of the materials involved in the process. According to the study (A7), which they investigated on the supply chain and reverse logistics channels in expanded polystyrene packaging in Brazil, in the process of sorting this waste, the waste pickers carry out activities such as weighing, sorting the plastics, pre-cleaning and, later, the selected material is stored, sold or passed on to the recyclers, by the cooperative. Given the cultural aspect, the impact of the active presence of waste pickers is very noticeable in Brazil, since according to government representatives, these professionals are priority agents and indispensable in the implementation of reverse logistics in the country (A5).

In the Brazilian context, the occupation of waste pickers was recognized as "Waste Pickers" only in 2002, by the Brazilian code of Occupations (Zanin et al., 2018). However, waste pickers already carried out the collection activities before the Brazilian law was passed, and currently the professionals can be recognized as relevant environmental agents (A5).

Expanding to the legislative base of the country, the waste pickers were inserted into the process of home selective collection by the PNRS, which originated with the participation of the National Movement of Waste Pickers (MNCR), promoting a greater visibility for the importance of these professionals both for the processes of LR and for economic and environmental contributions (Zanin et al., 2018, Brazil, 2010, Pinhel et al., 2011).

In view of this, it is possible to observe that the benefits promoted by the actions of the waste pickers, such as the minimization of solid waste disposal in landfills and landfills, the reduction of costs for industries and the optimization of social welfare (Biridi et al., 2020), align with the strategies of both LR and EC.

4.2 Implementation of the circular economy and reverse logistics

In order to gather information about factors influencing the implementation of RL processes and JU principles, the "Implementation of JU" category has been subdivided into four subcategories, these being:

4.2.1 Strategic management

Costa (2012) says that a gestannually é is the decision-making process carried out by senior managers, managers and collaborators of the organization ç. It aims to ensure the growth, continuity and survival of the ç institution through the adaptation ç i é çadaptation adaptation of its strategy Strategic management plays a key role in the context, because to combine sustainability and profit optimization, a strategic plan is needed with commitment from managers.

The company that plans to operate along the lines of the EC must reduce resource consumption and waste emissions, carry out internal damage assessment and at the same time
evaluate the effect of its activities on the environment. To meet the requirements of the circular economy, companies can use strategies, present in the LR processes, such as recycling, remanufacturing and waste reuse and treatment that in addition minimize the need for new resources, and thereby contribute significantly to the reduction of waste throughout the production chain (A9, A18). These strategies will ensure that companies take responsibility for their direct and reverse supply chains.

Still considering the complexity of managing the direct and reverse supply chain, many companies to focus on their primary sector transfer their logistics to an outsourced reverse logistics provider (3 PRLP). This delegation helps companies increase their success rate and maintain a competitive edge. (A15) states that outsourcing this service and choosing the right outsourced LR provider is one of the key decisions made by a company's managers, since if implemented efficiently, in addition to increasing the business success rate, it can also generate competitive advantage.

4.2.2 Product Design

For Mozota, Klöpsh and Costa (2011), design is an activity that involves problem solving, creativity and the systematic coordination of these activities. This problem-solving capacity began to be used in the development of more sustainable production methods, acting in opposition to consumption patterns and in favor of social equity and the environment, through strategies aimed at innovation (Vezzoli & Manzini, 2008). Sustainability-focused design aims at: (1) resource selection with low environmental impact; (2) product design with low environmental impact; (3) system design for eco-efficiency; (4) design for social equity through sustainability, environment, society, economy and politics dimensions (Vezzoli & Manzini, 2008).

Within the context of the EC-LR implementation, design is a key part, because companies need to verify that products are compatible with the processes of recycling, remanufacturing and reuse, since besides it not being pertinent to recover a product that has no more value, the cost of recovering the product is another aspect to be considered, since, often, the sum of the investment and the cost of requalifying a given material is considered financially unviable for a company (A6, A12, A1).

Also according to Duarte (2021), design contributes with the concept of CE from 4 strategic propositions that can be used in the creation of products and services: a) reduction of the use of materials with high environmental impact; b) maintenance and repair, this proposition involves the creation and generation of work, provides opportunity and workflow and income generation while decreasing obsolescence in a general way; c) the participation of artisans and micro and small companies in productive activities; d) the interaction of business models with different cultures and thoughts, bringing to the conception of the product material and symbolic and creative value.

4.2.3 Industry 4.0, technologies and information systems

When it comes to Industry 4.0, the scientific literature has emphasized the great contributions of this theme in the area of reverse logistics and circular economy. The technologies and information systems present in Industry 4.0, depending on the level of maturity, have great potential to foster the transition to the CE, assisting in activities related to data management and material tracking, which facilitate the collection process, present in LR (A1), promoting remanufacturing, increasing the efficiency of critical resources such as water, energy, and CO2, assisting in waste disposal and improving business models (A17).
In addition, (A16) state that disruptive technologies, based on industry 4.0 principles, contribute to the provision of real-time information not only related to product traceability, but also across the entire flow of resources, as well as monitoring process performance. Under the same strand, (A9) state that the use of software has been proposed to solve logistical problems, related to the reverse cycle of items and waste, by determining, in fact, what will be the final destination of a product—which avoids not only transportation costs and CO2 emissions, but also minimizes the amount of items destined for landfills.

5 CONCLUSION

This paper addressed the intersection of the concepts of Circular Economy and Reverse Logistics through a content analysis of articles incorporated into a time horizon between 2011 and 2021. As to the method used, research is characterized as a qualitative approach, of a descriptive nature, in which he used the Systematic Review of Literature as a way of collecting the necessary information.

Thus, from the articles analyzed in RSL, it is concluded that there is a high level of proximity between the two concepts, given that while CE is an economic system alternative to the linear system used in mass, LR can be considered an instrument or tool used to help in the closure of the cycle of a product or material. Thus, the JU assumes the use of LR so that waste generated by end-of-life or maintenance products returns to production cycles to be remanufactured, recycled and re-integrated into a new product or to be disposed of in an environmentally sound manner.

In addition, another important contribution of the research deals with the importance and the great influence generated by the agents that permeate the relationship between CE and LR, being them: end users, government, industries/companies and waste pickers’ cooperatives. From this perspective, the work concluded that the agents can act both as incentives and hinders in the implementation processes or even in the efficiency of the LR and CE. As for the implementation process, aspects related to strategic organizational management, product design and industry 4.0 performance were highlighted in conjunction with the use of technologies and information systems to facilitate and optimize reverse logistics processes.

The main limitation found in the work is associated with the time horizon admitted by the research strategy. Between 2011 and 2016, no articles were found that met the requirements determined by the study. In this sense, only articles that addressed the two concepts (CE and LR) could be analyzed by the stages of the systematic review. As an alternative to future work, it is suggested that investigations point to: 1) the influence of the main actors/actors in the Circular Economy and Reverse Logistics; and 2) the impact of legislation, in globalized and developing countries, in the process of implementation and operationalization of the processes and activities of LR and CE.
REFERENCES


