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# Circular Economy Based on Reverse Logistics: A Systematic Literature Review

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## *Abstract*

*The Circular Economy is an evolving concept, and its practices must be adapted according to the needs of the region where they are implemented. Latin America is in an initial phase. The area of operations management is crucial in achieving the inclusion of efficient and environmentally friendly processes through reverse logistics. This study aims to identify the primary references, approaches, and theories related to the circular economy and reverse logistics. Systematic Literature Review, applying the PRISMA approach, which different authors have adapted. In addition, the VOSviewer tool was used to build and visualize bibliographic networks. Among the findings, the growing tendency to publish on the subject stands out, with more than 33% of publications made in the last five years concentrated in 2022, highlighting the concentrations of countries with large economies, England, China, India, and the USA; most of them are based on mathematical models to address their proposals.*

***Keywords:*** *Circular Economy, Reverse Logistics, Operations Management, Supply Chain Management, Waste Management.*

## Introduction

The transition towards a Circular Economy (CE) supported by the management of operations through the efficient use of resources is gaining attention worldwide to prolong their use throughout their life cycle (Yamaguchi, 2022). CE is among the most commented and referred concepts in academic and institutional social fields. It constitutes an alternative in the search for new solutions for the social, economic, and environmental surroundings characterized by sustainability; therefore, it is consubstantial of sustainable development, closely linked to the Sustainable Development Goals (Da Costa, 2022). It is a relatively new concept with growing global appeal and acceptance. It seeks to be perceived as a realistic approach that would enable sustainable development at various levels of the economy, regardless of a nation's state of development (Dunmade & Oyedepo, 2022).

CE has a systemic view that seeks to maintain a circular flow of resources by regenerating, retaining, or adding value to them. For Lindahl & Dalhammar (2022), it consists of emission and waste minimization technologies with notable profit gains, the goal of any industry concerned with environmental conservation. In an evolving CE, companies and customers

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should strive to conserve the use of resources as much as possible while obtaining maximum value to ultimately regenerate and recover materials and components at the end of the useful life of a product or service (Han et al., 2020).

Reverse Logistics (RL) constitutes a strategic decision in operations management that has captured significant attention among organizations due to its benefits for sustainable development (Banihashemi et al., 2019). This business strategy generates a sustainable competitive advantage, allowing the reduction of costs and environmental pollution, which contributes to the credibility of companies and customer loyalty (Ruiz et al., 2020). The importance of these practices is gradually increasing since, as part of its contribution, it favors the effective use of resources, the incorporation of recyclable waste, energy savings, and increased consumer satisfaction; at the same time, RL also provides essential contributions to the economy due to the opening of new business fields, such as reproduction and recycling (Desticioglu et al., 2022).

Overall, RL, based on the concept of "sustainable development" and CE, has become the focus of academic and business circles due to its emphasis on recycling waste materials and environmental pollution control (Cao et al., 2021). Its synthesis is essential in building social and economic value; therefore, they are different concepts but are mutually supportive (Fernando et al., 2022). RL of end-of-life products represents a vital part of CE practices for manufacturers; however, significant amounts of resources are still deposited in landfills instead of recovered (Mallick et al., 2023); therefore, more actions are required from different business, academic, and governmental scenarios.

This research aims to identify the primary references, approaches, and theories to support the development of a supply chain management model based on CE and RL.

## Theoretical Foundations

### Circular Economy

CE has gained attention in recent years (De Angelis, Howard, & Miemczyk, 2018) as the consumption and use of resources to meet the needs of a rapidly growing population increases. The European Investment Bank-CE (2020) was born as a counterposition to the linear economy, characteristic of the predominant industrial model, with an "extract-produce-use-throw away" type sequence and which responds to a logic that assumes that the planet is an unlimited reserve of resources that supports any magnitude of impacts (Vence & López, 2022). CE represents a sustainable solution to the problems of linear economic systems that treat the environment as a waste repository (Heshmati & Rashidghalam, 2021).

CE offers a different perspective on organizational and operational production and consumption systems, focused on restoring the value of resources used (Lopes de Sousa Jabbour et al., 2018). Its main objective is to avoid waste generation; it essentially focuses on environmentally friendly practices (Czikkely et al., 2018). Implementing its principles has economic, environmental, and social benefits, where technology is a critical factor that facilitates the successful application of these principles (Alamerew, 2020). In a CE, the value of products and materials is maintained within the economy when a product has reached the end of its life (Geisendorf & Pietrulla, 2017).

For Van Hoof et al. (2022), CE as a development model does not have a unified theoretical framework; its sustenance comes from diverse interpretations, highlighting contributions to

society; however, the literature review shows that some programs, policies, and research resemble the concept with only the use and recycling of waste; the definitions found differ in terms of epistemology or the way of interpreting CE.

A single definition does not represent the concept of CE, although it has evolved and has been developed by different authors; however, its characteristics fundamentally focus on eliminating waste and pollution from design to maintaining products and materials in use and regenerating natural systems (Aponte, 2022). Although there is no consensus and definitive definition, one of the most widely accepted is the one proposed by the Ellen MacArthur Foundation (EMF): "economy that is restorative and regenerative by design, and that aims to maintain products, components, and materials at their maximum utility and value at all times, distinguishing between technical and biological cycles" (Ellen MacArthur Foundation, 2022).

At its inception, the concept of CE was introduced by Pearce and Turner in 1990 (Han et al., 2021; Popović et al., 2022), although, according to Hanet al. (2020), it was first used by Stahel & Reday-Mulvery in 1981. Pearce and Turner (1990) described the theories of natural resource economics and their interactions and implications (Patel et al., 2021), illustrating that ignoring the environment means ignoring the economy, being considered an open loop or linear system, but not an integrated one that promotes the reuse of materials and recycling of waste (Han et al., 2020).

For Heshmati & Rashidghalam (2021), the World Commission on Environment and Development (WCED, 1987) coined the concept by Pearce & Turner (1990), who followed with influential research on the economics of natural resources and the environment that led to growing interest in environmental economics. The roots of a circular flow of materials concept go back many decades, with Boulding's (1966) proposal in his book "The Economics of the Coming Spaceship Earth", where he stated that circular systems within the global economy are inevitable to ensure human life on Earth in the long term.

According to the European Parliament (2022), the CE is a model of production and consumption that involves renting, reusing, repairing, renewing, and recycling existing materials and products as many times as possible to create added value (Krikke et al., 2022); in this way, the life cycle of products is extended; it is restorative and regenerative, and aims to ensure that products, components, and resources, in general, maintain their usefulness and value at all times (Gutiérrez-León, 2022).

In Latin America and the Caribbean, CE offers an opportunity for development, both through the creation of new economic activities linked to the provision of environmental goods and services and through the transformation of existing economic activities to increase their material efficiency and reduce their environmental impact. According to Da Costa (2022), the economies of Latin America and the Caribbean are not yet sufficiently prepared to take the great leap of implementing a CE; however, it is also a fact that several initiatives in the region give greater centrality to circularity in economic matters, highlighting a green culture.

The principles of CE, such as design for reuse, remanufacturing, and recycling, have been implemented by forward-thinking organizations to keep materials at their highest value use (Brendzel-Skowera, 2021). With the ultimate goal of a zero-waste economy, these strategies offer a promising alternative to our current take-make-waste economic model that operates with almost unlimited extraction of natural resources, transformation into single-use products, and disposal in landfills, where materials are inaccessible for future applications (Frost et al., 2020).

The CE model applied to business is an alternative that positively permeates factors: economic because it allows obtaining income and at the same time generates employment due to the principles of recycling, reuse, and reuse, which reduces solid waste, contributing to the mitigation of pollution; also to the social, and creating greater awareness for consumption (Gutiérrez-León, 2022). It is a new paradigm that demands gradual changes but also radical transformations; this will require strategies aimed at reducing environmental impacts and obtaining and generating resources that facilitate the transition, as well as cultural changes in people and companies (Carrillo & Pomar, 2021); this model allows increasing the useful life of products and using the excess capacity of existing ones to reduce waste and create a long-term sustainable model; it is an integral framework where the product design, its manufacturing process, the distribution channel (Aboulamer et al., 2020).

CE is a challenging concept where the potential implications of the product as a service model are freed from the constraints of the traditional servitization framework (Han et al., 2020). It can play an essential role in sustainable business management, and the current literature considers it a guide for sustainable business models. The implications for commercial areas are unclear (Barros et al., 2021); however, it will substantially affect innovation and employment generation even though data to confirm these effects are scarce and not uniform (Popović et al., 2022).

**Reverse Logistics (Rl)**

Operations Management encompasses areas of product design, planning, production control, logistics, and supply chains that face new challenges and can support the transition of companies toward CE. Logistics and supply chain management have adopted new roles in today's economic models by optimizing direct and reverse flows (Jabbour et al., 2019).

RL and closed-loop supply chain management promote environmentally friendly practices, one of the pillars of sustainable operations management (Kazemi et al., 2019). RL is applied in the global manufacturing sector, creating sustainable reverse supply chains complementary to traditional ones, incorporating new variables in the process and a higher level of uncertainty: quality, quantity, and time (Singh et al., 2023).

RL is a fundamental part of logistics and supply chain management, whose scope and interest have become more recurrent (Desticioglu et al., 2022; Montes & Rodríguez, 2021) due to the importance of sustainability in the production systems of organizations globally (Malpica, Caicedo, & Lasso, 2022); environmental agendas and regulations (Guarnieri et al., 2020); and, the use of wasted products for reproduction (Harsaj et al., 2022).

RL strategies can help reduce environmental impacts while ensuring efficiency (Moktadir et al., 2020). It is an area that is part of business logistics. It comprises several necessary processes to restore a product the customer wants to discard, reuse, or resell (Mattos & dos Santos, 2022). Although the literature on the subject is abundant, RL strategies are scarce, as well as how they can lead to a company's competitiveness (Makaleng & Hove-Sibanda, 2022). Considering the valorization of products at the end of their use, as a business opportunity, and for its strategic processes.

The concept of RL was proposed by James R. Stock in 1992. For Rogers & Tibben-Lembke (1998), it is the process of planning, implementing, and controlling the efficient and cost-effective flow of raw materials, in-process inventory, finished goods, and related information

from the point of consumption to the point of origin to recover value or proper disposal. Hashemi (2021) defines it as all logistics activities for products that have reached the end of their useful life or require a series of processes for further improvement, while the Cambridge Dictionary (2022) defines it as a process that deals with goods that have been returned to the company by customers.

RL is the planning, implementation, and control of backward flows of raw materials, in-process inventory, packaging, and finished products from the point of manufacture, distribution, or use to recovery or proper disposal. Campoverde et al. (2022) define it as the closed chain that encompasses the process or set of strategies through which flows return to the beginning, producing the return of products or materials, which are subsequently recycled, reused, repaired, remanufactured, collected or renewed, to recover value, or contribute to the environment.

RL is for all operations related to the reuse of products and materials; it is the process of moving goods from their typical final destination to capture value or proper disposal (Mbovu & Mburu, 2018; Rakhmasari et al., 2020); remanufacturing and refurbishment activities can also be included in this definition. The most important reason for its growing interest worldwide has led several countries to develop regulations that impose responsibilities on network actors, manufacturers, logistics service providers, and municipalities (Bolat et al., 2019).

RL includes several practices: reuse, resale, recycling, proper disposal, remanufacturing, incineration, repackaging, and product returns management (Makgedi & Lambert, 2021). The essential principle is that many materials the consumer considers unusable or unused are valuable and can re-enter the supply chain with minor modification and refurbishment (Hashemi, 2021).

One of the most critical aspects of RL is the return of products, including defective products, maintenance, repair, an overhaul of products, and surplus (Bernon et al., 2018). Thus, one of the most significant barriers to successful RL is the difficulty in developing an accurate system to forecast the number of product returns (Bolat et al., 2019). As Lechner Reimann (2019) put it, opportunities also involve risks: the main challenges that arise when organizations implement RL processes are the increasing complexity and uncertainty.

As pointed out by Malpica, Caicedo, & Lasso (2022), there is no evidence in the research field that there is a comprehensive implementation of processes related to IL in the production of goods and provision of services by regional organizations, which negatively affects competitiveness and value-added in the short term for companies in the country and the region. (Palacios-Alvarado et al., 2022) argue that there is little experimentation and scientific evidence of developed IL processes that provide relevant results in Latin America; most of the scientific production is available in English, and the studies have been developed in European or Asian countries; and despite its breadth, there is lack of convergence in its conceptualization and application (Campoverde et al., 2022); however, studies conducted in Brazil have positive results, and, although there are approaches to RL conducted in Argentina, Colombia, Cuba, and Venezuela, these are focused on route design.

**Circular Economy and Reverse Logistics**

CE business models often rely on reverse supply chains and RL to close material cycles, such as recycling waste and scrap into secondary raw materials, to extend product life by promoting direct reuse, repair, refurbishment, and remanufacturing (Yamaguchi, 2022).

Studies in recent years address the applications of RL used to minimize the damage of used products and scrap as the central theme (Desticioglu et al., 2022), but it also takes advantage of the value of end-of-life products, giving them a new function or using them to manufacture new products; it makes possible cost reduction in production and packaging, reduces the use of virgin raw material, improves the distributor-customer relationship, establishes a good company image, and minimizes the environmental footprint, which contributes to CE (Ruiz et al., 2020).

RL is essential in adopting and implementing CE concepts in supply chains (Agrawal & Singh, 2019). The Municipal Solid Waste reverse logistics chain is a particular case of a reverse supply chain, which it defines as a network consisting of all entities involved in the flow of discarded products leaving the point of consumption; it includes several stages: generation, storage, collection, recovery and/or final disposal of waste (Rossit & Nesmachnow, 2022).

Campoverde et al. (2022) highlight the contribution of RL to the future study of CE and the commitment to product recovery as a strategy to recover value. Although it is not a new concept, there is a need to create a collaborative mechanism to accommodate CE based on RL activities (Fernando et al., 2022). There is also a lack of research addressing the critical success factors of RL to create value from the perspective of the technical cycle of the circular supply chain (Julianelli et al., 2020). To address these issues and prospects of restoration and circularity in the manufacturing business model, integrated CE and RL are the keys to environmental protection and economic growth (Rajput & Singh, 2021).

For Bernon, Tjahjono, & Ripanti (2018), RL fits and thus becomes the main component of CE, as its activities encompass the management of product returns followed by end-of-life processing and product recovery activities, such as repair, reuse, refurbishment, remanufacturing, and recycling.

## Methodology

Literature review plays a fundamental role, as it affects the development and evolution of the theory of an area of study; it allows researchers to evaluate and propose new conceptualizations and pathways for future studies (Tsiotsou et al., 2022; Macas-Acosta et al., 2022). There are several procedures, but the one selected by researchers is the Preferred Reporting Item for Systematic Reviews and Meta-Analysis (PRISMA) approach (Rethlefsen et al., 2021; Vergara-Romero et al., 2021). It comprises four stages: identity, select, evaluate, and synthesize, represented in a flowchart, which allows visualizing the procedure of collecting original documents (Vu-Ngoc et al., 2018). The source of the literature studied is "Web of Science" from Clarivate Analytics. The following elements are analyzed to search the variables "circular economy" or "rever logistics" by selecting articles in English and Spanish: title, abstract, and author's keywords, published between 2018 and 2022.

Additionally, the deductive-inductive method concentrates the analysis in Operations Management Research because Reverse Logistics is part of it. It allows a bibliometric analysis using the VOS-Viewer tool from the keywords, countries, authors, citations, organizations, and methodology. For the search of the variables in the Web of Science database, it was decided to use the "and" connector between the variables EC and RL. However, the total number of articles on operations management was less than 50. Therefore, the "or" connector was used to obtain the independent articles of each variable and those found together in operations management because the articles with the "and" connector are found within the selected database.

This study constitutes the first phase of doctoral research, whose objective is to identify the primary references that propose a study model for the area of operations based on the analysis of the two variables indicated above and that serve as support for designing a model that relates these constructs.

## Results

This section reports the results of the Systematic Literature Review, following the steps indicated in the methodology. Figure 1 shows the PRISMA flow diagram of the selected articles.

The figure above shows the analysis of the base of 109 articles resulting from the selection of the Operations area, which allows us to identify the references and methodology implemented in terms of the two study variables mentioned.

Figure 1 shows ample literature on the two variables studied. However, when the area of operations is selected, it is reduced to 4.66% of the total number of articles established in the selection phase. Figure 1 shows the need to increase the number of studies that include Circular Economy and Reverse Logistics to evaluate their contribution to the generation of solutions that minimize the environmental impact of organizations.

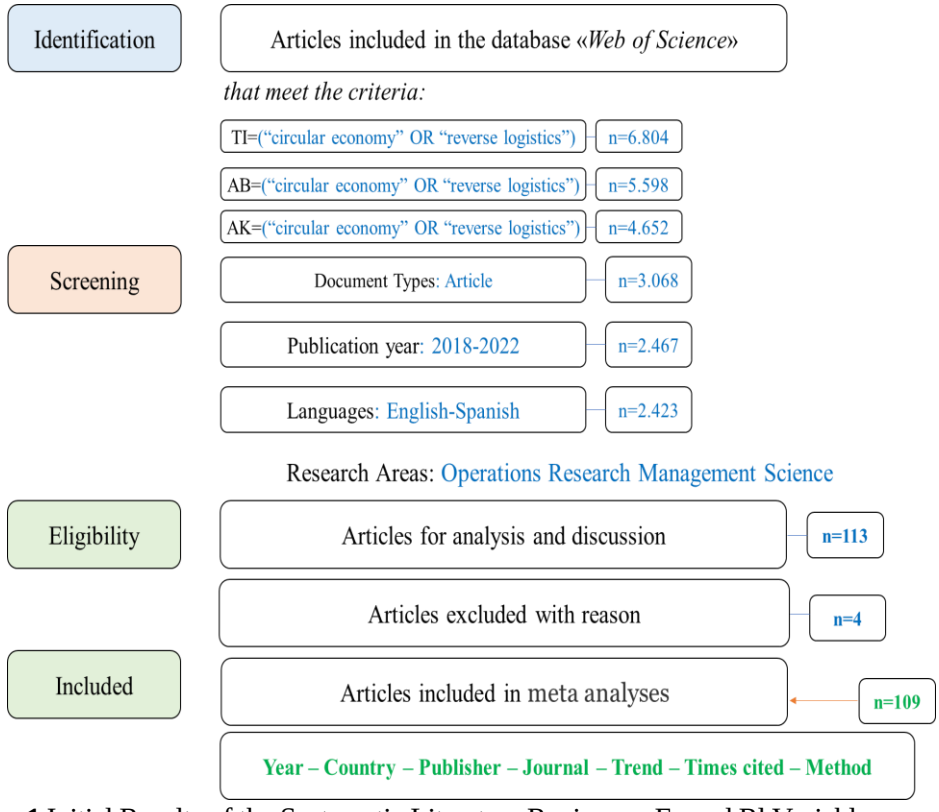
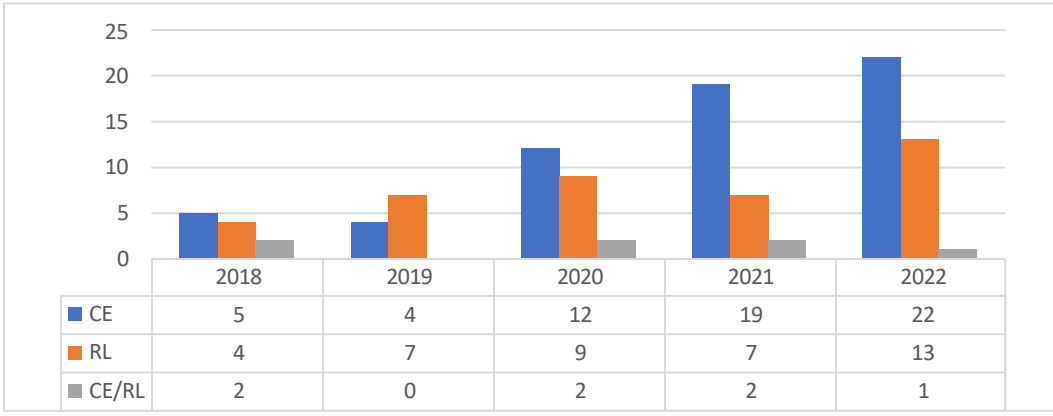



**Figure 1** Initial Results of the Systematic Literature Review on Ec and Rl Variables.

**Note:** The representation of the Prisma flow diagram is shown in its four phases, in which a wide range of literature dealing with the two study variables is evident, but when selecting the Operations area, it is significantly reduced to 113 articles, of which four were excluded, since despite the selection of the period, three corresponded to 2023 and one to a book chapter. Own elaboration.

Although Figure 2 shows a growing trend that evidences how these variables have gained relevance within operations, especially in 2022, there is insufficient information. In addition, there is a need to delve deeper into the field of Operations Management in studies that combine the two variables.




| | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|
| CE | 5 | 4 | 12 | 19 | 22 |
| RL | 4 | 7 | 9 | 7 | 13 |
| CE/RL | 2 | 0 | 2 | 2 | 1 |

**Figure 2.** Evolution of Publications Per Year in Circular Economy and Reverse Logistics in Operations Management Research.

**Note:** Information from the selected database, own elaboration. The number of publications per year is shown according to the three categories reflected in the titles of the articles: Circular Economy, Reverse Logistics, Circular Economy, and Reverse Logistics; a more significant number of publications can be seen in CE. Own elaboration.

A concentration of 56% of publications is distributed in 6 developed countries, which could be a reference, with little presence of those in the category of developing countries. Within the bibliographic review, it is evident that although in the selection stage (see Figure 1), the articles in Spanish and English were chosen, 100% of the articles in the database are in English because, in Figure 3, most of the referent countries are English-speaking.

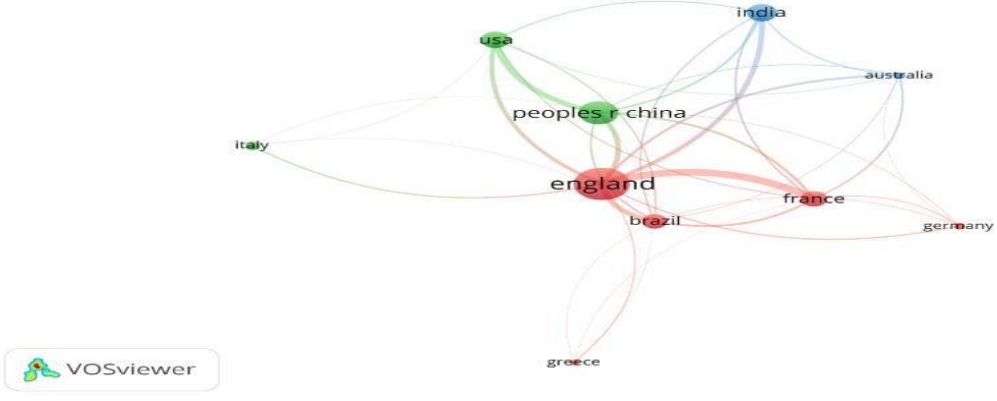



**Figure 3.** The Concentration of Publications by Country in Ec and Rl in Operations Management Research.

**Note:** Distribution of publications by EC and RL countries in Operations Management Research. England stands out in the first place, representing Europe and China from Asia, followed by India and the United States with the same percentage; Brazil stands out with the highest percentage of publications from South America. Own elaboration.

In Figures 4 and 5, an analysis of citations of the scientific articles in the database is made. The authors that have been cited most frequently and the relationship that exists according to publications as a whole are identified.

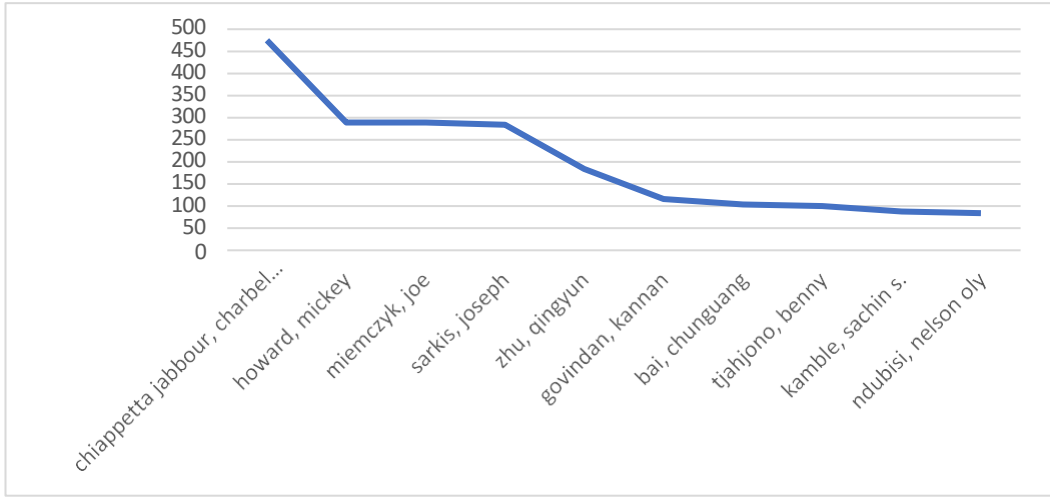



**Figure 4.** Number of Citations Per Author of Articles Published in Ec and Rl in the Area of Operations Management Research.

**Note:** The prominent authors are shown according to the number of citations. It is observed that the first 10 with more than 80 citations represent 69% of the total number of citations, which makes them referents in the subject. Information from the study database. Own elaboration.

The database includes 109 articles with 366 authors, of which ten are the most cited (see Figure 4). These authors are related through clusters (see Figure 5), and in the year 2022, they are still referents: Jabbour, Agrawal, Kamble, and Tsolaski (see Figure 6).

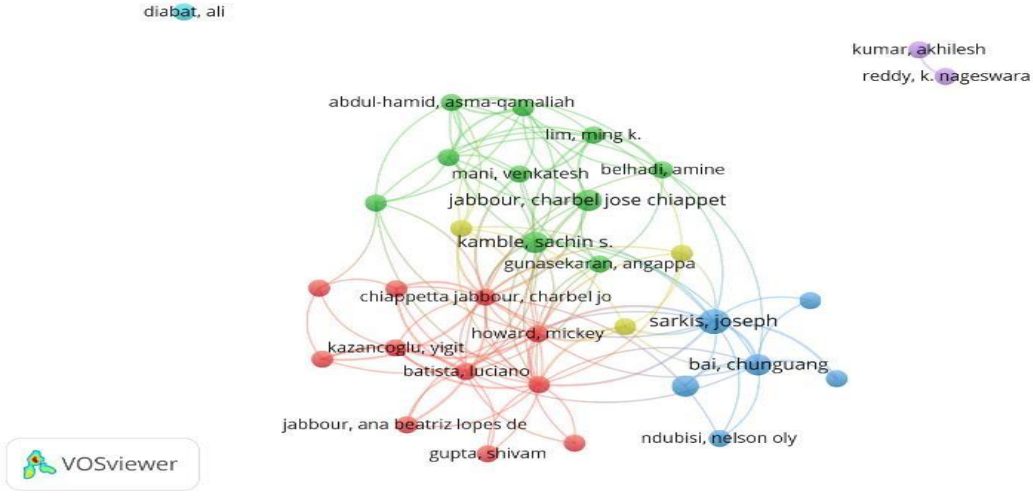



**Figure 5.** Citation Map by the Author with a Minimum of Two Docum.

**Note:** We have considered 33 of 366 authors in the database with at least two documents per author, of which 30 are connected in 4 clusters.

Figure 6 shows in yellow color the authors who dealt with the topic in 2022, of which some authors are related in clusters while others are not connected. In 2018, 2019, 2020, and 2022, the article with the highest citation used the qualitative methodology and only the 2021 quantitative. In comparison, the most cited articles within the quantitative stream use multi-criteria decision-making approaches or Structural Equation Models.

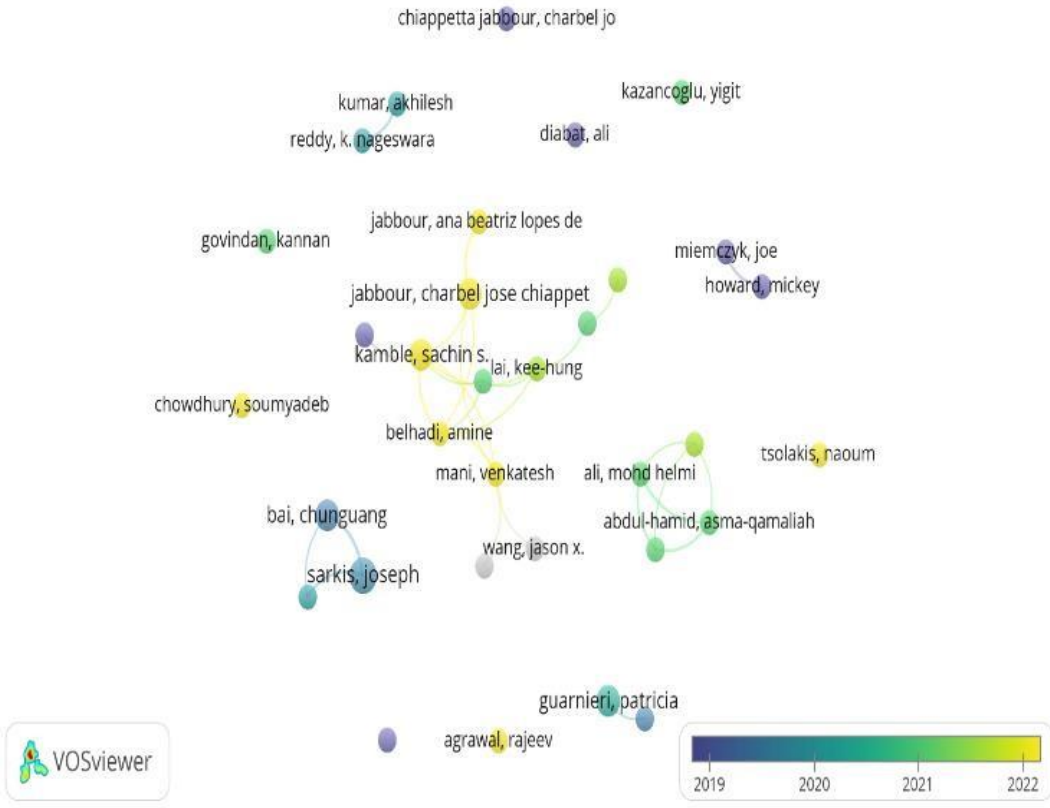



**Figure 6.** Co-authorship Map with a Minimum of Two Papers Per Author.

**Note:** Co-authorship map showing the relationship of authors with at least two articles that have worked collaboratively on Circular Economy and Reverse Logistics research in the area of Operations, and the colors represent a period.

Figure 7 shows the keywords with more than five occurrences in the articles analyzed. The circles that describe the words are nodes identified with different colors, representing themes or categories within the clusters. A cluster is a group of keywords that are closely related to each other. These clusters are formed based on the co-occurrence and similarities of the keywords. Each cluster has a specific color that helps us to identify the common theme or focus of the grouped keywords. The keywords represent 4 clusters: reverse logistics, circular economy, sustainability, and models. Lines or connections between the circles represent the relationships between the keywords. These lines tell us that two keywords co-occur with a particular frequency in the dataset. The strength of the connection can be represented by the intensity of the line, where a thicker line indicates a more frequent or more substantial co-occurrence between the keywords.

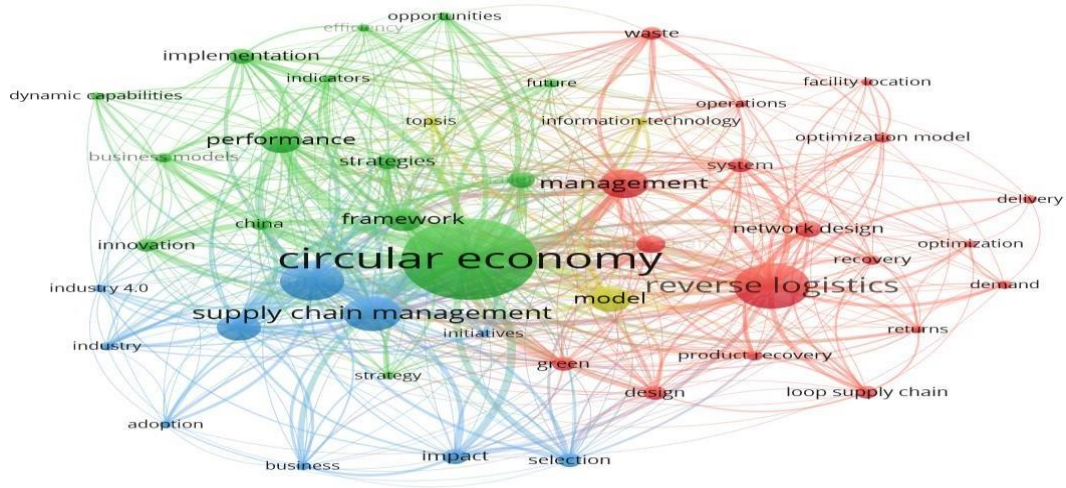



**Figure 7.** Cooccurrence of Keywords.

**Note:** The co-occurrence of the keywords is observed where the size of the circles represents the relevance of the term; a more significant size means that these topics have been investigated much more frequently among the articles that comprise the database.

In addition to the relationship between the Circular Economy and Reverse Logistics, through the keywords used in the articles, as shown in Figure 7, other trends that are being studied in conjunction with these variables and that mark trends towards environmental care can be seen, such as innovation, optimization, sustainability, and supply chain management.

Among the organizations that stand out in the subject's research in several documents and citations are Montpellier Business School, University of Exeter, Worcester Polytechnic Institute, University of Warwick, University of West England, and University Southern Denmark, among others.

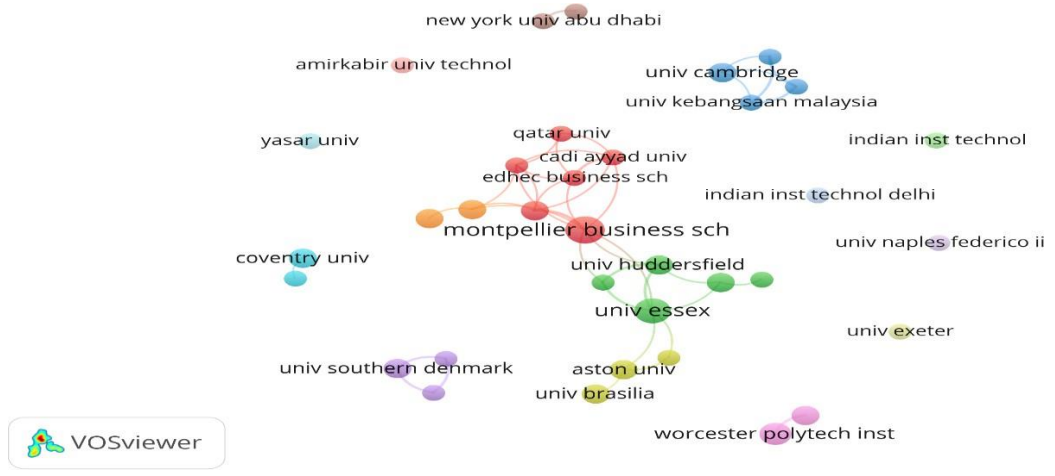



**Figure 8.** Co-Authorship of Organizations.

**Note:** The list of organizations that collaborated in the subject research is shown, with at least two documents and ten citations as parameters. Of the 244 organizations that comprise the database, 35 have been selected.

## Discussion

According to the findings of the research, even though there is a substantial amount of published material on circular economies and reverse logistics, the number of studies that have specifically focused on these topics within the operations area is relatively low, accounting for only 4.66 percent of the total articles that were examined. It demonstrates the importance of conducting additional studies to assess the role of circular economies and reverse logistics in reducing organizations' adverse effects on the surrounding environment.

In addition, the research identifies organizations that have made significant contributions to the research on circular economies and reverse logistics. Researchers interested in collaborating or finding relevant sources of knowledge may find this helpful information.

The essay also highlights the importance of utilizing various research approaches while examining circular economies and reverse logistics. In previous decades, qualitative research methods were the norm; however, in more recent times, researchers have turned to quantitative techniques, such as multi-criteria decision-making and structural equation models, for their investigations. This study area points to a move toward more rigorous and analytical procedures.

In general, this comprehensive assessment of the relevant research literature offers helpful insights into the state of research on circular economies and reverse logistics in operations. It sheds light on developing trends and techniques, identifies gaps in the existing literature, spotlights collaborative networks and significant organizations, and discovers gaps in the existing literature. This knowledge can potentially direct and contribute to developing future research endeavors and sustainable practices for operations.

## Conclusions

The literature on research on circular economy and reverse logistics is abundant; however, the approach as a whole is barely representative, so the construction of models with the relationship between these constructs remains a space of interest for academics and entrepreneurs, and it is worth focusing efforts on these research initiatives; in contrast, their dissemination in Latin America remains scarce, at least in high-impact journals, which is evidenced by the concentration of publications made mainly by countries with large economies, geographically located in other regions. However, Brazil is a benchmark for other South American countries.

Although the environmental impact of production processes continues to be a global concern, and companies are aware of the need to change production processes from linear to circular in order to reduce pressure on ecosystems and address the climate crisis, the benefits of reverse logistics have not been fully exploited in the field of operations. Reverse logistics can be used to treat waste and residues and generate competitive advantages in optimizing processes. This optimization allows for an excellent corporate image, improved customer service, reduced costs, and maximized profits while contributing to the conservation of natural resources.

Finally, it is suggested to address research using emerging theories such as consumer behavior, where it would be possible, based on the perceptions of users and other stakeholders, to develop structural equation models that establish relationships between these constructs: circular economy and reverse logistics. The application in supply chains that directly impact

the user's daily life and have a short life cycle, for example, food, could awaken public interest in the design of policies that allow the inclusion of these variables as an alternative for the sustainable development of countries.

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