European Transport \ Trasporti Europei (2023) Issue 94, Paper n° 7, ISSN 1825-3997

https://doi.org/10.48295/ET.2023.94.7

Reverse logistics and circular economy: A literature review

Marta Biancolin [1,3*], Luigi Capoani [2], and Lucia Rotaris [3]

[1] Scuola Universitaria Superiore IUSS, Pavia, Italy
[2] Università Ca' Foscari, Dipartimento di Management, Venezia, Italy
[3] Università di Trieste, Dipartimento di Scienze Economiche, Aziendali, Matematiche e Statistiche (DEAMS), Trieste, Italy

Abstract

The application of circular economy (CE) principles in reverse logistics (RL) processes involves the recovery, recycling, reuse and remanufacturing of materials that return from the consumer to the producer. This literature review assesses whether the manufacturing sector, technology, supply chain (SC) structure, customers' preferences, and policy makers influence the diffusion of circular RL, highlighting the strategies adopted by companies.
The results show different levels of circular RL implementation in different industries. Technology is an enabler but also an obstacle, as it requires large financial resources and a skilled workforce. The involvement of all SC stakeholders proves to be a critical factor in the successful implementation of circular RL, although the likelihood of success depends significantly on producers being the initiators. Policymakers also play a key role in guiding business investment in circular RL projects.
This article summarizes the literature on CE and RL on analytical dimensions rarely studied together, providing researchers, companies and public decision makers with an overview of the most critical factors influencing the management of RL within circular processes. Controversial findings, open questions, and promising lines of future research are also outlined.

Keywords: reverse logistics, circular economy, supply chain.

1. Introduction

The world population will reach about 9 billion in 2050 and more than 10 billion in 2100 (Bastein, 2013). The use of raw materials and resources in production processes will intensify to meet the growth in demand for goods and consumption, putting pressure on ecosystems in a potentially unsustainable way. Natural resources, especially non-renewable resources, need to be used more wisely (Franklin-Johnson et al., 2016). A solution to the sustainability of industrial processes is reverse logistics, which aims to reduce the cost of managing returned materials and packaging by applying circular

[*] Corresponding author: Marta Biancolin (marta.biancolin@phd.units.it, marta.biancolin@iusspavia.it)

economy principles such as recovering, recycling, reusing, and regenerating materials and products (Govindan & Soleimani, 2017).

Some scholars have classified the RL literature according to the method of analysis, the industry sector (Govindan & Soleimani, 2017), the type of data, and the enablers and barriers (Prajapati et al., 2019). Kumar & Kumar (2013) identified five major themes: operations management, design, production, waste management and environmental impact assessment, whereas Pokharel & Mutha (2009) identified three macro themes: structure, logistics process and outflow characteristics. Instead, the review by Brito et al. (2005) analyses the function of the supply chain actors in the incoming and outgoing flows and identifies the factors that activate RL activities. Finally, Xu & Yang (2022) summarise the role of environmental and fiscal policies in the implementation of sustainable RL processes.

However, a literature review combining the impact of the industrial sector, SC structure, and sectoral policies on the diffusion of circular RL is lacking. Our work aims to fill the existing information gap for the benefit of researchers studying the topic, policymakers designing industrial policies promoting the adoption of CE practices within RL processes, and managers wishing to understand the critical factors for successful sustainable RL and environment-friendly logistics practices.

The paper is structured as follows: Section 2 describes the notion of RL and CE; Section 3 explains the methodology used to select and analyses the articles; Section 4 describes the results of the bibliometric analysis; Section 5 presents the dimensions we used to review the existing literature; Section 6 concludes by outlining the main findings and describing the open questions that deserve further investigation.

2. Circular Economy

In recent decades, environmental sustainability and the need to manage non-reproducible natural resources, by-products and production waste more efficiently have attracted the attention of many scholars (Friant et al., 2021). They have begun to evaluate the CE paradigm for all stages of the production process, from extraction to delivery of the finished product, by recycling and reusing materials (Boulding, 1966).

CE is a model of production and consumption that includes reuse, repair, reconditioning, and recycling with the aim of extending the life of materials and products (Calzolari et al., 2022). Merli et al. (2018) highlight how CE achieves eco-efficiency by increasing productivity while reducing resource use and waste generation. Sauvé et al. (2016) instead emphasise the intergenerational sustainability that can be achieved by internalising the social costs of production processes.

Other authors have further contributed to the CE literature by describing best practices, technologies, and business models aimed at increasing the sustainability of the production process while reducing its carbon footprint and environmental impact (Pigosso et al., 2021).

3. Reverse Logistics

The concept of RL has evolved considerably over time. However, its main objective is still to reduce the amount of discarded products and packaging materials through recovery (Stock & Lambert, 1987). To achieve this, products and materials follow the opposite direction to standard logistics flows. In fact, RL deals with the flows from customers to producers and the consequent reconditioning activities and regeneration processes that are carried out to conveniently and efficiently recover their residual value (Rogers &

Tibben-Lembke, 1999). RL activities include also waste disposal and management of hazardous materials and end-of-life products (Stock, 1992).

Integrating CE principles into RL processes not only provides environmental benefits by reducing the footprint of production processes (Rajput & Singh, 2021), but also increases business profitability (Larsen et al., 2022). In fact, RL fits into the broader and more recent concept of "social responsibility of logistics", according to which the principles of corporate social responsibility apply to the logistics functions and the supply chain organisation (Crotti & Maggi, 2021). However, the literature focusing on the application of CE in the context of RL activities is relatively new and still underdeveloped (Schöggl et al., 2020). Our research aims to fill this gap by critically summarising the literature focusing on the integration between CE principles and the RL process, thus achieving circular reverse logistics.

4. Selecting criteria and methodology

The methodology used follows the guidelines of Tranfield et al. (2003). After defining the research questions, we selected the scientific papers published in the Emerald, Scopus, Science Direct and Transport Research International Documentation databases. We used 'reverse logistics' and 'circular economy' as search terms in the title, abstract or keywords. The selection process took place in August 2022. This phase yielded 332 articles. We then checked whether the selected papers analysed the topics we were interested in, i.e. the role of the productive sector, the degree of technological innovation, the SC actors, the structure of SC, consumer preferences, business strategies and the role of policy makers. After reviewing the abstract, introduction and conclusion of each article, we decided to exclude 96 papers from the initial set as their content was not related to our research objective. However, by reviewing the literature cited in the remaining papers, we found 41 additional articles whose topics were in line with our research. The process ended with a total of 277 articles (Figure 1). We classified each article according to its main characteristics (Table A1 in the Appendix) and the research dimensions (Table A2 in the Appendix) we wanted to analyse.

Finally, we performed a scientometric analysis to ensure an objective, consistent and reproducible visual analysis of the content and trends of the articles. For this purpose, we used Biblioshiny, a Bibliometrix package in R, which is flexible and provides high-quality data visualisation analysis. It supports the workflow for scientific mapping and provides several possibilities for data analysis, such as descriptive analysis, conceptual structure mapping, network analysis and mapping (Aria & Cuccurullo, 2017). Default settings (e.g., automatic layout or "walk trap" clustering algorithm) were used since perform better in terms of clarity of network representation.

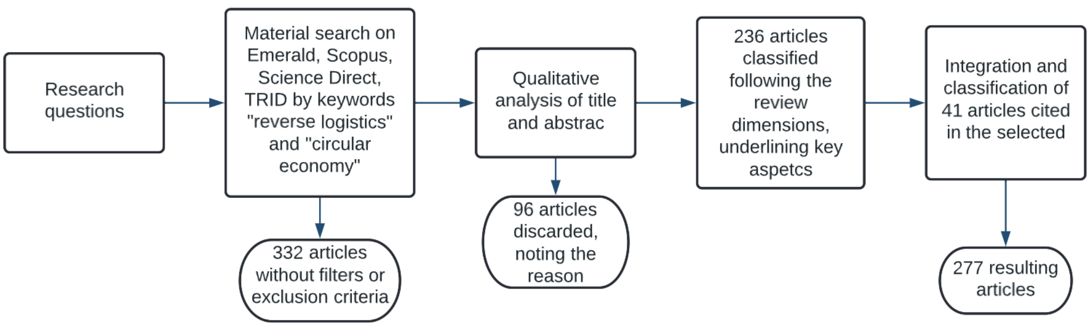

Figure 1: Paper selection process

5. Results of the co-occurrence network analysis

Co-occurrence network analysis is an effective technique for identifying the relationships between research topics through a map of word pairs grouped into nodes and links (Figure 2). Eight clusters emerged. The black clusters on CE, the striped ones on RL and the grey ones on sustainable development show the highest number of pairs.

The CE cluster includes planning and organisational decisions of industrial activities and challenges, opportunities, social and economic impacts of circular production processes. Many authors list the existing barriers and drivers to making business activities sustainable (Rizos & Bryhn, 2022). Others instead study how to reduce the environmental impact of production processes through life cycle analysis (Diaz et al., 2021), input-output models or cost-benefit analyses that take into account the emissions generated by the production process. The term Industry 4.0 identifies its positive impact on the planning and control of reverse flows, information sharing and collaboration between the economic actors involved. The keywords 'literature review' and 'semi-structured interviews' indicate the predominance of qualitative analysis.

The grey cluster includes the relationships between sustainable development, recycling and recovery (Howard et al., 2022). It also includes strategies adopted by companies (Berlin et al., 2022), consumer preferences and policies designed by regulators to encourage such activities (Flygansvær et al., 2021). A frequently studied topic is the environmental impact of the electronics industry and electronic waste (e-waste) (Martins et al., 2021). Articles in this group rely primarily on qualitative analysis (e.g. conceptual structure and content analysis). Closely related to the latter is the dotted black cluster, which includes strategies for adequate waste management.

The striped cluster concerns the RL, the design and management of the initiatives and activities developed for this purpose (Viegas et al., 2019). Quantitative (e.g., structural equation modelling) and qualitative (surveys) methodologies prevail, as well as the conceptual framework approach (Prajapati et al., 2019).

The checkered cluster illustrates the impact of production choices on the environment aimed at maintaining the balance between sustainability and economic performance.

The dotted grey cluster reports the relationship between the management of e-waste by companies through remanufacturing processes and by customers at end-of-life disposal (Flygansvær et al., 2018).

The fine stripes and black bubbled clusters focus on closed SC and regeneration activities, willingness to pay for remanufactured products (de Vicente Bittar et al., 2018) and the regeneration strategies adopted by companies in terms of costs, marketing, and price.

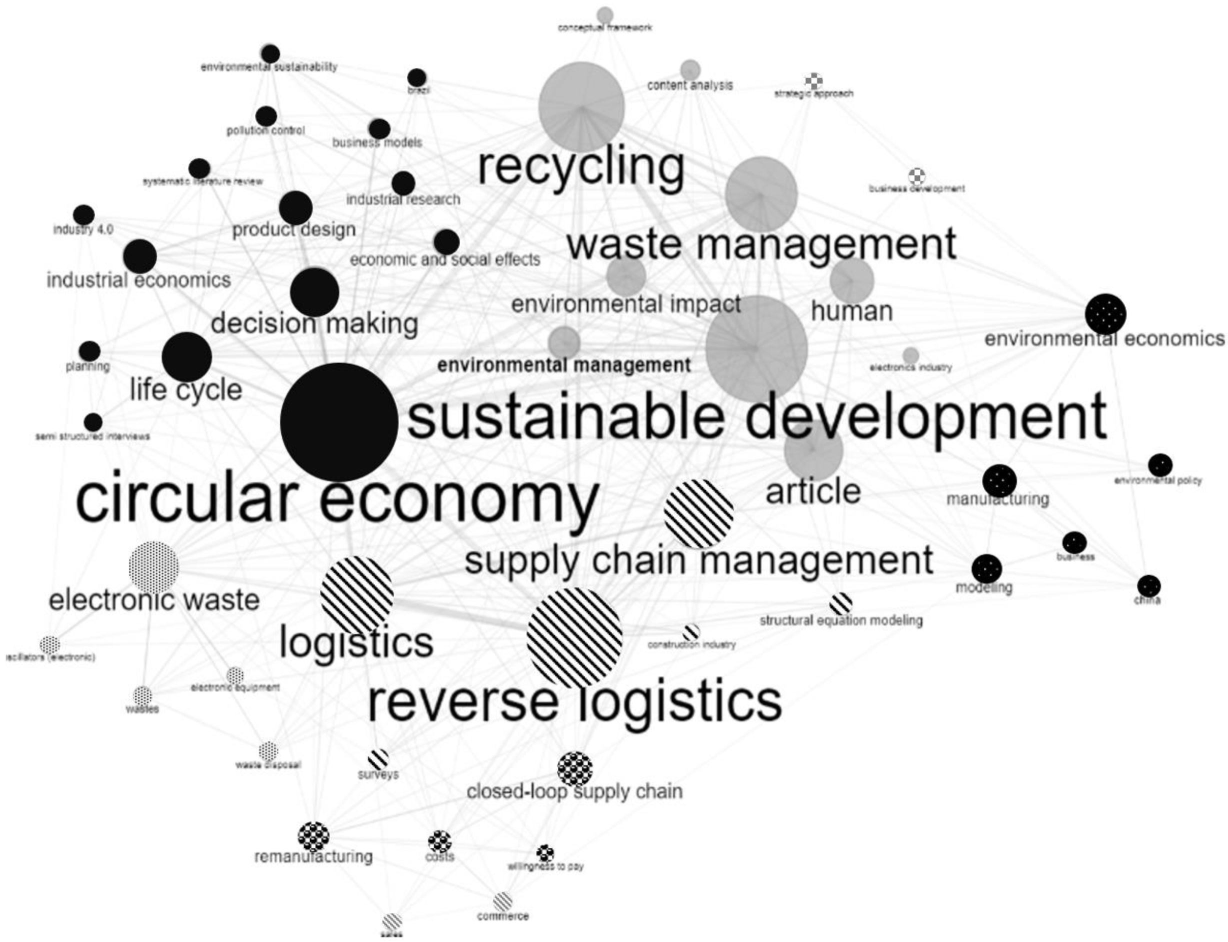

Figure 2: Co-occurrence network analysis

6. Dimensions that impact on circular RL

6.1 The role of the industrial sector

Several factors limit the diffusion of circular RL within sectors, making the merger of CE and RL ineffective in most production areas (Frei et al., 2020; Waqas et al., 2018). According to Diaz et al. (2021), circular models involving recycling, reuse and remanufacturing are mainly feasible in the electronics and textile sectors. Stål & Jansson, (2017) demonstrate the use of recycled or organic clothing materials to reduce the environmental impact of products and packaging. Caldarelli et al. (2021) highlight the impact of garment recycling processes as one of the main factors limiting the effectiveness of circular RL in the sector. Developing countries such as Pakistan, Vietnam, Bangladesh and India face greater constraints (Kazancoglu et al., 2021a). European countries are also affected, although to a lesser extent (Franco, 2017).

While in the electronics sector the existence of automated and interconnected processes enables circular practices (Martins et al., 2021), uncertainty about the quality and quantity of returned products and inefficient management of demand for remanufactured products. are the most relevant barriers. Furthermore, there are rarely strong relationships based on trust along the SC, which limits the exchange of information and a common vision towards sustainability (Flygansvær et al., 2018).

In the construction sector, the prevailing negative aspects relate to the ineffectiveness of regulation and the reluctance of builders, contractors and designers to adopt circularity, perceiving it as a source of additional costs rather than a competitive advantage. In addition, the high price of recycled materials hampers circular RL and the possibility of using recycled materials in several construction projects (Anastasiades et al., 2021).

In the food sector, there is little implementation of circularity due to the short shelf-life of products and the massive packaging required to preserve food quality (Kazancoglu et al., 2021b).

In the pharmaceutical sector, long SCs hamper the coordination of actors involved in the handling of drugs and medicines in RL flows. The lack of regulatory support and smart tracking systems also makes it difficult to properly track and execute the collection of used medicines, a problem compounded by consumer distrust (Viegas et al., 2019).

Figure 3 summarises the barriers to the application of circular RL for each production sector.

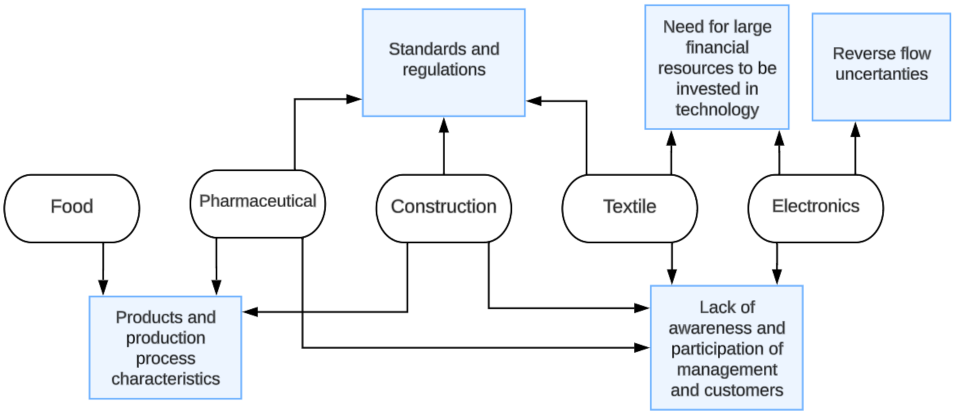

Figure 3: Circular RL limits by sector

6.2 The role of technology and innovation

The level of technological innovation and the type of infrastructure used influence the integration between CE and RL within the production process and along the SC (Julianelli et al., 2020).

Internet of Things (IoT) and radio frequency identification tags (RFID) promote the circularity of material flows by enhancing collaboration between SC actors and tracking resources and material flows (Rejeb et al., 2022). Blockchain technologies minimise the vulnerability of reverse flows and increase trust between partners (Khan et al., 2021). Many authors demonstrate the improvements offered by Industry 4.0 technologies in orienting the SC towards circularity (Rajput & Singh, 2021).

Additional tools based on innovative technological solutions, such as smart contracts or optimisation systems that link customer requests to e-waste collection services, prevent unfair behaviour (Khan et al., 2021) and minimise costs and streamlining collection routes.

However, the level of technological innovation to ensure the benefits of circular RL and the efficient use of resources and energy is still limited, even in high-tech companies (Hickey et al., 2022). On the one hand, this is due to the high investments required to acquire new technologies. On the other hand, it is caused by the lack of skills and capabilities of the workforce, which prevents firms from fully exploiting their potential, especially in SMEs (Caldarelli et al., 2021) and in developing countries (Piyathanavong et al., 2019). In addition, the growing diversity of products and their shorter lifespans make it increasingly difficult and expensive for companies to adapt and update production processes to circularity.

Figure 4 shows the most cited technologies for circularity in the RL.

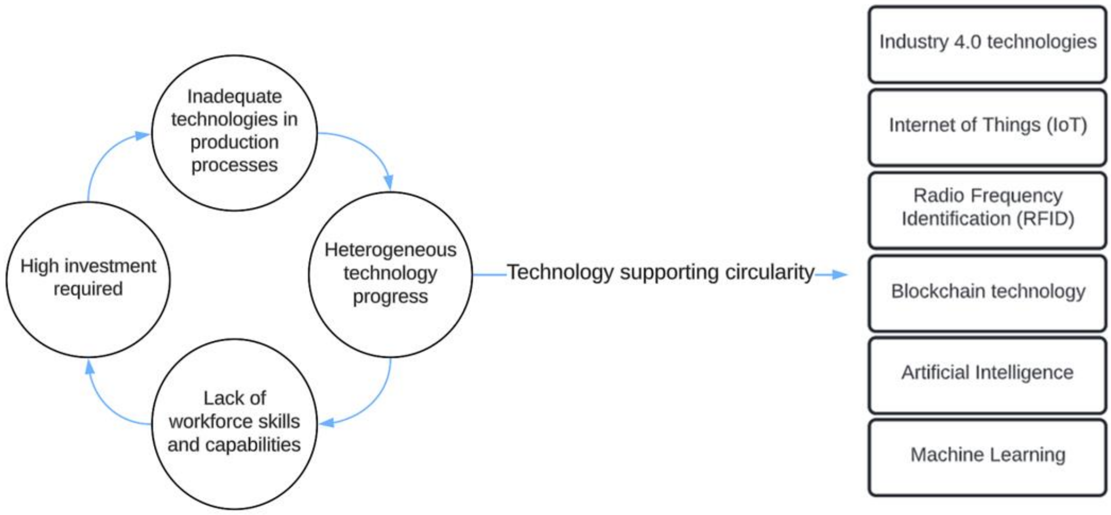

Figure 4: Technology supporting circular RL

6.3 The role of the SC members

In the literature, it is not clear which actor is primarily responsible for the circular RL activation (Figure 5). Success depends on the involvement and cooperation of all SC members and, according to Debacker et al. (2017), regardless of who activates the circular process. On the one hand, producers, importers, retailers and distributors are jointly responsible for the organisation and management of the RL system (Pushpamali et al., 2019). On the other hand, consumers are responsible for returning used products at the end of their life (Ottoni et al., 2020). Finally, governments and institutions regulate, support and monitor these activities (Wijewickrama et al., 2021).

Furthermore, the establishment of vertical and horizontal collaborations (Cricelli et al., 2021) between producers, suppliers, distributors, consumers, non-profit organisations or research centres (Batista et al., 2019) facilitates the success of reverse circular flows. It also makes it possible to control the quality of products and materials and the efficiency of operations (Berlin et al., 2022).

However, producers often play a dominant role in financing projects and investments aimed at spreading sustainability practices and behaviours throughout the SC (Flygansvær et al., 2018). As they are primarily responsible for the production and design of the goods that are then recycled or regenerated, they are at the forefront of managing return flows along the SC (Parsa et al., 2020), as TetraPak is doing in China and Brazil (Batista et al., 2019). However, the visibility of companies that activate reverse flows depends on the proximity to the consumer, which allows higher returns on investments in circular RL (Franco, 2017).

Figure 5 describes the actors involved in the circular return flows.

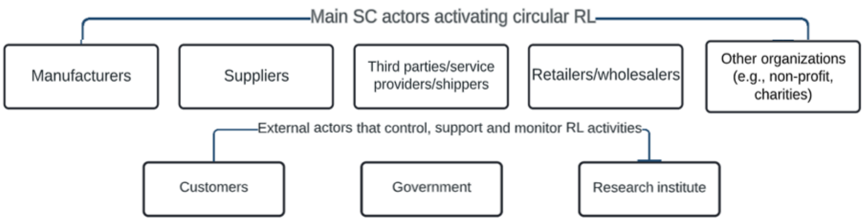

Figure 5: SC members involved in circular return flows.

6.4 The role of the SC structure

Product type, costs, level of uncertainty and market competition also influence the structure of circular SCs. Roy et al. (2006) categorize SCs as open to the market, vertical integrated with recyclers (hierarchical) or hybrid when the government externally coordinates and regulates the market.

However, there is still debate in the literature about the preferred structure of SCs. Specifically, whether collection should be performed directly or indirectly by a single firm or by several firms using common collection points in order to generate benefits and reduce pollution (Kazancoglu et al., 2021b). Research also argues for proximity to products and customers. Hvass & Pedersen (2019) state that it is more convenient to internalise recycling and remanufacturing activities (i.e. centralised structure).

Instead, Dutta et al. (2021) believe that outsourcing these activities to planning service providers or collection companies preserves the company's core business, creates economies of scale, and provides access to new technologies and expertise (Tombido & Baihaqui, 2021). Companies that outsource RL activities benefit from the sharing of resources, experience and costs (Cricelli et al., 2021).

Figure 6 summarizes the characteristics of the SC that influence the implementation of the CE principles within the RL processes.

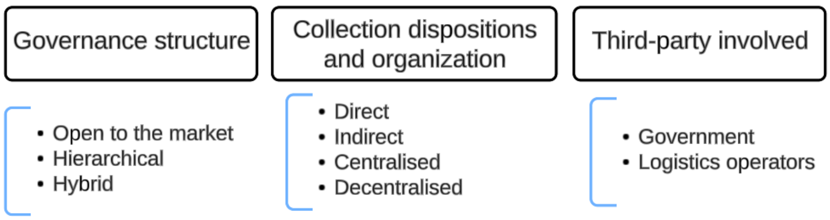

Figure 6: SC organization

6.5 The role of customers

Consumer preferences significantly drive business decisions in circular RL. Indeed, customers influence investment decisions in circular projects, remanufacturing and product life cycle extension. Recent consumer interest in the environmental impact of their consumption choices requires companies to be more transparent about the environmental costs of products and to move from a linear to a circular RL (Frei et al., 2020).

However, most consumers are unaware of the environmental costs associated with their purchasing choices and are often reluctant to buy remanufactured products (Van Weelden et al., 2016). The perception and willingness to pay for the latter compared to new products depend on price, sensitivity to discounts, risk, quality and functionality (Abbey et al., 2015).

Mugge et al. (2017) observe that longer battery life, guaranteed updates and improved performance positively influence the purchase of refurbished smartphones. On the other hand, distribution channel does not influence purchase decisions. Conversely, brand loyalty positively influences purchase intentions, especially for consumers who are new to refurbished products (de Vicente Bittar, 2018). Finally many other authors highlight the influence of personal, social, cultural and behavioural factors (Van Weelden et al., 2016) on consumers' willingness to return products for regeneration and to buy used and regenerated products.

Figure 7 summarizes the factors influencing consumer preferences for circular RL.

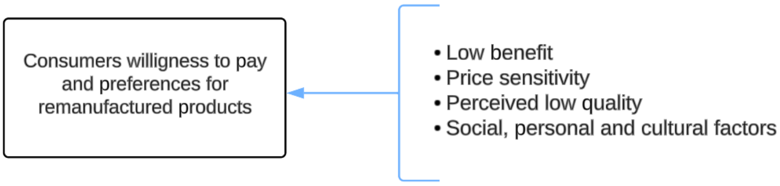

Figure 7: Factors affecting consumers’ preferences.

6.6 Strategies fostering the RL uptake

Packaging and modular design are some of the strategies that can be used to ensure product reusability, disassembly, recycling, and waste reduction (Frei et al., 2020). Authors also recommend innovative technologies to monitor return flows and predict demand for remanufactured products, careful planning of collection points, route optimisation and storage capacity (Krug et al., 2021).

Possible additional strategies to drive SC towards sustainability include sharing environmental visions, experiences and values with all SC members by publishing the results of circular RL or collecting feedback from customers on circular RL services (Ritola et al., 2022).

To engage customers, Govindan & Hasanagic (2018) recommend quality assurance for remanufactured products. Batista et al. (2019) suggest subsidies, information campaigns and education programmes to highlight the positive role of RL. While de Oliveira et al. (2019) suggest tax exemptions for remanufactured products and additional environmental taxes for new products. Kazancoglu et al. (2021a) and Kazancoglu et al. (2021b) suggest loans or grants to be given to companies as tools to support sustainability-oriented business models and investments in technologies and infrastructure. In addition, Howard et al. (2022) suggests servitisation or leasing strategies to promote ethical purchasing and consumption.

Figure 8 provides a summary of strategies that promote circular RL uptake.

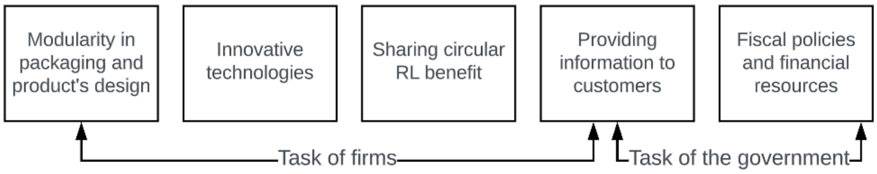

Figure 8: Strategies fostering circular RL

6.7 The role of the policy-maker

Friant et al. (2021) identified product life cycle management as the cornerstone of the European strategy to support green markets. Policies should include minimum environmental standards for manufacturing processes that incorporate circular economy (Kazancoglu et al., 2021a; Kazancoglu et al., 2021b; Khan et al., 2021). However, many authors criticise the current legislation and inadequate government action at both national and local levels (Cricelli et al., 2021). The high regulatory heterogeneity of e-waste disposal and material regeneration and reuse (Anastasiades et al., 2021) critically affects not only developing countries but also European countries (Waqas et al., 2018). The proposed legislative measures need to avoid market distortions, be effective and be based on financially sustainable business models (Whalen et al., 2018). However, regulations requiring data erasure from old devices make consumers more inclined to buy refurbished products (Rizos & Bryhn, 2022).

The environmental awareness of consumers and businesses affects the effectiveness of policies. Therefore, it is necessary to communicate the environmental impact of production processes and consumer choices through appropriate information campaigns (Govindan & Hasanagic, 2018). Figure 9 summarises the role of government and policy makers.

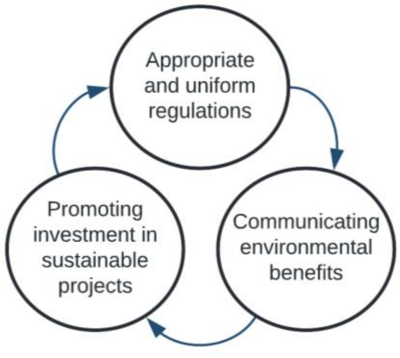

Figure 9: Policy makers' tasks

7 Conclusion

On the basis of our review of the literature we can conclude that circular RL is not suitable for all sectors because of the cost of implementation and the nature of the production processes and products. It is quite widespread in the textile and electronics industries, while in others, such as construction, food or pharmaceuticals, it is still poorly adopted.

It is also interesting to notice that only a few studies focus on sectors with a high potential for circular economy development, such as the automotive sector.

According to our review, technological innovation is an enabling factor for the successful adoption of circular RL systems. However, it requires significant investment, which is not feasible for smaller companies or for countries with less consolidated technological progress.

Collaboration along the SC is a key factor in successful RL, while proximity to the end user ensures visibility and return on investment. However, also the length of the SC and its organisational setting (e.g. outsourcing or direct collection of returns) have a significant impact on the success of circular RL.

Several articles highlight the driving role of consumer purchasing decisions in promoting the uptake of circular RL and creating a market for sustainable remanufactured products, which are however often constrained by perceptions, scarce information, personal and social attitudes of consumers. Many authors, therefore, conclude that it is up to the policy makers to define appropriate fiscal instruments to steer companies' strategies towards more sustainable RL processes and to guide consumers' choices through information and communication campaigns on the benefits of circular RL.

Our review systematises the literature on CE and RL according to eight analytical dimensions not yet explored, highlighting the lack of in-depth research on the role of SC members and the impact of the structure of the SC (short and vertically integrated vs. long) on the adoption of circular RL.

References

Abbey, J. D., Blackburn, J. D., & Guide Jr, V. D. R. (2015). Optimal pricing for new and remanufactured products. J Oper Manag, 36, 130-146.

Aria, M. & Cuccurullo, C. (2017) bibliometrix: An R-tool for comprehensive science mapping analysis. J Informetr, 11(4), pp 959-975, Elsevier.

Boulding, K. (1966). The Economics of Coming Space-Ship Earth. In: Environment Quality in a Growing Economy, Baltimore, John Hopkins.

Brito, M. P. D., Dekker, R., & Flapper, S. D. P. (2005). Reverse logistics: a review of case studies. In Distribution Logistics (pp. 243-281). Springer, Berlin, Heidelberg.

Crotti, D., & Maggi, E. (2021). Il ruolo della logistics social responsibility per la sostenibilità nella movimentazione delle merci. Rivista di Economia e Politica dei Trasporti, 1 (4), 1-23, 2282-6599

de Oliveira, C. T., Luna, M. M., & Campos, L. M. (2019). Understanding the Brazilian expanded polystyrene supply chain and its reverse logistics towards circular economy. J. Clean. Prod., 235, 562-573.

de Vicente Bittar, A. (2018). Selling remanufactured products: Does consumer environmental consciousness matter?. J. Clean. Prod., 181, 527-536.

Diaz, A., Schöggl, J. P., Reyes, T., & Baumgartner, R. J. (2021). Sustainable product development in a circular economy: Implications for products, actors, decision-making support and lifecycle information management. Sustain. Prod. Consum., 26, 1031-1045.

Dutta, P., Talaulikar, S., Xavier, V., & Kapoor, S. (2021). Fostering reverse logistics in India by prominent barrier identification and strategy implementation to promote circular economy. J. Clean. Prod., 294, 126241.

Flygansvær, B., Dahlstrom, R., Nygaard, A. (2018). Exploring the pursuit of sustainability in reverse supply chains for electronics, J. Clean. Prod., 189, 472-484.

Franco, M. (2017) Circular economy at the micro level: A dynamic view of incumbents' struggles and challenges in the textile industry. J. Clean. Prod., 168, 833-845.

Franklin-Johnson, E., Figge, F., Canning, L. (2016). Resource duration as a managerial indicator for Circular Economy performance, J. Clean. Prod.. 133, 589-598.

Frei, R, Jack, L, Krzyzaniak, S-A. (2020). Sustainable reverse supply chains and circular economy in multichannel retail returns. Bus Strategy Environ, 29(5), 1925-1940.

Friant, M. C., Vermeulen, W. J., & Salomone, R. (2021). Analysing European Union circular economy policies: words versus actions. Sustain. Prod. Consum., 27, 337-353.

Govindan, K., & Soleimani, H. (2017). A review of reverse logistics and closed-loop supply chains: a J. Clean. Prod. focus. J. Clean. Prod., 142, 371-384.
Hickey, P., Kamal, M. M., & Kozlovski, E. (2022). Viewpoint enabling circular supply chains in a high-tech manufacturing industry. J. Enterp. Inf. Manag..
Howard, M., Yan, X., Mustafee, N., Charnley, F., Böhm, S., & Pascucci, S. (2022). Going beyond waste reduction: Exploring tools and methods for circular economy adoption in small-medium enterprises. Resour Conserv Recycl, 182, 106345.
Hvass, K. K., & Pedersen, E. R. G. (2019). Toward circular economy of fashion: Experiences from a brand's product take-back initiative. J. Fash. Mark. Manag.
Julianelli, V., Gusmão Caiado, R. G., Scavarda, L. F., Pinto de Mesquita Ferreira Cruz, S. (2020). Interplay between reverse logistics and circular economy: Critical success factors-based taxonomy and framework, Resour Conserv Recycl, 158.
Kazancoglu, I., Sagnak, M., Kumar Mangla, S., & Kazancoglu, Y. (2021a). Circular economy and the policy: A framework for improving the corporate environmental management in supply chains. Bus Strategy Environ, 30(1), 590-608.
Kazancoglu, Y., Ekinci, E., Mangla, S. K., Sezer, M. D., & Kayikci, Y. (2021b). Performance evaluation of reverse logistics in food supply chains in a circular economy using system dynamics. Bus Strategy Environ, 30(1), 71-91.
Khan, S. A. R., Razzaq, A., Yu, Z., & Miller, S. (2021). Industry 4.0 and circular economy practices: A new era business strategies for environmental sustainability. Bus Strategy Environ, 30(8), 4001-4014.
Kumar, N. R., & Kumar, R. S. (2013). Closed loop supply chain management and reverse logistics-A literature review. Int. J. Eng. Res. Technol. 6(4), 455-468.
Martins, L. S., Guimarães, L. F., Botelho Junior, A. B., Tenório, J. A. S., Espinosa, D. C. R. (2021). Electric car battery: An overview on global demand, recycling and future approaches towards sustainability. Journal of Environmental Management, 295.
Merli, R., Preziosi, M., & Acampora, A. (2018). How do scholars approach the circular economy? A systematic literature review. J. Clean. Prod., 178, 703-722.
Mugge, R., Jockin, B., & Bocken, N. (2017). How to sell refurbished smartphones? An investigation of different customer groups and appropriate incentives. J. Clean. Prod., 147, 284-296.
Pigosso, D. C., & McAloone, T. C. (2021). Making the transition to a circular economy within manufacturing companies: the development and implementation of a self-assessment readiness tool. Sustain. Prod. Consum., 28, 346-358.
Piyathanavong, V., Garza-Reyes, J. A., Kumar, V., Maldonado-Guzmán, G., & Mangla, S. K. (2019). The adoption of operational environmental sustainability approaches in the Thai manufacturing sector. J. Clean. Prod., 220, 507-528.
Pokharel, S., & Mutha, A. (2009). Perspectives in reverse logistics: a review. Resour Conserv Recycl, 53(4), 175-182.
Prajapati, H., Kant, R., & Shankar, R. (2019). Bequeath life to death: State-of-art review on reverse logistics. J. Clean. Prod., 211, 503-520.
Rogers, D.S. and Tibben-Lembke, R.S. (1999). Going Backwards: Reverse Logistics Trends and Practices. Reverse Logistics Executive Council, Pittsburgh, PA
Roy, J., Nollet, J., & Beaulieu, M. (2006, January). Reverse logistics networks and governance structures. In Supply Chain Forum: An International Journal (Vol. 7, No. 2, pp. 58-67). Taylor & Francis.
Stock, J. R., & Lambert, D. M. (1987). Strategic Logistics Management. Homewood IL: Richard D. Irwin.

Stock, J.R. (1992). Reverse Logistics. Council of Logistics Management, Oak Brook, IL.

Tombido, L., & Baihaqi, I. (2021). Dual and Multi-channel closed-loop supply chains: A state of the art review. J. Remanufacturing, 1-35.

Viegas, C. V., Bond, A., Vaz, C. R., & Bertolo, R. J. (2019). Reverse flows within the pharmaceutical supply chain: A classificatory review from the perspective of end-of-use and end-of-life medicines. J. Clean. Prod., 238, 117719.

Waqas, M., Dong, Q., Ahmad, N., Zhu, Y., & Nadeem, M. (2018). Critical Barriers to Implementation of Reverse Logistics in the Manufacturing Industry: A Case Study of a Developing Country. Sustainability, 10(11), 4202.

Whalen, K. A., Milios, L., Nussholz, J. (2018). Bridging the gap: Barriers and potential for scaling reuse practices in the Swedish ICT sector. Resour Conserv Recycl, 135, 123-131.

Xu, X., & Yang, Y. (2022). Municipal hazardous waste management with reverse logistics exploration. Energy Rep., 8, 4649-4660.

Acknowledgement

Our paper and the related research have been conducted during and with the support of the Italian inter-university PhD course in sustainable development and climate change.

Author information

Authors and Affiliations

- Scuola Universitaria Superiore IUSS, Pavia, Italia; Università di Trieste, Dipartimento di Scienze Economiche, Aziendali, Matematiche e Statistiche (DEAMS), Trieste, Italia - *Marta Biancolin*
- Università Ca' Foscari, Dipartimento di Management, Venezia, Italia - *Luigi Capoani*
- Università di Trieste, Dipartimento di Scienze Economiche, Aziendali, Matematiche e Statistiche (DEAMS), Trieste, Italia - *Lucia Rotaris*

Contributions

Marta Biancolin: Data curation, Software, Writing – original draft, Writing – review & editing.
Luigi Capoani: Writing – review & editing.
Lucia Rotaris: Conceptualization, Methodology, Supervision, Writing – review & editing.

Corresponding author

Correspondence to Marta Biancolin
E-mail addresses: marta.biancolin@phd.units.it, marta.biancolin@iusspavia.it

Compliance with Ethical Standards

Authors disclosure that are directly related to the work submitted for publication.

Ethics declarations

Ethical Approval

This manuscript is only submitted to this journal.

Consent to participate.

Not applicable.

Consent to publish.

Authors consent to publish this work. No other participant involved.

Availability of data and materials

Due to space constrain only part of the bibliographic material has been listed, however authors are available to provide the complete references' list.

Statements & Declarations

Funding

Our paper and the related research have been conducted during and with the support of the Italian inter-university PhD course in sustainable development and climate change.

Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

ANNEX

Table A1: Main characteristics of the papers reviewed

Authors	Journal	Geographic area	Paper type	Data collection and analysis	Sector	Focus
Abbey et al. (2015)	J Oper Manag	U.S.	Empirical	Nationwide database - regression model	Electronics	Model to avoid demand cannibalization and optimal pricing for new and remanufactured products based on customers' preferences.
Anastasiades et al. (2021)	J. Clean. Prod.		Review		Construction	Conceptualization of regulations and policies on circular practices over time.
Batista et al. (2019)	Int. J. Prod. Res.	Brazil and China	Theoretical		Food	Conceptual analysis and comparative study of the reverse SC and circular initiatives implemented by Tetra Pak.
Berlin et al. (2022)	Resour Conserv Recycl	Sweden	Review		Steel	Analysis of the collaborations among SC's actors to control quality and efficiency in a circular framework.
Caldarelli et al. (2021)	J. Organ. Chang. Manag.	Italy	Theoretical		Textile	Assessment of barriers that hinder blockchain technologies adoption.
Cricelli et al. (2021)	Int. J.Prod Econ.	Germany	Empirical	Panel data from Community Innovation Survey – GSEM		Description of the domestic collaboration between competitors, customers, suppliers, and research institutions in a reverse logistics context.
Crotti & Maggi (2021)	REPoT		Review			Taxonomy of the existing logistics practices including sustainable packaging and storing.
de Oliveira et al. (2019)	J. Clean. Prod.	Brazil	Theoretical		Expanded polystyrene	Investigation on the main SC and reverse flow challenges.
De Vicente Bittar et al. (2018)	J. Clean. Prod.	U.S.	Empirical	Online Questionnaire in Qualtrix – ANOVA	Electronics	Definition of the key factors to boost remanufactured sales.
Debacker et al. (2017)	International HISER Conference		Theoretical		Construction	Opportunity and barriers identification related to two innovative solutions provided by the European project "Building as Material Banks".
Diaz et al. (2021)	Sustain. Prod. Consum.	Austria, France, Sweden, Netherlands, UK	Theoretical		Textile and electronics	Assessment of the R-strategies (refuse, reduce, repair, recycle, refurbish, recover, etc) in the process of sustainable product development.
Dutta et al. (2021)	J. Clean. Prod.	India	Theoretical			Ranking of the most relevant barriers to RL implementation in a development context.

Flygansvær et al. (2018)	J. Clean. Prod.	Norway	Empirical	Survey - PLS-SEM	Electronics	Definition of governance mechanisms and culture aspects that benefit the implementation of reverse flows.
Franco (2017)	J. Clean. Prod.	Austria, Switzerland, Germany, Italy	Theoretical		Textile	Conceptualization of the critical factors that affect the relationship between actors in circular SCs of small businesses.
Frei et al. (2020)	Bus Strategy Environ	Europe and UK	Theoretical		Textile, electronics, food	Assessment of the sustainable practices and CE initiatives.
Friant et al. (2021)	Sustain. Prod. Consum.		Theoretical			Overview of the European policies and actions on circularity.
Govindan & Hasanagic (2018)	Int. J. Prod. Res.		Review			Drivers and barriers to circular RL practices.
Hickley et al. (2022)	J. Enterp. Inf. Manag		Review			Circular practices in high-tech manufacturing sectors.
Howard et al. (2022)	Resour Conserv Recycl	Europe and UK	Theoretical		Food, textile, mobility.	SMEs' tools to plan and map the circularity and sustainability of SC activity.
Hvass & Pedersen (2019)	J. Fash. Mark. Manag	Scandinavia n	Theoretical		Textile	Challenges and solutions to circular business models.
Julianelli et al. (2020)	Resour Conserv Recycl		Theoretical	Taxonomy		Critical success factors to RL implementation.
Kazancoglu et al. (2021a)	Bus Strategy Environ	Turkey	Theoretical		Textile	Focus on legislative barriers that hinder the transition toward circularity of SCs in developing countries.
Kazancoglu et al. (2021b)	Bus Strategy Environ	Turkey	Empirical	Interviews – SD	Food	Estimation of the environmental impact due to RL activities in developing countries.
Khan et al. (2021)	J. Clean. Prod.	China and Pakistan	Empirical	Questionnaire – PLS-SEM	Chemicals, electronics, textile, paper and plastic	Examination of blockchain technologies to foster CE principles and RL practices.
Krug et al. (2020)	Int. J. Prod. Res.		Empirical	Assumptions – Two-stage programming		Definition of strategies to design a reverse flow of EOL products.
Martins et al. (2021)	J. Env. Manag		Theoretical		Electronics	Overview of the EV's batteries management.
Mugge et al. (2017)	J. Clean. Prod.	Germany, Netherland, UK, Swiss, French, Italy, Austria,	Empirical	Online questionnaire - Cluster analysis and stepwise regression		Rating of product features that impact customers' refurbished device choices.

		Russia, US, Australia.				
Ottoni et al. (2020)	J. Clean. Prod.	Brazil	Theoretical		Electronics	Responsibilities along a circular SC.
Parsa et al. (2020)	Int. J. Prod. Res.		Empirical	Assumptions – MILP		CLSC analysis with producers, retailers, suppliers and two recycling and collecting organizations.
Piyathanavong et al. (2019)	J. Clean. Prod.		Theoretical			Drivers and limits to CERL in developing countries.
Pushpamali et al. (2019)	Sustainability		Review		Construction	RL practices implemented within the construction sector.
Rajput & Singh (2021)	Int. J. Logist. Res. Appl.		Empirical	Assumptions – MILP		Appraisal of the integration between Industry 4.0, CERL to maximize products' life cycle.
Rejeb et al. (2022)	J. Clean. Prod.		Review			Technologies adoption to foster the circularity of SC.
Ritola et al. (2022)	The International Journal of Logistics Management		Theoretical		Electronics, textile	Conceptualization of a model to manage CLSC and product return.
Rizos & Bryhn (2022)	J. Clean. Prod.	Europe	Theoretical		Electronics	Policies analysis on e-waste management.
Roy et al. (2006)	Supply Chain Forum: An International Journal	Canada	Theoretical		Recycled paint and paper, beer bottles and used tyres	Comparison between different SC structure organization.
Stål & Jansson (2018)	Sustain Dev	Sweden	Theoretical		Textile	Description of sustainable reverse practices adopted by firms.
Tombido & Baihaqui (2022)	J. Remanufacturing		Review			SC organization to implement RL and CLSCs.
van Weelden et al. (2016)	J. Clean. Prod.	Dutch	Theoretical		Electronics	Definition of factors influencing the consumer's acceptance of refurbished electronic devices.
Viegas et al. (2019)	J. Clean. Prod.		Review		Pharmaceutical	Summary on RL initiative along the pharmaceutical sectors.
Waqas et al. (2018)	Sustainability	Pakistan	Theoretical			Barriers and strategies to implement RL in the manufacturing industry in developing countries
Whalen et al. (2018)	Resour Conserv Recycl	Sweden	Theoretical		Electronics	Impact of policy-maker decisions on firms' strategies and business models' design.
Wijewickrama et al. (2021)	J. Clean. Prod.		Review		Construction	Solutions to overcome information lacking problems to enhance information sharing within circular SC.

Table A2: Papers reviewed by dimensions addressed

	Dimensions						
Authors	**Sector**	**Technology**	**SC members**	**SC structure**	**Customers**	**Strategies**	**Policy-makers**
Abbey et al. (2015)					x		
Anastasiades et al. (2021)	x						x
Caldarelli et al. (2021)	x	x					
Cricelli et al. (2021)			x	x			x
de Oliveira et al. 2019						x	
De Vicente Bittar et al. (2018)					x		
Debacker et al. (2017)			x				
Diaz et al. (2021)	x						
Dutta et al. (2021)				x			
Flygansvær et al. (2018)	x		x				
Franco (2017)	x		x				
Frei et al. (2020)	x				x	x	
Friant et al (2021)							x
Govindan & Hasanagic (2018)						x	x
Hickley et al. (2022)		x					
Howard						x	
Hvass & Pedersen (2019)				x			

Julianelli et al. (2020)		x					
Kazancoglu et al. (2021a)	x					x	x
Kazancoglu et al. (2021b)	x			x		x	x
Khan et al. (2021)		x					x
Krug et al. (2020)						x	
Martins et al. (2021)	x						
Mugge et al. (2017)					x		
Ottoni et al. (2020)			x				
Parsa et al. (2020)			x				
Piyathanavong et al. (2019)		x					
Pushpamali et al. (2019)			x				
Rajput & Singh (2021)		x					
Rejeb et al. (2022)		x					
Ritola et al. (2022)						x	
Rizos & Bryhn							x
Roy et al. (2006)				x			
Stål & Jansson (2018)	x						
Tombido & Baihaqui (2022)				x			
van Weelden et al. (2016)					x		
Viegas et al. (2019)	x						
Waqas et al. (2018)	x						x
Whalen et al. (2018)							x
Wijewickrama et al. (2021)			x				