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Innovation and the circular economy: A systematic literature review

Nathalia Suchek[1] | Cristina I. Fernandes[1,2] | Sascha Kraus[3] | Matthias Filser[4,5] | Helena Sjögrén[5]

[1]Department of Management and Economics & NECE Research Unit in Business Sciences, University of Beira Interior, Covilhã, Portugal

[2]Corporate Entrepreneurship and Innovation, Loughborough University, Loughborough, UK

[3]Faculty of Economics & Management, Free University of Bozen-Bolzano, Bolzano, Italy

[4]ZHAW School of Management and Law, Zurich University of Applied Sciences, Winterthur, Switzerland

[5]School of Business and Management, LUT University, Lappeenranta, Finland

Correspondence
Helena Sjögrén, LUT University, School of Business and Management, Lappeenranta, Finland.
Email: helena.sjogren@lut.fi

Abstract

The circular economy emerged as an alternative model to the linear system, which now appears to be reaching its physical limitations. To transition to a circular economy, companies must not only be aware of but also engage in more sustainable practices. For such a transition, companies must rethink and innovate their business models and the ways they propose value to their clients while simultaneously considering environmental and social facets. This systematic literature review sought to map out from the company perspective the key topics interrelated with innovation and the circular economy, describing the internal and external factors to consider in such transition processes. Key lines of research were identified, and suggestions for future research and for facilitating movement toward a circular economy are provided. This work contributes to deepening the literature by identifying the priority areas concerning the circular economy and encouraging future research that meets international standards of excellence.

KEYWORDS
bibliographic coupling, circular economy, innovation, sustainability, systematic literature review

1 | INTRODUCTION

The current linear economic model based on “take-make-dispose” is reaching its physical limitations (Ellen MacArthur Foundation, 2015) amid estimates that the waste produced annually will reach 2.59 billion ton by 2030 and that this total will surge to 3.40 billion ton worldwide by 2050. The Agenda 2030 identified 17 Sustainable Development Goals (SDGs) that balance the three dimensions of sustainable development (economic, social, and environmental) and highlights how social and economic development also depends on sustainable management of the natural resources of our planet (United Nations, 2015).

Recognizing the fundamental role played by the environment, its functions, and its interactions with the economic system, the circular economy (CE) has emerged as an alternative to the neoclassical economic model (Ghisellini et al., 2016). The CE incorporates a regenerative system that minimizes the entry and waste of resources, emissions, and expenditure of energy through slowing down, closing, and straightening material and energy circuits (Geissdoerfer et al., 2017).

The CE provides a reliable structure for radically improving the current business model within the scope of developing preventive and regenerative eco-industry, as well as boosting well-being based on recovered environmental integrity (Ghisellini et al., 2016; Kumar et al., 2021). The Ellen MacArthur Foundation (2015) highlights how the transition to a CE involves a systemic change that seeks not only to reduce the impacts of the linear economy but also to construct long-term resilience and generate economic and business opportunities while returning environmental and social benefits. According to the foundation, three principles form the basis for the CE: (1) preserving and enhancing natural capital, controlling finite stocks, and balancing flows and renewable resources; (2) optimizing resource earnings through making products, components, and materials in use at the highest level of utility for the greatest possible length of time, in the technical cycle and the biological cycle; and (3) stimulating the effectiveness of systems by identifying and excluding negative externalities at the outset.

The CE cannot be obtained through attempts by individuals. Instead, the CE involves a systemic change in companies, industries, and economies through radical shifts in societal values, norms, and behaviors (Chizaryfard et al., 2020). Furthermore, the CE is intrinsically bound to environmental innovation in the way societies legislate, produce, and consume (Prieto-Sandoval et al., 2018). According to Kirchherr et al. (2018), cultural barriers, especially consumers' lack of interest and awareness and hesitant company cultures, constitute the most significant obstacles to companies advancing toward the CE, which leads to the understanding that the CE has yet to reach the mainstream. In turn, de Jesus and Mendonça (2018) maintain that the drivers of CE are essentially social, institutional, and regulatory factors. Simultaneously, technological and financial barriers may hinder the CE transition process. In this context, eco-innovations (EIs) are crucial to overcoming these barriers. Prieto-Sandoval et al. (2018) propose eight types of EIs for developing the CE: (1) business model, (2) network, (3) organizational structure, (4) process, (5) product, (6) service, (7) market, and (8) client involvement innovations. The authors suggest that these EIs make the shift in the paradigm to the CE visible. However, de Jesus et al. (2019) defend that systematic innovations, involving multidimensional policies, provide the most promising paths toward the transition to the CE.

Leading studies on this theme have also focused on business model innovation to secure the transition to this new economic model. Lewandowski (2016) identifies two components that should be added for circular business models: the *take-back* system related to reverse logistics and adoption factors, especially internal factors interrelated with organizational capacities for change to the CE business model, and external factors, which include technological, political, sociocultural, and economic issues. Innovation for circular business models inherently presents a high risk related to the traditional linear business models (Linder & Williander, 2017). According to Bocken et al. (2016), business model innovation closely aligns with product innovation for circularity. These authors propose several strategies for business model innovation and product design based on slowing down and closing resource cycles. Slowing down the resource cycle deals with the extended use of goods over time based on designing goods with longer lifespans and extensions to product lifespans, especially through service cycles to extend the working life of products, for example, through repair and remanufacturing. Closing resource cycles means reusing materials through recycling. Reducing the flow of resources associated with the product and production processes involves resource efficiency.

In addition, according to Konietzko et al. (2020), innovation ecosystems need to be further within the framework of CE and sustainability scenarios. Based on their results, these authors identified three main groups of principles for innovation in the circular ecosystem: collaborating, encapsulating the ways companies interact with other organizations to innovate in the direction of circularity, experimenting, and considering how companies may organize a structured process of trial and error to implement greater circularity and platforms, which relate to how companies may organize social and economic interactions through online platforms to obtain greater circularity.

In this perspective, in keeping with its emerging characteristics, research into innovation remains fragmented with diverse and different dimensions investigated. Previous systematic reviews focused on drivers and barriers to CE and the importance of EI in this transition (de Jesus et al., 2019; de Jesus & Mendonça, 2018; Kraus et al., 2017). However, the literature on innovation and CE has grown in keeping with the progress that the theme has made in going mainstream. Thus, this article maps the main research topics at the intersection of innovation and the CE, spanning a general view of the theme and identifying companies' internal and external factors during this economic transition process. Bibliographic coupling is used identify the main lines of research in the literature on innovation and CE within a broad scope and suggest topics for future research.

2 | METHODOLOGY

In order to achieve the objectives of this research, this systematic review made recourse to *VOSviewer* (Kraus et al., 2020; van Eck & Waltman, 2010) to undertake the bibliographic coupling process. Bibliographic coupling represents a method that applies a number of shared references between the two articles in order to measure their mutual similarities. Littell et al. (2008, p. 1–2) define systematic literature reviews as a "research that bears on a particular question, using organized, transparent, and replicable procedures at each step in the process." Observing the classifications of systematic reviews of the literature proposed by Paul and Criado (2020), we found that our investigation is part of the Method-based review. This type of systematic review aims to synthesize and extend a body of literature that uses an underlying methodology (either quantitative or qualitative).

In this systematic review, VOSviewer was used (Kraus et al., 2020; van Eck & Waltman, 2010) for bibliographic coupling. This process examines numerous shared references between two articles to measure their similarities. The greater the extent of the overlap in the articles' bibliographies, the stronger the articles' level of connection. Bibliographic coupling does not require accumulated citations and may be applied to new publications (which have not yet been cited), emerging fields, and less developed sub-fields (Zupic & Čater, 2015).

The systematic literature review protocol included three phases. In Phase 1, the Web of Science database was searched for the keywords "innovation*" and "circular econom*." Only articles written in English in the fields of Business, Management, and Economics were

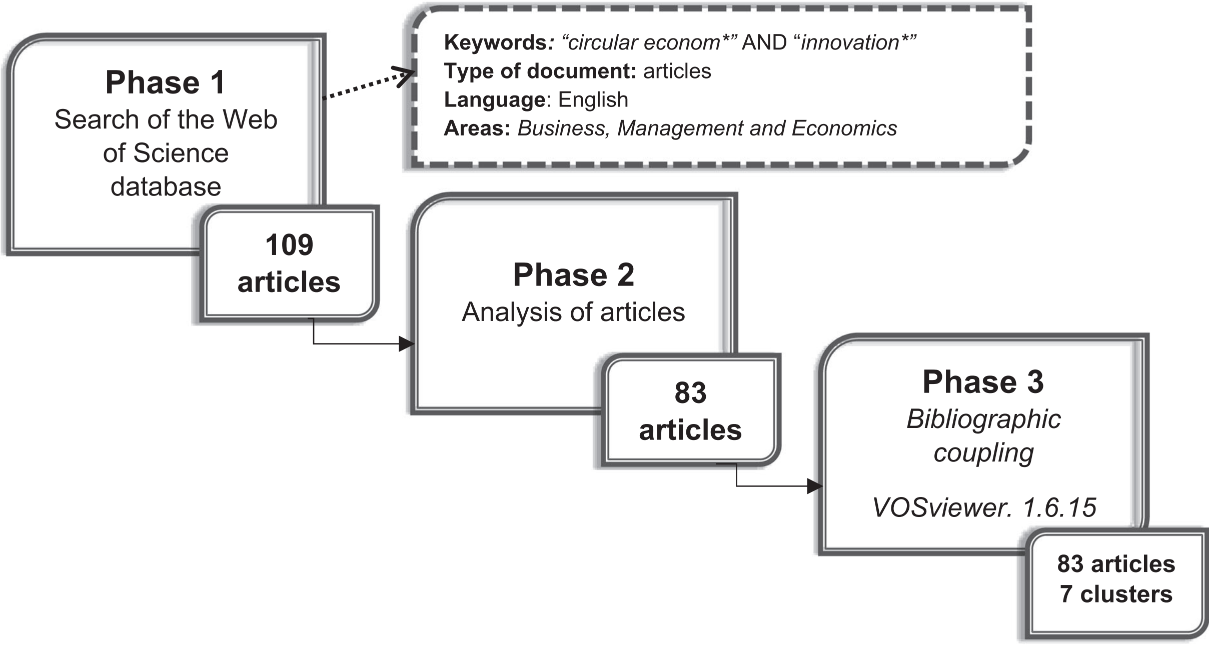

FIGURE 1 Structure of the systematic literature review approach

selected. The search took place at the beginning of November 2020, and 109 publications were returned. In Phase 2, the articles' titles and summaries were analyzed, resulting in 26 articles excluded due to their lack of relevance to the research topic. Finally, in Phase 3 VOSviewer software version 1.6.15 was used for bibliographic coupling. The research protocol is shown in Figure 1.

3 | RESULTS

3.1 | Descriptive analysis

Figure 2 presents the trends and fluctuations in the number of articles published annually. The first article was published only in 2016. Identification of and broader interest in innovation and the CE rose especially since 2018, when almost three times more articles were published than in 2017. This theme has been increasingly emphasized in every year since.

The 83 articles were published in 43 journals. *Business Strategy and The Environment* had the most articles, 16. Next is *Ecological Economics* with five articles, then *California Management Review* and *Forest Policy Economics*, both with four articles. In general terms, 12 journals contain three or two articles, and 27 journals included only a single article on innovation and CE. Figure 3 presents the number of articles published annually in each journal.

3.2 | *Analysis* of bibliographic coupling

To identify the main research themes in innovation and CE, we carried out bibliographic coupling of these documents with VOSviewer. All articles were analyzed irrespective of the number of citations given that 39 of the 83 articles were published in 2020, and excluding uncited articles might lead to excluding relevant articles from the study. This process attributed a minimum of three articles per cluster. The 83 articles formed a total of seven clusters. The cluster network is shown in detail in Figure 4.

Table 1 displays the composition of the clusters. Each cluster corresponds to a different approach: (1) Strategic alliance for innovation in the CE; (2) innovations in CE transition business models; (3) factors influencing EI- and CE-focused implementation; (4) dynamic company dynamics and CE implementation, value creation in the Indian fashion sector, and transformational agents; (5) technology and waste management; (6) transition to the CE, the necessary resources and internal capacities, and benefits of clusters; and (7) biological cycle and competitive advantage in clusters. The main contributions of the authors in each cluster are described below.

3.2.1 | Cluster 1: Strategic alliances for circular economy innovation ($N = 20$)

In this cluster, 20 studies contribute evidence for the inherent need for cooperation and collaboration among stakeholders to foster innovation and advance the CE. Some studies also discuss the logics of Business to Business (B2B) value creation, aspects related to consumers, and opportunities in the post-COVID-19 pandemic period.

Skawińska and Zalewski (2018) describe how the implementation of the CE as a management sustainability model may take place through (1) strengthening the social capital deriving from different assets (such as trust, customs and values, solidarity, and cooperation)

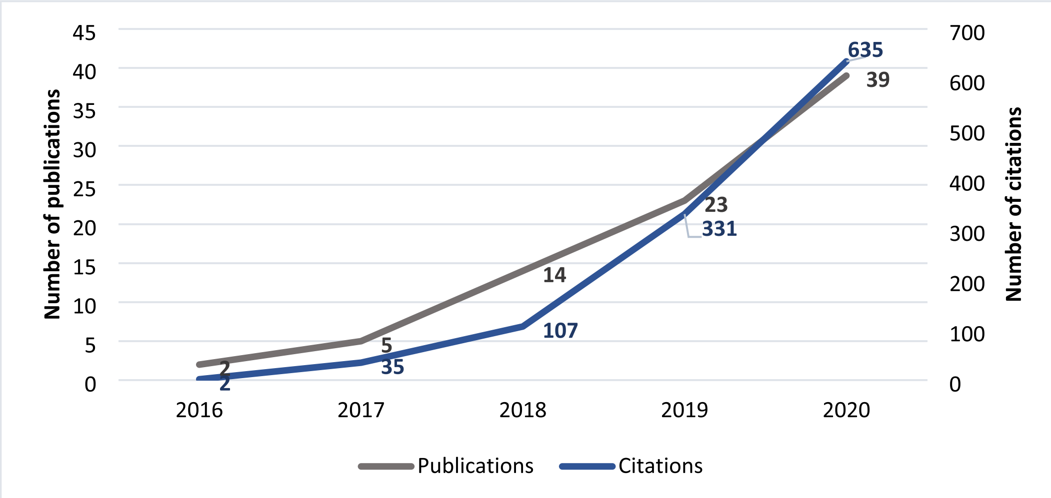

FIGURE 2 Annual growth in the number of publications on innovation and the circular economy (CE) per year [Colour figure can be viewed at wileyonlinelibrary.com]

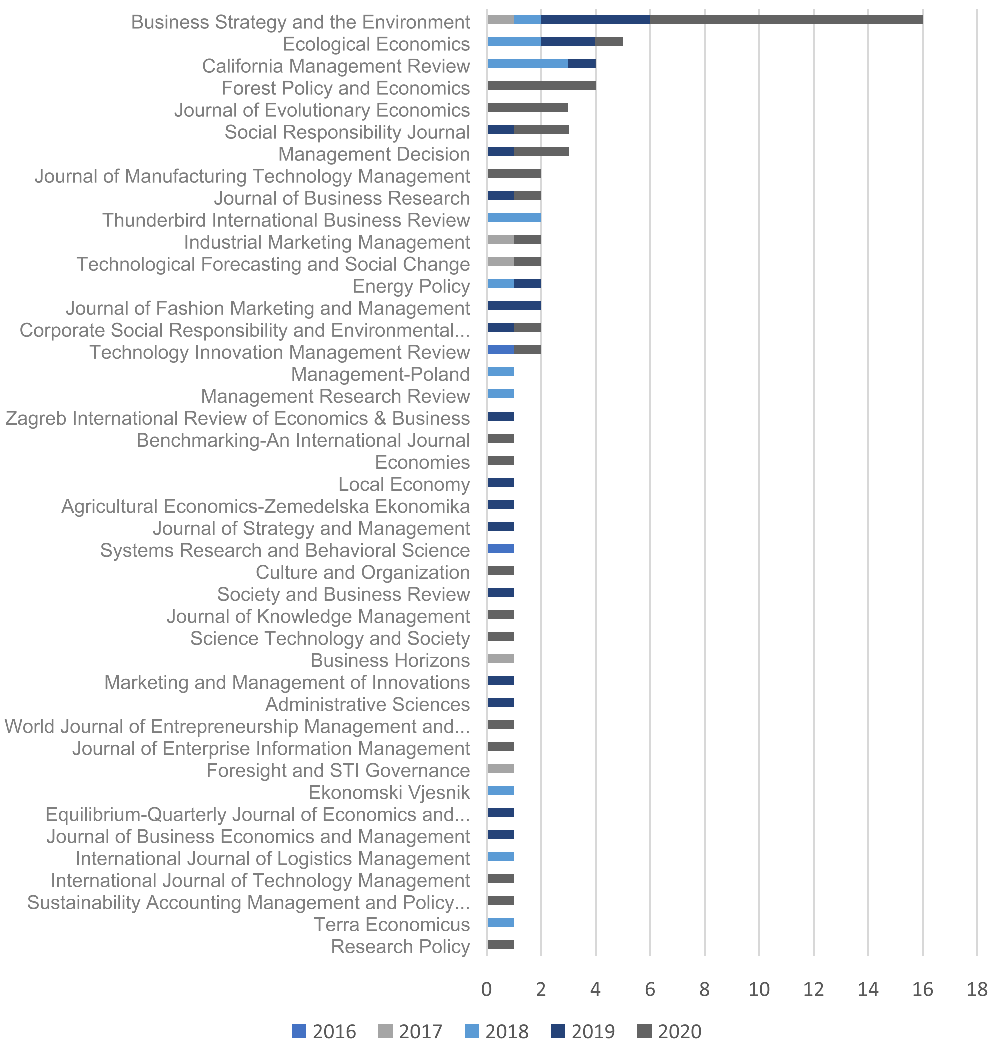

FIGURE 3 Number of publications by journal including the year of publication [Colour figure can be viewed at wileyonlinelibrary.com]

that require investment to improve, (2) establishing a preference system for managing resources in a circular approach to weaken the competitive advantages of linear management models, (3) fostering cooperation between suppliers and consumers and manufacturers and consumers within the framework of a shared and collaborative economy, and (4) establishing and promoting regulations for

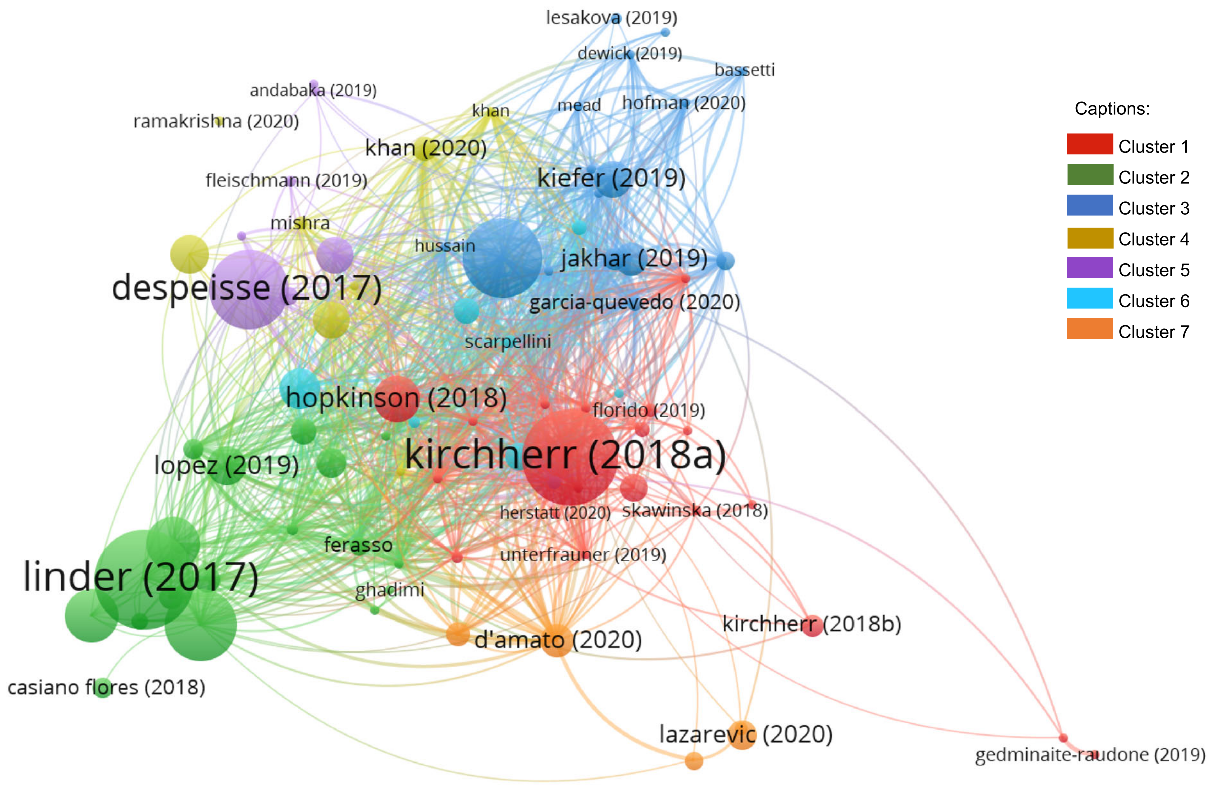

FIGURE 4 Cluster network [Colour figure can be viewed at wileyonlinelibrary.com]

protecting the natural environment, recycling charges for various types of waste, and product quality standards.

According to Hopkinson et al. (2018), individual companies may influence the conditions of the CE support system, establish standards to reduce costs and shape the prevailing levels of consumer awareness and customers' purchase decisions, and support regulation for remanufacturing and reutilization. Furthermore, managing circular business models involves designing for reutilizing and remanufacturing, operating services at scale, and automating to achieve these scales and reduce reverse costs.

Rajala et al. (2018) highlight that an ecosystem and collaboration among the different actors are needed for a closed-cycle economy to prosper. The authors identify three archetypes for closed-cycle systems (internal circuits, decentralized systems, and open systems) and then debate the implications of applying information generated by ecosystems to create new value creation opportunities for the business.

Kirchherr and Urban (2018) identify transferring and cooperating involving low-carbon energy technology as a factor in successful government policies as well as the appropriate capacities in the recipient countries. Furthermore, the authors verify a positive relationship between research and innovation activities and resource productivity in the European Union. Kirchherr et al. (2018) describe how the key barriers to the CE are related to cultural aspects, particularly consumers' lack of interest and awareness alongside a hesitant business culture. The drivers behind these barriers derive from market barriers that, in turn, result from the lack of government intervention to accelerate the transition to the CE. The authors also report that technological barriers do not rank among the most severe barriers.

Florido et al. (2019) identify the roles of the public administration and management entities of the destinations, the resident population, and the tourism sector in the CE transition process and thus, recognize the need for multi-level approaches to nurture innovations in business models for the CE. Sehnem et al. (2019) show how Natura, a leading company in the cosmetics sector, has sought out partnerships with startups to generate business with innovative firms. According to this company, sustainability is a driver of the CE and is measured by innovation, which helps establish a product portfolio that takes into account how demand among consumers changes constantly.

Gedminaitė-Raudonė et al. (2019) apply the quadruple helix model to analyze collaboration seeking intelligent specialization among stakeholders in the Lithuanian rural biogas sector. The results convey how collaboration for intelligent specialization encounters major difficulties due to the passive role of government institutions in the necessary collaborative processes. Furthermore, integrating a fourth section into the quadruple helix model (clients represented by non-government organizations) has been slow because companies lacks the knowledge to involve all the clients and business infrastructures available for this implementation task (Vilkė et al., 2020).

Unterfrauner et al. (2019) describe how actors in the Maker movement, through cooperation, share different types of knowledge, such as bio/recyclable raw materials, new production techniques, new equipment, new production and consumption standards, and new business models. Thus, the Maker space provides a unique

TABLE 1 Cluster contents

Cluster 1 ($n = 20$)	Cluster 2 ($n = 19$)	Cluster 3 ($n = 16$)	Cluster 4 ($n = 8$)
Chaurasia et al. (2020)	Antikainen and Valkokari (2016)	Bassetti et al. (2020)	Ghisetti and Montresor (2020)
Chizaryfard et al. (2020)	Bryant et al. (2019) Diaz Lopez et al. (2019)	Cainelli et al. (2020)	Goyal et al. (2018)
Confente et al. (2020)	Ferasso et al. (2020)	de Jesus and Mendonça (2018)	Hofmann and Jaeger-Erben (2020)
Cramer (2020)	Flores et al. (2018)	Demirel and Danisman (2019)	Khan et al. (2020a)
De Angelis (2020)	Frishammar and Parida (2019)	Dewick et al. (2019)	Khan et al. (2020b)
Florido et al. (2019)	Fulconis et al. (2019)	Durán-Romero et al. (2020)	Mishra et al. (2020)
Gedminaitė-Raudonė et al. (2019)	Ghadimi et al. (2020)	García-Quevedo et al. (2020)	Ramakrishna et al. (2020)
Herstatt and Tiwari (2020)	Holtström et al. (2019)	Hofman et al. (2020)	Zucchella and Previtali (2019)
Hopkinson et al. (2018)	Horvath et al. (2019)	Hojnik et al. (2017)	
Kirchherr and Urban (2018)	Hvass and Pedersen (2019)	Hussain et al. (2020)	
Kirchherr et al. (2018)	Kalverkamp (2018)	Jakhar et al. (2019)	
Maldonado-Guzmán et al. (2020)	Lardo et al. (2020)	Kiefer et al. (2019)	
Mathews (2020)	Laurenti et al. (2016)	Lesakova (2019)	
Rajala et al. (2018)	Linder and Williander (2017)	Mead et al. (2020)	
Ranta et al. (2020)	Parida et al. (2019)	Salo et al. (2020)	
Sehnem et al. (2019)	Shao et al. (2020)	Vokoun and Jílková (2020)	
Skawińska and Zalewski (2018)	Spring and Araujo (2017)		
Unterfrauner et al. (2019)	Todeschini et al. (2017)		
Vilkė et al. (2020)			
Völker et al. (2020)			
Cluster 5 ($n = 8$)	**Cluster 6 ($n = 7$)**	**Cluster 7 ($n = 5$)**	
Andabaka et al. (2019)	Järvenpää et al. (2020)	D'Amato et al. (2020)	
Bauwens et al. (2020)	Perey et al. (2018)	Korhonen et al. (2020)	
Despeisse et al. (2017)	Prieto-Sandoval et al. (2019)	Ladu et al. (2020)	
Fleischmann (2019)	Rattalino (2018)	Lazarevic et al. (2020)	
Garmulewicz et al. (2018)	Razminiene and Tvaronavičiene (2018)	Razminiene (2019)	
Harc (2018)	Scarpellini, Marín-Vinuesa, et al. (2020a)		
Martens et al. (2020)	Scarpellini, Valero-Gil, et al. (2020b)		
Sandvik and Stubbs (2019)			

opportunity for citizens to develop and experiment with ideas without the need for the considerable investment normally required to launch a product development cycle.

Chaurasia et al. (2020) suggest that to develop a vision for creating value to resolve sustainability-related problems open innovation in the configurations of the knowledge management system, organizational openness, and structure are necessary and require active participation, interaction and collaboration of manufacturers, retailers, and other interested parties. In this context, Cramer (2020) discusses the role of transition correctors as intermediaries orchestrating the processes of change and facilitating actors in the market, niches, and the regime to achieve high-level CE ambitions. According to Chizaryfard et al. (2020), transformation into the CE involves systematic complementarities across the micro-, meso-, and macro-levels. This includes circular tensions, such as ethical-normative behavioral, industrial-institutional, and technological-organizational tensions. Finally, transformation into the CE extends to the flow of basic inputs, such as energy, materials, economic value, and social value.

Mathews (2020), in turn, approaches the issues around intelligent green platforms that emerge from the interactions between the development of business models equipped for IT (which are platform business models that capture open code and network effects as well as the functioning of complementary aspects) and specific green initiatives, such as investments in renewable energies and CE-focused initiatives. The expansion and spread of green platforms explain green growth, that is, sustainable growth without increased resource production.

Ranta et al. (2020) analyze how B2B suppliers deploy their value propositions and then, identify four logics for creating value: (1) resuscitating the reduced value of resources and returning them to the market, (2) sharing the value of a single resource among various clients, (3) optimizing the value of a resource to a unique client, and (4) replacing traditional resources with new higher-value resources. The construction of each logic incorporates different combinations of sustainability-focused innovation alongside different configurations in the design features for client value propositions and highlighting alternative means of including, articulating, and signposting the different environmental and social facets. The value propositions for clients in the CE tend to turn toward the exterior and the market as they emerge from innovations that require active participation not only of direct clients but also of wider-reaching actors in the ecosystem.

Confente et al. (2020) explore how consumers perceive innovative products made of bioplastics. The high perceived value of bioplastic products drives greater intentions to purchase and exchange, and in turn, this value is too boosted by consumers' green self-identification. Consumers thus display their willingness to accept bioplastic products whenever there is clarification about the product value and the potential positive effects on the environment, and when the alignment between the characteristics of these products and consumers' personal values is emphasized.

Maldonado-Guzmán et al. (2020) examine the interdependence between EI and the CE and conclude that EI activities (thus, the EI of the products, processes, and management) carried out by companies that make up the Mexican automobile industry have a strong influence on activities integrated into the CE. Herstatt and Tiwari (2020) describe opportunities for frugal innovations, especially within the context of managing the collateral effects of the COVID-19 pandemic. According to these authors, financial sustainability, social justifications, reasonableness of the infrastructures, and environmental sustainability all are dimensions that must be considered in the search for technological excellence.

Völker et al. (2020) argue that the monitoring structure and the development of indicators, as in the case of European Commission policies, function as a collective local imagination in which the desirable “circular” futures undergo co-production. These futures should provide new opportunities for the private sector and generate employment and economic growth, while simultaneously improving the natural environment as measured by the environmental indicators selected.

Finally, according to De Angelis (2020), the CE becomes possible through multiple, cooperative, and simultaneous innovations across different scales within a broader socioeconomic context, involving regulation, policies, and production and consumption systems. Companies deploying the CE operationally may obtain sustained competitive advantage through innovative business models in which the circular principles applied to supply and relationships enable the creation, delivery, and capture of economic value, while ecological and social values accumulate for nature and for society.

3.2.2 | Cluster 2: Innovations in circular economy transition business models ($n = 19$)

Nineteen studies contribute to the literature on the process of transitioning from linear business models to circular business models through innovation for creating value. Antikainen and Valkokari (2016) propose a framework for sustainable circular business model innovation based on Canvas and emphasize the importance of systemic innovations considering various different levels in contrast to singular innovations in business models. The authors highlight the difficulties established companies face in redesigning their business models; therefore, recently launched firms may be more capable of disrupting and designing value chains (e.g., Airbnb and Uber).

Horvath et al. (2019) examine the trend for innovation in business models applied to the biotechnology sector and identify innovation processes in the sector aligned with CE practices, but how such efforts primarily result from new client demands in terms of tailor-made products and the search for competitive advantages. The authors also propose a business model based on Canvas for the pharmaceutical biotechnology sector.

Diaz Lopez et al. (2019) analyze resource efficiency measures (REMs) related to business model innovation. The authors report that supply-side REMs, such as cleaner production, control over pollution, and improvements in waste management, mostly interrelate with changes in the supply chain and internal processes. Demand-side REMs, such as the provision of services instead of products and reverse logistics management, interrelate mostly with changes in the value proposal. In addition, in many cases life-cycle REMs require a combination of changes in business models.

Ghadimi et al. (2020) analyze the main facilitators for successfully implementing green manufacturing by SMEs and confirm that their relationships with the chain of green advances represents the key facilitator for green manufacturing, followed by the costs of manufacturing and improved logistics installations. Laurenti et al. (2016) warn about the ricochet effects of implementing incremental innovations due to the rise in consumption that then drives increased extraction of raw materials, production, waste/pollution, and environmental impacts. The authors defend a change in regime to move toward a product-service system (PSS). Linder and Williander (2017) show how in practice the various different operational challenges set out in the literature can be overcome, therefore validating how a circular business model, that is, the PSS model, always incurs greater business risk than the corresponding linear business model. The validation of a circular model may take place only following the second complete cycle, and therefore, the resources remain exposed to risks for longer periods. Design strategies for reducing the risk of ownership may narrow the scope for business risk between linear and circular business models. Spring and Araujo (2017) debate product biographies and opportunities for rendering a service range in the CE.

Shao et al. (2020) investigate remanufacturing business models in the Chinese automobile sector and identify four stages for the models: recovering raw materials, managing used components, developing production, and marketing processes and technologies. The authors also identify another barriers to the process of remanufacturing automobiles, including political barriers and failures in government support, lack of consumer awareness, and issues about product quality and technology. Also in the field of remanufacturing, Kalverkamp (2018) points out how independent actors are essential to reverse chains, as these actors comply with the functions of commerce crucial to the CE and contribute to the competitiveness of the system in adapting to supply and demand in increasingly efficient approaches. Within the same scope, central actors may consider vertical or horizontal forms of collaboration such as cooperating regarding purchases.

Hvass and Pedersen (2019) conclude that the implementation of processes striving to make the CE transition in the fashion sector, especially through reverse logistics initiatives, drive innovation in the business model and related organizational change: the transformation of the value proposal, the role and involvement of the client, and the construction of new partnerships with interested external parties. Todeschini et al. (2017) highlight and describe the importance of the design strategy phase for the product, consumers' education levels, client expectations, and alignment of values throughout the supply chain for business model innovation in the fashion sector. Opportunities focused on corporate social responsibility (CSR), business models based on services, and monetization of the voluntary simplicity embedded in the drivers of sustainable innovation, such as upcycling and secondhand goods, are core factors for many of the successful business models analyzed. The authors stress the importance of startups to any transition in the fashion industry toward a CE model and alongside the need for collaboration with incumbent players for any truly successful transition, in keeping with the position taken by Antikainen and Valkokari (2016).

In the same sector, Holtström et al. (2019) identify core aspects of sustainable business model innovations, focused on the PSS model: (1) the external environment plays an important role in ensuring sustainable consumption thrives and prospers as an alternative to traditional consumption; (2) clients' attitudes and behaviors; (3) the perseverance of the actors involved, as well as the political and legislative actors in their support for developing markets appropriate for sustainable business models; (4) advantages of the value proposition; (5) development of technological solutions, and (6) quality, based on the functioning of the products and reliability and ease of services.

Frishammar and Parida (2019) propose a structure for transforming the linear business model that spans four phases: (1) launching the transformation of the circular business model through identifying opportunities, (2) auditing the current business model, (3) designing and developing a circular business model, and (4) scaling up the business model, thus, validating and implementing the new circular business model. Although an incumbent firm might play a central role and coordinate the efforts, the incentives need aligning among companies in a strategy of mutual gains that encourages all companies to make contributions. Parida et al. (2019) focus on understanding how large incumbent manufacturing companies orchestrate the transformation of the entire ecosystem to the CE paradigm, indicating how the ecosystem leaders are fundamental for implementing CE principles. After evaluating the ecosystem, major companies may use the standardization, negotiation, and input mechanisms to influence other ecosystem actors to engage in the transition to a CE model.

According to Lardo et al. (2020), to achieve success in the transition to sustainable business models aligned with Industry 4.0, major corporations require integrated thinking to underpin their management decisions and make approaches to co-creators of capacity suppliers in association with open innovation processes. These capacity suppliers are specialist companies in planning, developing, launching, managing, and growing Internet of Things (IoT) solutions, point-to-point based on intelligent, interoperable, interconnected, and pre-connected technologically entitled capacities.

Flores et al.'s (2018) results strengthen the role of government policies in innovation in CE business models in the water sector. In this context, the government demands negotiations and agreements with the industrial sector, and a lack of trust potentially is a crucial factor in this process. In the energy sector, Bryant et al. (2019) identify how many government strategies incorporate awareness of the need for innovative circular business models, but a weakness between the rhetoric applied in discourses and the "how" behind private business entities' implementation of circular business models remains.

Fulconis et al. (2019) introduce the concept of frugal chains of production, especially within the CE context, from the perspective of companies, consumers, and public management. Finally, Ferasso et al. (2020) carry out a systematic literature review of business models and the CE based on key interrelated themes identified: product, technology, industry, strategy, and sustainability.

3.2.3 | Cluster 3: Factors influencing EI and circular economy-focused implementation ($n = 16$)

In this cluster, 16 articles contribute to a better understanding of the drivers, barriers, and necessary capacities for the implementation of EI by companies focused on the CE. The articles in this cluster also discuss the application of CE-focused EI and the different types of EI.

Kiefer et al. (2019) explore internal factors, especially different resources, competences, and capacities (RCCs), as drivers of and barriers to different types of innovation. The authors identify the greater or lesser relevance of RCCs as motivators depending on the type of EI and how RCC determinants of radical and systemic EI differ from those for continuous improvement of EI. The results suggest that physical RCCs, involvement in green supply chains, and EI-favorable corporate culture, technology, and the attraction of markets and internal financial resources are drivers. Cooperation, organizational learning, International Standard Organization (ISO) ecological certification, and technological dependence are barriers.

Hojnik et al. (2017) explore the relationships between the EI of products, processes, and organizations and the efficiency of Slovenian companies, irrespective of their efficiency levels, from the dynamic capacities point of view. The authors conclude that the most innovative companies display higher levels of EI, and that the EI of these companies, their processes, and organization lead to greater business efficiency. Based on innovative capacities, Jakhar et al. (2019) explore the pressures of interested parties as drivers of the CE and observe that for companies with exploratory innovative capacities, it becomes easier to adopt such CE-related practices because their structures are tailored toward adopting rapid changes.

de Jesus and Mendonça (2018) perceive that the CE drivers most quoted in the literature are planning, institutional and regulatory factors; economic, financial, and market factors; technological factors; and social and cultural factors. The most frequently cited barriers are technological; followed by institutional and regulatory; economic, financial and market; and finally, social and cultural barriers.

García-Quevedo et al. (2020) explore five barriers perceived by different Small and Medium Enterprises (SME) of which the main obstacles derive from regulatory issues and the lack of human resources. The authors report that companies engaging in EI through ecological design have a greater probability of understanding the barriers thrown up by human resources, expertise, finances, administrative procedures, and cost regulations as the most important.

Following an analysis of European Union companies, Cainelli et al. (2020) identify that environmental policies and drivers of green demand sustain the adoption of resource-efficient EI. This influence primarily shapes innovation related to product recycling and to post-usage, while innovations related to reductions in consumption of material supplies return a weaker level of evidence in terms of policy. In the United Kingdom, the regulatory conditions for extracted materials and other contextual conditions do not provide appropriate support to regenerative EI in the construction sector, as detailed by Dewick et al. (2019).

In the Chinese context, Hofman et al. (2020) analyze how collaborations between suppliers and clients aid in improving the EI of products and processes, and the institutional context influencing these relationships. The authors verify that regulatory pressures do not influence the collaboration of suppliers or clients toward innovation. However, community pressures have a positive effect on supplier collaboration, especially leading to process-based EI. Simultaneously, market pressures raise the level of client collaboration but these pressures do not strengthen product EI.

Salo et al. (2020) identify how internal stimuli motivate the textiles sector and the IT sector to adopt sustainability. The latter sector is also frequently stimulated by legislation. These results also reveal how the companies examined focus on technological innovation of products, and these innovations tend to be radical rather than incremental. In this context, ecological design tools emerge as important for fostering EI. Hussain et al. (2020) also highlight the importance of technological innovations for SMEs in the United Kingdom that carry out activities for converting waste into energy.

Demirel and Danisman (2019) examine the relationship between circular EI and the growth of SMEs, and identify how ecological design EI generates the most significant growth returns to SMEs. The authors also report how SMEs encounter a lack of economic justifications to integrate into the CE due to the high levels of investment necessary. Using a sample of Slovak SME, Lesakova (2019) analyzes the context of the country in setting out the challenges encountered by business owners and entrepreneurs, and the respective implications for managers and policy makers in Slovakia.

Vokoun and Jílková (2020) verify that Czech firms that deploy product EI experience an increase in sales and innovative services, while firms applying process EI do not gain any sales increases. In this context, urban locations report higher competitive pressures and lower sales of innovative goods and services in comparison with non-urban areas.

The findings of Bassetti et al. (2020) convey how environmental performance, measured in terms of environmental orientation and environmental innovation, positively impacts returns on assets and net equity. Furthermore, these returns depend on the capacity of green firms to generate the same revenue flows as their non-green counterparts but through less capital. This context frames how the adoption of CE practices is a means not only of improving the well-being of society but also of leveraging competitive advantages.

Mead et al. (2020) explore the factors that influence multinational corporations' adoption of sustainability-focused innovations. The authors detail how the implementation of these innovations depends on the stage of corporate sustainability, the vision that nature constitutes a key interested stakeholder rather than a bank of resources, leadership's support, experience in design, a network of external specialists involved in radical innovations, and interested parties and intermediaries in the supply chain. In this context, nature-inspired innovations appear as long-term investments in the development of organizational capacities rather than as a unique approach to innovation.

Durán-Romero et al. (2020) introduce the quintuple helix model to characterize stakeholders in the innovation ecosystem and propose applying CE principles to EI throughout (1) every phase of the manufacturing process, (2) the definition of cleaner energy sources and cleaner consumption patterns, (3) the use of products throughout each stage of their life cycles, and (4) the definition of technologies for recycling, reutilizing, and recovering materials and reducing waste, effluents, and carbon emissions.

3.2.4 | Cluster 4: Dynamic company dynamics and circular economy implementation, value creation in the Indian fashion sector, and transformational agents ($n = 8$)

Regarding companies' dynamic capabilities, Khan et al. (2020b) empirically demonstrate how they significantly facilitate the implementation of the CE, which consequently improves the companies' general performance. Companies identify CE-based opportunities through sensing, seizing, and reconfiguring (Khan et al., 2020a). These authors describe four activities for sensing CE opportunities: (1) monitoring the market and technological progress, (2) generating ideas,

(3) creating knowledge, and (4) experimental learning. Seizing capabilities to approach the opportunities include activities related to (1) strategic planning, (2) business models and governance, and (3) collaboration. In turn, the reconfiguration activities are (1) restructuring the organization, (2) advancing technologically, (3) integrating knowledge, and (4) adopting best practices. In this context, a life-cycle evaluation and R&D activities play an important role in identifying CE-based opportunities.

The capacity for financing is important for Ghisetti and Montresor (2020), who state that, in the case of European SMEs, self-financing capital and debt, also denominated by the authors as the usual means of financing, is fundamental for implementing CE practices. Hofmann and Jaeger-Erben (2020) conclude that the innovation in circular business models requires an intra-organizational experimental space for testing, negotiating, reflecting on, and evaluating the new rules of the game for circularity. A successful balance incorporates (1) the adoption of a zooming-in/zooming-out approach, (2) effective moderation of heterogeneity, and (3) decision-making procedures based on a normative framework of reference for ecological performance enabling long-term circular business models to emerge.

In the fashion sector, according to Goyal et al. (2018), Indian companies' value creation requires planning for an integrated configuration of reverse logistics for collecting raw materials, followed by separating and transforming them into the product or service supply commonly involving the creation of an ecosystem for collecting discarded resources. For delivering and capturing value, companies need to design distribution channels and adopt different revenue flows in accordance with the respective target segment. Mishra et al. (2020) state that the main drivers of a closed value chain in the Indian fashion sector consists of collaborative networks, innovation, an effective waste management system, client education, and changes in utilization patterns. The authors suggest that in the context of weak regulatory pressures these motivations emerge from a discrete level toward the peripheral level, especially based on the entrepreneurial mentalities and visions that drive ethical business models.

Regarding transformational agents, Zucchella and Previtali (2019) maintain that companies with innovative business models may act as orchestrators of their ecosystem through their transformational leadership. The leaders create a governance model for the ecosystem, involving different types of innovation and close collaboration among network members. Ramakrishna et al. (2020) show how higher education institutions can and should play roles in the transformation of the economy to a circular model. Universities may provide cutting-edge research on Industry 4.0 that fosters adoption of CE practices, analyzes the concept from a theoretical perspective, and influences their students and stakeholders, such as the government, political entities, future generations, and the public.

3.2.5 | Cluster 5: Technology and waste management ($n = 8$)

This cluster deals with the role of technology, including three-dimensional (3D) printing and its application to recycling systems, and waste management issues. Three studies focus on the opportunities raised by 3D printing. According to Despeisse et al. (2017), the combination of 3D printing (3DP) with other disruptive technologies and emerging manufacturing systems, such as Industry 4.0, the Internet of Things, and new materials, is changing the industrial scenario in radical ways. The characteristics of 3DP align with the principles of sustainability and circularity and represent significant potential benefits for moving societies in more sustainable directions. Garmulewicz et al. (2018) detail how 3DP has intrinsic potential to change the existing manufacturing value chain as this technology enables local and small-scale production to become economically viable. Furthermore, 3DP provides clear opportunities for developing a cycle of recycling and manufacturing from local materials that returns benefits in terms of reducing landfill and emissions as well as generating local employment and value creation. Martens et al.'s (2020) results show how manufacturing company managers are adopting 3DP as a result of the potential competitive advantage provided by the technology rather than efforts to bring about market disruptions.

In exploring the motivators, inhibitors, and facilitators for establishing a textile recycling system in the Scandinavian fashion industry, Sandvik and Stubbs (2019) report that the main inhibitors are limited technology, the high costs of R&D and construction of support logistical structures, and the complexity of supply chains. Facilitators include design and use of new materials, collection of clothing, and collaboration. The authors suggest that production and recycling technologies may become more effective through applying 3D and digitalization technologies as they nurture transparency, testability, and automation.

Bauwens et al. (2020:6) elaborate on four scenarios for the future of the CE based on a 2 × 2 matrix in which the main factors of change are the types of technology in effect (high- or low-technology innovations) and the governance regime (whether centralized or decentralized). The scenarios identified, especially “planned circularity,” the “appropriateness of bottom up,” “circular modernism,” and “point-to-point circularity,” reveal that perceptions of the CE vary and contrast significantly, and with the concept, therefore requiring explaining and detailing before embarking on such efforts. The preferred scenario, point-to-point circularity, involves the development of reutilization and sharing practices for products facilitated by certain enabling technologies (1D printing, collaborative platforms) and with administration by multi-level institutions.

Regarding waste management, Fleischmann (2019) explores local council waste managers' points of view on CE practices and examines whether innovation based on design performs a role in the transition to such practices. This author defends that design-oriented innovations, applying methodologies such as design thinking, service design thinking, and co-creation, may assist managers to generate ideas and identify opportunities present in the CE.

Andabaka et al. (2019) identify the highest rates of economic growth and citizens' trust in EU institutions with the highest rates of recycling of urban waste that have positive impacts on EI in the EU. Considering that EI opens the way to the EU developing a CE, providing institutional support fostering EI activities and consumers' commitment to sustainable consumption practices and recycling are important factors driving systemic change in the current socioeconomic model. Harc's (2018) results show how the development of EI and the transition to a new economic model, efficient in its resource utilization, is in only the initial phase in Croatia. Furthermore, in countries such as Germany, the efficient regulatory structure, technological innovations, producer responsibilities for waste packaging, reduction of greenhouse gases, and consumer awareness of responsibility for recycling form benchmarks for waste management infrastructures.

3.2.6 | Cluster 6: Transition to the circular economy, the necessary resources and internal capacities, and benefits of clusters ($n = 7$)

In this cluster, the authors reflect on how companies go about the transition to the CE, the resources and internal capacities necessary for this process, and the benefits returned by clusters. Perey et al. (2018) analyze how organizations adapt their business models to obtain greater sustainability based on reconceptualization of the role of waste in their products and services. In exploring how companies achieve their economic, social, and environmental objectives while simultaneously adopting circularity, Rattalino (2018) confirms that the path in the direction of truly circular companies incorporates five innovation practices oriented toward sustainability: (1) changing the business models, (2) guaranteeing backing by senior management, (3) measuring and monitoring the sustainability performance, (4) understanding the willingness of clients to pay for sustainable products and services, and (5) collaborating effectively with stakeholders. Razminiene and Tvaronavičiene (2018) defend how clusters generate incentives for the CE as they add competitive advantages to companies based on the emergence of close cooperation, knowledge transfers, and the innovative solutions transmitted by the cluster.

Scarpellini, Marín-Vinuesa, et al. (2020a) verify that CE-related activities, especially adopting environmental management systems (EMSs), their environmental accountancy practices, and corporate social responsibility, amount to capacities that may also improve the environmental and financial performances of companies adopting CE structures. According to Scarpellini, Valero-Gil, et al. (2020b), through EMSs' assistance in identifying profitable opportunities for environmental sustainability–related innovation, these systems play an important role in implementing EI. Informal EMS tools, such as corporate governance and environmental management accountancy, return a higher degree of efficiency than formal measures, as informal tools reach beyond the level of circular EI to impact companies' CE performance indirectly, thus aiding them to deepen their closed material cycles.

Prieto-Sandoval et al. (2019) identify strategies, resources, and capacities for implementing the CE at SMEs and present them in accordance with their respective sector of activity: extraction, production/transformation, distribution, usage/consumption, recovery, and industrial symbiosis. The authors also detail dynamic capabilities with the objective of experiencing and shaping opportunities and threats, taking advantages of opportunities and maintaining competitiveness. According to Järvenpää et al. (2020), forecasting-based activities is fundamental to SMEs preparing for future CE-based opportunities; therefore, SMEs should remain attentive to information in their operating environments, for example, information from industrial associations, close relationships with consumers, and benchmarking with other competitors.

3.2.7 | Cluster 7: Biological cycle and competitive advantage in clusters ($n = 5$)

In this cluster, the studies delve into CE innovation by companies acting in the biological cycle of the economy and the competitive advantages of clusters. Lazarevic et al. (2020) analyze the functioning of innovation technology systems (ITSs) in the construction sector for various stories in wood structure and highlight the importance of creative destruction to destabilize the regime in effect, especially when the emerging ITSs encounter strong institutional regimes.

D'Amato et al. (2020) explore how bio-circular economy SMEs capture and deliver value, before the authors identify six archetypes of sustainable business models among Finnish bio-circular economy SMEs: their material and energy efficiency, valuation of wastes, recourse to renewable materials, environment and social sterility, sufficiency and frugality, and increase in sustainable solutions. In this context, strategic resources, such as raw materials, technological know-how, and partnerships, are fundamental for generating and delivering value.

Ladu et al. (2020) analyze the policy combinations that help development of a circular forestry bioeconomy. Strengthening environmental policies is a pre-condition for combining effective policies. Combining policies for mitigating climate change, such as sustainable forest management, R&D policies, and campaigns to raise awareness, shows the best performance in driving circular and innovative trajectories. Korhonen et al. (2020) confirm that to establish more sustainable patterns of production and packaging consumption and head in the direction of a bio-circular economy social and technological innovations are mutually necessary.

Finally, Razminiene (2019) puts forward a model for the competitive advantage of clusters and highlights how they may encourage and supply the conditions for SMEs to turn toward the CE while simultaneously gaining competitive advantages.

4 | DISCUSSION: FRAMEWORK FOR INNOVATION AND THE CIRCULAR ECONOMY

Based on the clusters identified through bibliographic coupling of 83 articles, the proposed framework for innovation and the CE (Figure 5) features the following core themes. In general terms, innovation in the CE depends on forming strategic alliances and taking

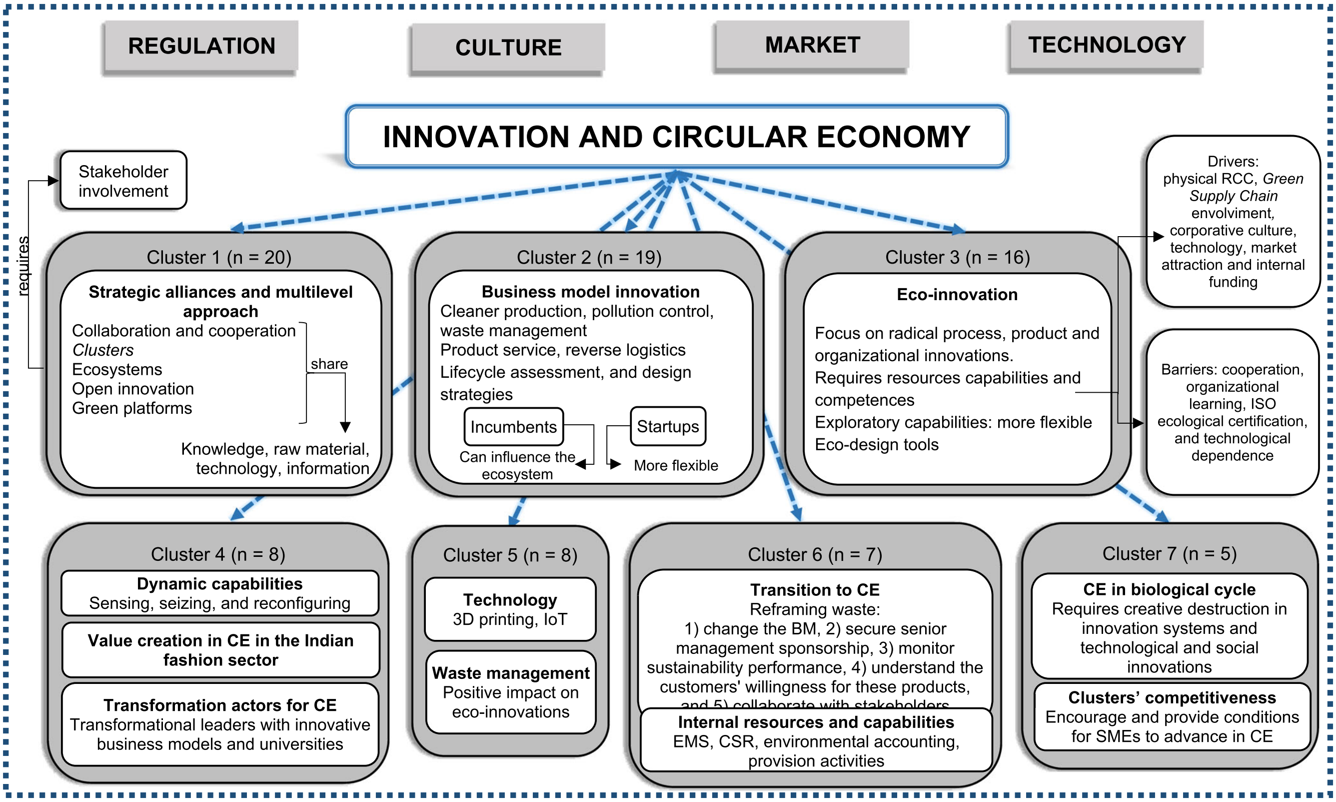

FIGURE 5 Framework for examining innovation in the circular economy [Colour figure can be viewed at wileyonlinelibrary.com]

a multi-level approach incorporating all interested parties. These alliances enable the sharing of knowledge, raw materials, technology, and information crucial for companies to establish the conditions to capture the opportunities and develop innovation within the scope of the CE.

5 | FINAL CONSIDERATIONS, LIMITATIONS, AND FUTURE LINES OF RESEARCH

We conclude that business model innovations provide a fundamental input for creating value in this new economic model. Cleaner production, pollution controls, waste management, a product-service logic, and reverse logistics are the main changes observed in the transition to circular business models. Tools such as evaluating the life cycle and ecological design are also high on the agenda. In this perspective, the business models of incumbent firms and startups differ. Incumbents may influence an ecosystem evolving into a CE, but they may also be less flexible than startups in capturing opportunities and developing radical innovations.

A fundamental dimension of the CE is EI. Radical innovations in products, processes, and organizations are necessary, as incremental innovation may be susceptible to rebound effects. To achieve them, companies need to be aware of the resources, competences, and capacities necessary that may, in turn, act either as barriers to or drivers of such processes. Companies deploying exploratory capacities in this context obtain greater success as they provide greater flexibility than companies applying exploitative approaches. Ecological design tools also frequently help develop EI.

Regarding the use of technology, the studies focus on 3D printing, the Internet of Things, and automatization and digitalization. Technology may aid in waste management which has a major impact on EI through turning waste into new sources of raw materials.

Any CE transition requires the re-signification of waste within the value chain. This transition requires changing business models, guaranteeing senior management's support, measuring and monitoring the sustainability performance, understanding client wishes for these innovations in products and services, and collaborating with interested parties.

Regarding studies of CE innovation, especially in the biological cycle, the literature reports on the need for creative destruction in innovation systems and technological and social innovations for establishing production and sustainable consumption patterns. Overall, all the topics have a relationship with regulatory issues, especially government regulation and incentive policies, and cultural and social questions within the scope of consumers' acceptance of innovative products and services and entrepreneurs' predisposition to target sustainable paths. These topics also interconnect with market-related issues, including availability and raw material costs, and technology, which very often come with extremely high costs that many companies are unable to access.

This work sought to identify the necessary conditions for advancing the CE through innovation. The number of articles in each cluster from bibliographic coupling demonstrates that the literature recognizes the importance of interactions among stakeholders, innovations in business models, and EI (clusters 1–3). However, other emerging topics, reflected in clusters 4–7, also deserve development, for example, exploring dynamic resource capabilities and the internal resources and activities necessary to capitalize on circular innovation opportunities. There is also the need to better understand the role of disruptive and emerging technologies in this process, as well as to understand the potential of waste management more deeply.

Furthermore, the literature reflects the need to expand research on innovation in the circular economy to all sectors given that many studies focus on the fashion and manufacturing sectors and sectors dealing with the biological cycle losing out in profile. There is the need to approach new companies and startups, as they may represent a more efficient and effective means of introducing radical innovations and identifying niche opportunities. In addition, in overall terms, the studies focus on European countries which leads to the need to explore other countries and contexts and conduct studies that capture the different terms of regulation, social and cultural conditions, markets, and technologies. The role of consumers in these sustainable innovations also requires deepening. Finally, longitudinal studies account for a priority within the framework of setting out the empirical results of organizations' adoption of circular economy innovations worldwide.

This article also identified internal company factors such as opportunities for waste management and implementation of ecological design tools and resources, competences and dynamic capabilities needed for opportunities for innovation in EC. Regarding external factors, emphasis is placed on involvement and collaboration with the different stakeholders and the regulation conditions. Based on the clusters identified, in Table 2, we list suggestions for future research.

This study maps the main topics in the literature at the intersection between innovation and CE-related themes, thus serving

TABLE 2 Suggestions for the future research agenda

Cluster	Suggestions for future studies
(1) Strategic alliances for innovation in the CE	• Introduce the quintuple helix model to research the interested parties and their interrelationships • Empirically explore the applications of the B2B value proposition in different sectors and geographic areas • Undertake empirical studies on digital platforms and intelligent products
(2) Business model innovations for the CE transition	• Research the business models introduced by startups and expand the understanding of how they capture and deliver value to their clients • Research the usage product biographies and their implications for service provision • Test Antikainen and Valkokari's (2016) proposed framework for sustainable circular business models • Expand the sample of studies measuring resource efficiency and changes in business models to encourage relationships
(3) Factors that influence EI- and CE-focused implementation	• Carry out studies focused on ecological innovations through collecting primary data • Map the resources and capabilities necessary to these types of eco-innovation
(4) Dynamic capabilities of companies and CE implementation, advances in the CE in the Indian fashion sector, and transformational agents	• Verify intra-organizational impacts generated by the innovation of business models • Develop studies on resources, competences, and dynamic capabilities in other countries and sectors • Explore the role of universities in promoting CE innovations
(5) Technology and waste management	• Research the application of disruptive technologies and industry 4.0 to the development of CE innovations in different sectors • Examine the interactions between organizations and waste management
(6) Transition to the CE, the necessary resources and internal capacities, and benefits of clusters	• Investigate the transition of different business model types as well as the internal resources and capabilities needed for each business model type
(7) Biological cycle and competitive advantage in clusters	• Expand the sample of companies examine in the bioeconomy sector • Map the bicircular economy ecosystem • Identify the specific resources, competences, and capacities (RCCs) of the sector • Investigate consumers' perceptions of and behaviors regarding innovative bioeconomy solutions • Continue to research government support policies for the sector

Abbreviation: CE, circular economy.

as a point of departure for future lines of research. The work differs from previous systematic reviews primarily through expanding and extending the temporal range of the articles analyzed and including a large number of recent articles that convey the rising prominence of this theme. However, the utilization of only one database represents a limitation that may have prevented the inclusion of relevant research studies.

ORCID

Sascha Kraus https://orcid.org/0000-0003-4886-7482
Matthias Filser https://orcid.org/0000-0002-1031-2820

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