



## Review

# How does circular economy work in industry? Strategies, opportunities, and trends in scholarly literature

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## ABSTRACT

The concept of circular economy (CE) has been a topic of interest for researchers, managers, and policy makers. It is recognised as the latest attempt to balance industrial development, environmental health, and economic growth. Although academic literature in this field has been gradually developing, it is limited in its analysis in terms of economic and competitive opportunity in the face of different strategies. This article provides a holistic view by mapping the literature on strategies-based EC for the economic competitiveness of companies through a systematic literature review supported on the co-citation bibliometric technique. To this end, 126 articles were selected and organised into 5 clusters: (i) strategic applications of CE; (ii) mediating factors for implementing CE strategies; (iii) drivers of CE strategies; (iv) determinants used to promote CE; and (v) emerging digital technologies used to enable CE practices. The results of this study help practitioners assess EC from a new point of view and design competitive strategies for a circular model without neglecting economic growth and competitive advantage, in addition to serving as crucial evidence for policymakers, helping them leverage policies to circumvent sustainability concerns and promote circularity. A future agenda for detailed cluster-based research is put forward based on the identified gaps, including a framework to help managers set priorities to escape the zero-profit trend associated with green and sustainable practices.

"The circular economy is a systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution." Ellen Macarthur's foundation

## 1. Introduction

Economic development has inevitably brought about resource depletion and environmental degradation (Švarc et al., 2022;

Mazzucchelli et al., 2022). As such, resource recovery from the waste stream has become important for a sustainable economy, ecosystem conservation, and reducing dependence on finite natural resources (Wainaina et al., 2020). In this sense, circular economy (CE) paradigm has increasingly gained prominence in academic, professional, and policy arenas around the world when addressing sustainability challenges through different circular strategies (Acerbi et al., 2021, 2022; Tura et al., 2019; Švarc et al., 2022). It has also received special attention in the fields of strategic management, operations management, and

**Abbreviations:** AI, Artificial Intelligence; BM, Business Model; CBM, Circular Business Models; CE, Circular Economy; CLSC, Closed-loop Supply Chain; CSC, Circular Supply Chain; CSCM, Circular Supply Chain Management; EI, Eco-innovation; IoT, Internet of Things; I4.0, Industry 4.0; LR, Literature Review; PSS, Product Service Systems; SBM, Sustainable Business Models; SC, Supply Chain; SD, Sustainable Development; SLR, Systematic Literature Review; SSC, Sustainable Supply Chain; WoS, Web of Science; WTE, Waste-to-energy.

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technology management (Sarkis et al., 2013; Centobelli et al., 2020). At this juncture, the field of research on CE-related innovations has expanded rapidly and significantly, resulting in an increased understanding of how new environmental technologies and practices enable companies to become more economically and environmentally sustainable (Acerbi and Taisch, 2020; Sarkis et al., 2013; Korhonen et al., 2018; Massaro et al., 2021). Management theories suggest that incorporating environmental practices into business operations can lead to sustainable competitive advantages and more integrated environmental and business value creation (Park et al., 2010). In practice, a firm's competitive advantage diminishes, as it depends on the stability of market demand and the ease of replicability and imitability that can be supplied through internal technological and organisational processes (Teecce et al., 1997). Nowadays, business success requires the creation of new products/processes and the implementation of new organisational forms and models (Linder and Williander, 2017; Lüdeke-Freund et al., 2019; Pieroni et al., 2019). In a CE, recycling and reuse are the main principle for designing and optimising products (Wainaina et al., 2020). Properly designed environmental standards can trigger innovation pay-offs, allowing firms to improve productivity and competitiveness (Bocken et al., 2014; McDowall et al., 2017). The challenges of balancing industrial development, environmental health, and economic growth motivate the recent use of resources and development strategies that include the application of the CE concept (Winans et al., 2017).

CE is a multidisciplinary approach that combines various strategies and technologies to promote social change towards a more sustainable future (Sonar et al., 2022). Beyond developing business strategies, sustainability requires firms to upgrade their technologies, production, products, skills, partnerships, supply chains (SC), and business models (BM) (Kaipainen and Aarikka-Stenroos, 2022). Simultaneously, to improve performance in a CE context, companies should strengthen SC, promote industrial symbiosis, and support remanufacturing reallocation and the circular transformation of design, production, and use (Acerbi and Taisch, 2020; Liu et al., 2022). These strategies allow firms to commit internally to adopt circular values and align externally with stakeholders who do not necessarily belong to the same supply chain (Acerbi et al., 2022). The BM represents the main lever used to implement CE at an organisational level (Geissdoerfer et al., 2020). This is proving to be a driver of competitiveness (Urbinati et al., 2017). Engaging with BMs and SCs can help companies increase profit, reduce costs, mitigate supply risks (Lüdeke-Freund et al., 2019), and sustain a competitive advantage (Pieroni et al., 2019). Furthermore, circular business models (CBM) can be used to enable industries to profitably increase resource productivity (Linder and Williander, 2017). They incorporate a triple-bottom-line approach, considering a wide range of stakeholder interests, such as the environment and society (Bocken et al., 2014). The closed-loop supply chain (CLSC) field is proving to be a high-value business tool, focusing on the profitable value of returned products (Govindan et al., 2015). In recent years, it has become evident that companies can benefit from the practical application of closed loops, such as business development, value creation, employment opportunities, improved profitability, cost reduction, and competitive advantage (Antonioli et al., 2022; Kumar et al., 2019). In particular, CE practices have been seen as a valid solution for generating wealth and have been adopted by companies by virtue of their implications when it comes to improving performance from both a market (Sonar et al., 2022) and a financial perspective (Mazzucchelli et al., 2022). However, some challenges hinder/delay implementation. These challenges pertain to

the scarcity of advanced technology, poor enforceability of legislation, weak economic incentives, inadequate management, and high financing costs (Su et al., 2013; Jaeger and Upadhyay, 2020; Kumar et al., 2019). Adopting CE as a future economic model requires immense environmental, economic, social, and legal efforts.

The timeliness of this paper can be evidenced in several ways. First, before embarking on an extensive systematic review, a thorough assessment was made of previous reviews included in our database that addressed the nexus between CE and strategies for business competitiveness – a set of keywords used as selection criteria, to understand the state of the art and identify gaps in the existing literature that deserve attention. The research conducted on this topic showed that, while there have been some attempts to systematise the literature on the CE phenomenon with some strategies for competitiveness – nine contributions – there has been, as far as we know, no attempt to organize the literature and establish a solid theoretical basis to collect the different circular strategies used for an economically competitive advantage of companies (Table 1). Most focused on analysing the introduction of circular philosophy to reduce waste, considering dynamic capability as a potential for companies to move towards a CE while constituting a source of competitive advantage (Seles et al., 2022). Other researchers (e.g., Hennemann and Sehnem, 2022; Liu et al., 2022; Silva and Sehnem, 2022) have focused on the interface between CE and digital technologies to implement circular strategies in SC. Kayikci et al. (2022) and de Angelis (2021) systematically investigated economic sustainability and concluded that while it is the best strategy for achieving the SDGs, there remains a lack of theoretical underpinning for aspects of competitiveness and profitability.

In light of this deficiency and, following the line of research left by de Angelis (2021), the fundamental aim of this research is advance the theoretical discussion by providing a holistic view of the existing literature on strategy-based CE for firms' economic competitiveness – by categorising the main themes, mapping them and identifying used methods and knowledge gaps. According to the research objective of this study, the research questions are: RQ<sub>1</sub>: What CE strategies exist? RQ<sub>2</sub>: What opportunities arise for companies as a result of CE strategies? RQ<sub>3</sub>: What are the main research themes, geographical scopes, methodological approaches, and industries in the field of CE research? By addressing RQ<sub>1</sub> and RQ<sub>2</sub> it is intended to develop a conceptual reference model to be adopted by the industry.

Companies strive to reduce costs, maximise profits, and improve competitiveness. However, there is an urgent need for firms to streamline green practices. Can CE strategies offer such opportunities? This article aims to find out by helping to facilitate the development of organisational policy and strategy guidelines that promote the implementation of CE to target sustainable development (SD) and economic growth while maintaining a competitive advantage.

To synthesise the literature in this area and broaden our understanding of the field of study, it was deemed pertinent to adopt a systematic literature review (SLR) approach, combined with a bibliometric analysis. Following the guidelines of Kiessling et al. (2021) and Dabić et al. (2020), the first step in outlining a research area is to select relevant articles to include in the analysis. After searching the Web of Science (WoS), 259 documents were collected. Subsequently, the co-citation bibliometric technique was applied – for providing a sustained picture of the intellectual structures of the topic – using VOSviewer software, returning us a sample of 126 articles.

Another literature reviews on CE highlighting the relevance of the research is present in the Table 1.

**Table 1**  
Overview of previous systematic reviews.

Authors	Sample	Focus	Key Findings
Sadraei et al. (2022)	163 articles	Food waste in production processes.	There should be a closer relationship between people and food waste.
Marques and Manzanares (2022)	72 articles	Describe how the linear to circular shift not only leads to higher rates of resource savings, repair, and recycling, but also reshapes SC's governance dynamics and network structures.	The combination of biomimicry, CE, the push-pull dichotomy, and social network metrics provides a theoretical framework for the circularity of SC.
Kalemkerian et al. (2022)	22 articles	To investigate whether implementing the Green Lean strategy promotes the introduction of the circular philosophy to achieve sustainable production processes.	The introduction of the circular philosophy into the Green Lean methodology can be achieved by redirecting Green Lean from waste reduction towards a focus on value creation.
Hennemann and Sehnem (2022)	63 articles	Analyse studies that address the interface between CE and Industry 4.0 (I4.0).	When assessing the relationship between CE and I4.0, one should apply technologies to clean production; use blockchain and Bigdata in the circular supply chain (CSC); increase the impact of additive manufacturing on CE; understand how I4.0 technologies can support CE in the eyes of stakeholders; and discern the factors used to implement these theoretical fields in SC.
Kayikci et al. (2022)	76 articles	Investigating the drivers of sustainable supply chain (SSC) to achieve sustainable development goals (SDGs) in low and middle-income countries through stakeholder theory.	Economic sustainability is the best key factor fostering the achievement of the SDGs. This means that, without financial assistance and support, the achievement of the SDGs becomes ineffective.
Silva and Sehnem (2022)	52 articles	Analyse the adoption and implementation of I4.0 and integration with CE to minimize the effects of resource scarcity.	Digitisation, traceability, software as a service, digital solutions and shared platforms take the lead in the interface between CE and I4.0.
Liu et al. (2022)	174 articles	Identify which functions of digital technologies are most useful for improving CE and how these functions can be used to enhance CE strategies.	The researchers proposed a framework that reveals seven mechanisms of digital functions, along with each mechanism's level of maturity for achieving CE strategies.
Seles et al. (2022)	22 articles	To identify the facilitators of CE and analyse them against the theories on resources and dynamic capabilities.	Some enablers can be considered as resources or dynamic capabilities, in which they have the potential to help firms transition to CE. Moreover, they can be sources of competitive advantage.
de Angelis (2021)	22 articles	To analyse how CE is understood while reflecting on how to establish a paradigmatic	There are several definitions of CE, but each one describes the concept narrowly and does not incorporate

**Table 1 (continued)**

Authors	Sample	Focus	Key Findings
		anchoring of CE in the management field.	aspects of competitiveness and profitability.

This study contributes to literature in this field in several ways. Firstly, it contributes to the field of CE research that currently lacks a holistic survey of circular strategies as decisive factors for the economic growth and competitive advantage of firms' – regardless of the sector in which they operate. It also provides a theoretical framework on different CE strategies - based on theory and practice - discussing their contribution to the competitiveness of companies, considering their establishment at the levels of adoption, implementation and development of circular practices, as well as the influence of digital technologies in enabling CE practices. By analysing reflections and trends in literature on CE strategies, it contributes relevant data with regards to practices aimed at rational resource use and waste reduction that subsequently contribute to environmental, economic, and competitive performance. The identification of emerging topics in the field of CE from a strategically competitive perspective provides a potential contribution for future studies. The study also contributes to innovation, entrepreneurship, strategic management, business management, and technological development. With regards to management, it provides researchers, senior managers, and policy makers with knowledge for decision-making and a baseline assessment to improve business performance and secure a competitive advantage through circular initiatives. It also provides data that enables firms to understand how, by adopting a CE, a business not only maintains and increases the value of its economic output, but also decreases the impact of economic activity on ecological systems, i.e., with CE, maximum economic value can be achieved with zero adverse ecological impact.

The article is divided into seven sections. The introduction covers the framework of the theme, illustrates its relevance, and summarises previous systematic reviews. The following section summarises the methodology and procedure of the systematic literature review. The third to fifth section presents and discusses the results. In the sixth section, proposals for future research are made. It is concluded with the main conclusions and limitations of the study.

## 2. Research design

To answer the research questions, the researchers adopted a hybrid methodology, combining a systematic review with a bibliometric analysis (Abarca et al., 2020) using Biblioshiny software (Aria and Cuccurullo, 2017) from the Bibliometrix R v.4.2.1 package (R Core Team, 2021) and VOSviewer v. 1.6.18 (van Eck and Waltman, 2010). The systematic review approach provides a holistic view of the state-of-the-art (Adams et al., 2017), identifying gaps and trends for future research to examine (Paul and Criado, 2020; Kraus et al., 2022). Additionally, bibliometric analysis allows for uncovering the evolutionary nuances of a specific field while shedding light on the emerging areas of that field (Donthu et al., 2021).

In the article identification and selection process, in September 2022, the WoS database was resorted to using the search equation: TOPIC ("circular econom\*") AND ("strateg\*" OR "competitiv\*") – TOPIC corresponds to the title, abstract and/or keywords. After identifying the articles, an initial database of 4284 documents was obtained. Subsequently, to further ensure the legitimacy of the review, the analysis was limited to full articles published in journals with a peer review process and review articles from the categories of "management", "economics" and "business". In addition, we limited the sample to articles written in English and excluded conference proceedings and book chapters to enhance quality and cohesion. No restrictions were set on the year of publication, as this article aims to explore the field of

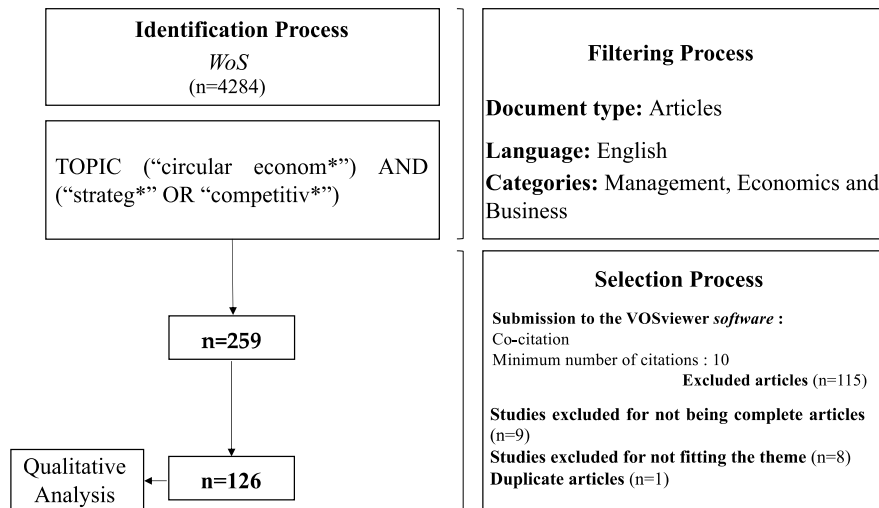


Fig. 1. Article selection process for qualitative analysis.

investigation. The sample included 259 documents later submitted to the VOSviewer software to create a concept map and co-citation network. In a co-citation network two publications are connected when they compete in the reference list of another publication (Donthu et al., 2021). The co-citation analysis provided us with a new base of 144 articles according to the references cited, which were distributed by five thematic groups. After detailed analysis, 18 documents were eliminated for not being full articles (n = 9) or for not responding to the study objective (n = 8), resulting in a final sample of 126 articles. One article was a duplicate. Fig. 1 presents the information arising from the article identification and selection phases.

### 3. Results

#### 3.1. Statistical data trends

In this point, standard dimensions of analysis, generally adopted in widely cited reviews (e.g., Acerbi and Taisch, 2020), are used to perform the statistics, particularly the year of publication, source, and authors.

Articles dealing with CE strategies for the competitiveness of companies were published between 2011 (1 article) and 2022 (143 articles), in which there was an explosion of contributions from 2017 (Fig. 2). Most papers (99.02%) contained in WoS were published in the last five years (2018–2022). Between 2021 and 2022, 73.36% of the papers were published. This distribution shows that the subject continues to arouse growing interest in the scientific community.

Table 2 lists the authors that have had the biggest impact in the field. Tiberius Daddi (Institute of Management, Sant’Anna School of

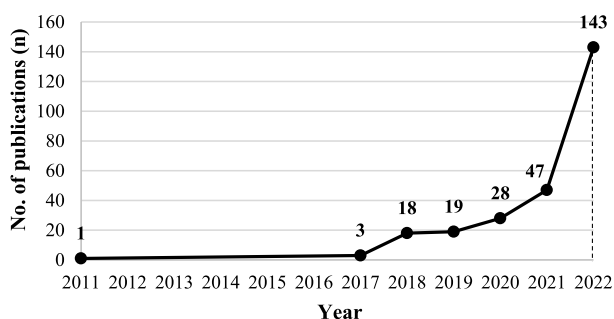


Fig. 2. Evolution of the number the articles per year.

Table 2

Top-5 most cited authors.

Author(s)	TC	NP	Py_start
Daddi, Tiberius	129	5	2019
Kumar, Pradeo	115	5	2020
Iraldo, Fábio	87	4	2020
Luthra, Sunil	116	3	2019
Mangla, Sachin	119	4	2019

Note: NP-number of publications, TC-total citations, PY-Start-the year in which first article on guilt was published.

Table 3

Top-10 most cited journals.

Source	Citations (n)	Impact factor	AJG 2021
Journal of Cleaner Production	2565	10.96	2
Business Strategy and the Environment	970	10.30	3
Resource, Conservation & Recycling	715	13.72	*
Sustainability	562	4.17	*
International Journal of Production Research	376	8.57	3
International Journal of Production Economics	355	7.89	3
Journal of Industrial Ecology	305	6.95	2
Ecological Economics	239	5.39	3
Journal of Business Research	236	7.55	3
Journal of Business Ethics	207	6.33	3

Note: \* is not in the AJG list. AJG, Academic Journal Guide.

Advanced Studies, Italy) and Pradeep Kumar (Mechanical and Industrial Engineering Department, Indian Institute of Technology Roorkee, India) have produced the most work in the field of CE strategies for business competitiveness. Their publications date from 2019 onwards. Both researchers have been actively contributing to the CE literature.

Table 3 presents the ten most cited journals, distributed according to their number of citations. Most of the journals considered publish on environmental and sustainability issues. The "Journal of Cleaner Production" occupies a place of prominence with an eminent disparity, having amassed 2.565 citations. The "Business Strategy and the Environment" journal published the most prolifically in this field of research, with 31.28% of the publications (n = 81) and a remarkable number of citations (n = 970). In third position is the "Resources, Conservation & Recycling" journal, with 715 citations.

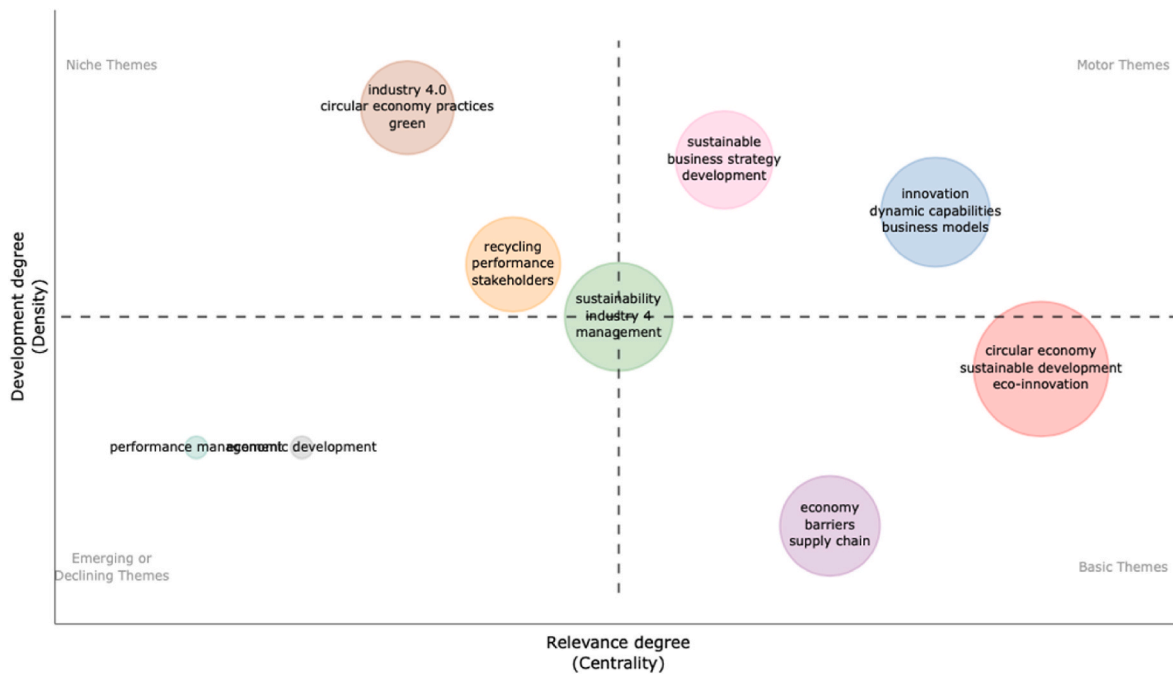


Fig. 3. Thematic map.

3.2. Thematic cartography

Fig. 3 presents the clusters, as defined by the keywords used in the articles, where the eigenvalues are used as weights. The size of the clusters, represented by the circles, indicates the number of articles each group has. The three most recurrent subjects are represented. The

clusters are spread out in four quadrants, determined by centrality and density. The analysis reveals that studies that discuss sustainable business strategies for the development of companies are driving themes allowing the research field to advance. Investigations that analyse the dynamic capacity of companies to innovate BM also facilitate the development of this field of research. The themes in the upper left

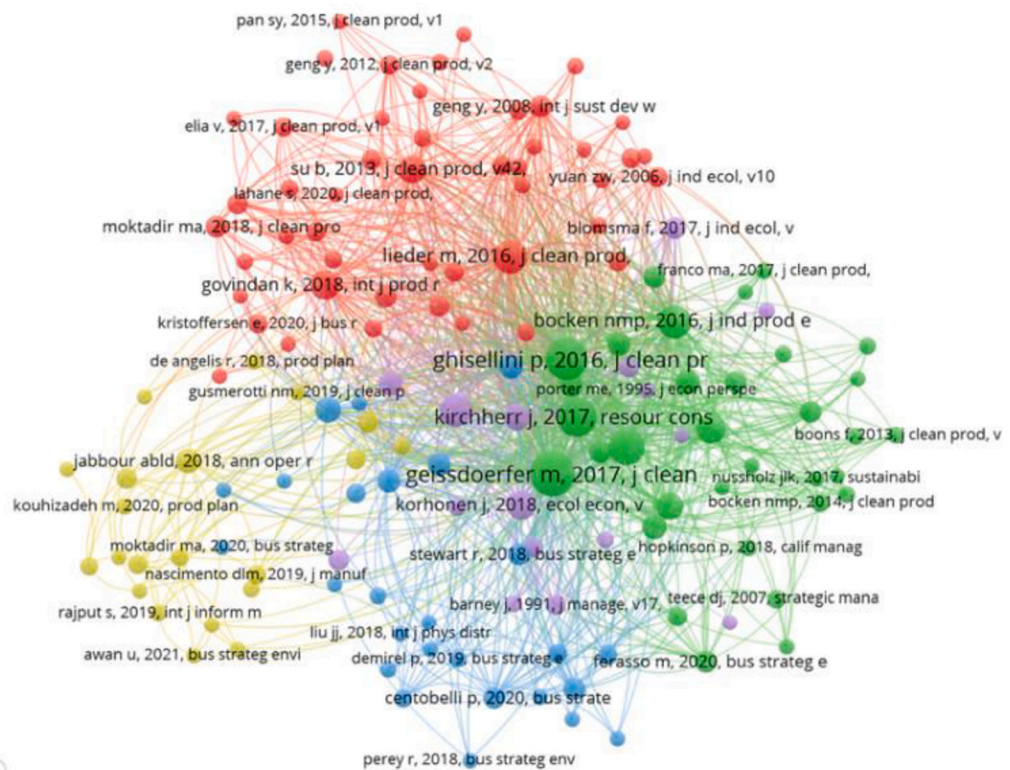


Fig. 4. Cluster network by co-citation.

quadrant, related to I4.0 for CE practices, present well-developed links. Issues related to CE and organisational development and performance are in the lower left quadrant. These represent emerging themes that may become driving themes. Finally, themes related to SC barriers and eco-innovation (EI) for SD are important to the research field but are not yet sufficiently developed.

### 3.3. Scientific mapping

In a second phase, to analyse the main themes of the CE literature from the perspective of strategies for the economic competitiveness of firms, it was decided to apply the bibliometric technique of co-citation of the references of the 259 articles. From its applicability and taking the minimum number of 10 citations as a reference, a new database of 144 articles was returned. The VOSviewer software produced the bibliometric map of the 144 documents that grouped them into five clusters formed by 7.703 links (Fig. 4): i) strategic applications of CE (cluster 1); ii) mediating factors for implementing CE strategies (cluster 2); iii) drivers of CE strategies (cluster 3); iv) determinants to promote CE (cluster 4) and v) emerging digital technologies to enable CE practices (cluster 5). However, only 126 were qualitatively analysed because 18 documents were excluded for being incomplete articles or not responding to the study objective.

## 4. Intellectual structure of the EC in the field of industry

To understand CE in more depth in the field of strategies to compete in the business market, it was important to explore four of its main features: key themes, geographic scope, industry and widely used methodologies. This practice has been used in recognised literature reviews published in flagship journals (Dabić et al., 2020; Obradović et al., 2021). To ensure the clarity and readability of the map, a parsimonious

approach was adopted by referring to a subsample of key articles. In this structure, only the ten most cited articles by each cluster (five thematic groups) were considered for discussion. Subsequently, a double-frequency boundary condition was adopted for topics and sub-topics to be shown on the map. Whenever the subtopics corresponded to more than one study per cluster, the article with the most citations was chosen. Fig. 5 presents the visual division of the main topics and sub-topics, where the notable references are presented. The remaining manuscripts are considered and explored in the following section.

For a more detailed analysis, Fig. 6 shows the most used topics and subtopics and their frequencies according to the key articles. For each category, the amount of articles using each main theme, geographical scope, industry and methodology can be seen. Since researchers grounded their research in more than one topic or subtopic, the frequency may be higher than 100% (e.g., papers that studied strategies to implement CE also used some indicators, including barriers, challenges, and opportunities).

### 4.1. Main research topics

This study aims to contribute to the existing literature on CE strategies in industry. The results presented in Fig. 5 outline numerous approaches categorised as: dynamic capabilities (Teece et al., 1997; Teece, 2007) to create wealth in a regime of rapid industrial and technological change; conceptualisation and characterisation of CE (Ghisellini et al., 2016; Kirchherr et al., 2017; Murray et al., 2017); relationship between CE and sustainability (Geissdoerfer et al., 2017; Hart, 1995); strategies, barriers and opportunities for transition (Bocken et al., 2016; Kirchherr et al., 2018) and implementation CE (Lieder and Rashid, 2016; Winans et al., 2017; Ormazabal et al., 2018; Suárez-Eiroa et al., 2019; Stewart and Niero, 2018); indicators (drivers, barriers, challenges) to develop CEs (Su et al., 2013; Kalmykova et al., 2018; Geng et al., 2012; Govindan

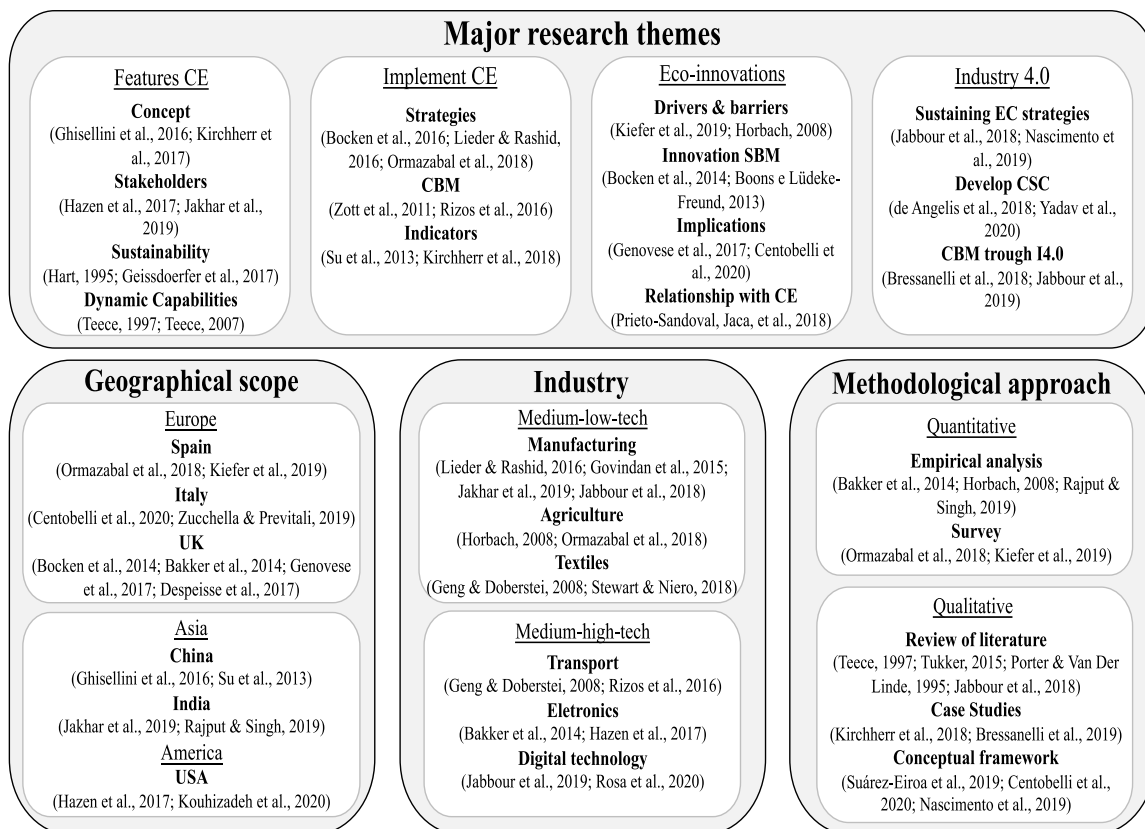


Fig. 5. Notable references on research trends in CE strategies, geographical scope, industry, and methodology.

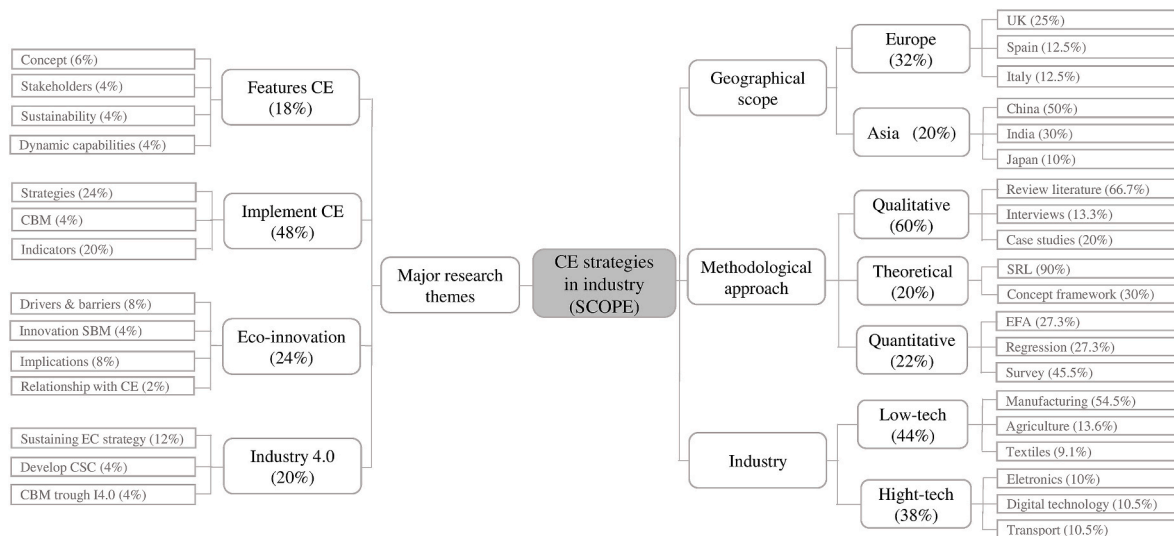


Fig. 6. The most used topics and subtopics and their frequency in the key articles.

and Hasanagic, 2018; Geng and Doberstei, 2008; Bakker et al., 2014); stakeholders to drive CE (Hazen et al., 2017; Jakhar et al., 2019); concept (Zott et al., 2011) and sustainable BM innovation (Bocken et al., 2014; Boons and Lüdeke-Freund, 2013); challenges and implications of CBM (Genovese et al., 2017; Zucchella and Previtali, 2019; Bressanelli et al., 2019; Centobelli et al., 2020); reverse logistics and CLSC as strong business prospects (Govindan et al., 2015; Guide and Wassenhove, 2009); determinants of eco-innovations (Horbach, 2008; McDonough et al., 2002; Prieto-Sandoval, Jaca, et al., 2018; Kiefer et al., 2019); I4.0 to support circular strategies (Jabbour et al., 2018; Nascimento et al., 2019); CBM through digital technologies such as blockchain (Kouhizadeh et al., 2020), Bigdata (Bressanelli et al., 2018; Jabbour et al., 2019) and 3DP (Despeisse et al., 2017); factors connecting CE and I4.0 (Rajput and Singh, 2019; Rosa et al., 2020) and I4.0 to develop CSC (de Angelis et al., 2018; Yadav et al., 2020).

#### 4.2. Geographical scope

The most frequent countries, in terms of geographical scope, are those in Europe (Ghisellini et al., 2016; Kirchherr et al., 2018; Bressanelli et al., 2018, 2019; Stewart and Niero, 2018; Kouhizadeh et al., 2020) and Asia (Ghisellini et al., 2016; Su et al., 2013; Geng et al., 2012; Geng and Doberstei, 2008; Winans et al., 2017; Jakhar et al., 2019; Kouhizadeh et al., 2020; Rajput and Singh, 2019; Yadav et al., 2020). Only three papers on the topic have appeared in North America (Bakker et al., 2014; Hazen et al., 2017; Kouhizadeh et al., 2020). Europe is characterised by studies addressing the main features and perspectives of CE at different levels (micro, meso and macro) and the challenges that make CBM unfeasible. On the other hand, Asia often looks at the potential of CE and examines near mid-high tech and I4.0. Most of those published studies have focused on China. Interestingly, China is one of three countries that have legislated the implementation of CE (Zhang et al., 2019), concluding that it is clearly more dedicated to implementing CE in response to population growth, rapid depletion of non-renewable resources and the country's social problems. But recent studies show that India could benefit from implementing CE (de Angelis et al., 2018; Mathivathanan et al., 2022). This analysis also shows that while countries in Asia were the first to publish on CE, European countries have significantly increased their interest since 2016. Finally, the countries where the institutions to which the first authors were affiliated are located were analysed. Distribution was concentrated in the UK, USA, and Italy. These three countries accounted for about 44% of the publications.

#### 4.3. Industry

Although CE initially emerged in the high-tech sector (McDonough et al., 2002), there has been an increase in articles exploring CE strategies in the low-tech sector. The most investigated industry in the low-tech sector is manufacturing (Lieder and Rashid, 2016; Govindan and Hasanagic, 2018; Jakhar et al., 2019; Jabbour et al., 2018; Nascimento et al., 2019; Despeisse et al., 2017; Rajput and Singh, 2019; de Angelis et al., 2018; Kouhizadeh et al., 2020). In the medium and high-tech industry, the electronics (Bakker et al., 2014; Hazen et al., 2017) and digital technology (Jabbour et al., 2019; Rosa et al., 2020) sectors were the most explored.

#### 4.4. Methodological approaches

Empirical articles represent 82% of the sample. The qualitative method is most often represented in methodological issues (60%). Qualitative studies were mainly based on qualitative literature reviews (e.g., Despeisse et al., 2017; Guide and Wassenhove, 2009; Murray et al., 2017; Winans et al., 2017) and conceptual frameworks (Bressanelli et al., 2018, 2019; Centobelli et al., 2020; Jabbour et al., 2019; Nascimento et al., 2019; Rosa et al., 2020; Suárez-Eiroa et al., 2019). The research was located between the concept of CE and indicators for adopting circular practices. The studies on strategies and challenges of eco-innovations for sustainable transitions and stakeholder collaboration for successful CE were mainly based on quantitative empirical analyses. The most used methods were exploratory factor analysis (Ormazabal et al., 2018; Kiefer et al., 2019) and regressions (Hazen et al., 2017; Jakhar et al., 2019). Aspects related to CE implementation, circular and sustainable BM perspectives, and emerging digital technologies were the main research themes located away from qualitative and quantitative methods, thus offering a potential avenue for future studies. Furthermore, it was clear that the number of conceptual studies increased from 2019 to 2020 while the number of literature reviews decreased. However, no study was found that systematically addressed circular business strategies as a financial and competitiveness opportunity in the industry at large, again revealing the need for this article.

#### 5. Description of the clusters

All articles were read and analysed. The analysis facilitated the identification of points of similarity and divergence, which dictated the different clusters. The constitution of each cluster by authors, journal,

objectives, methods, and key results is presented in the Appendix according to the number of citations (Table A).

### 5.1. Cluster 1: Strategic applications of EC

Given the subjects' size and diversity, cluster (n = 29) was divided into sub-clusters: sub-cluster 1A - CE principles of the EC; and sub-cluster 1B - new organisational models (Table A1).

#### SUB-CLUSTER 1A: PRINCIPLES OF THE CE.

This sub-cluster includes ten articles related to the principles and objectives of CE. CE acts at the micro, meso, and macro levels for achieving SD (Kirchherr et al., 2017; Merli et al., 2018). CE principles can be adopted in linear, circular Upstream, circular Downstream, and full circular modes, depending on management's commitment to adopting CE principles (Urbinati et al., 2017). The relationship between CE and sustainability allows one to potentiate the combination of circular and complementary strategies (Geissdoerfer et al., 2017). CE is seen as a mechanism promoting sustainable production, resulting in economically industrial transformations (Korhonen et al., 2018). When shifting towards renewable energy, significant social stock reduction and decisive ecological designs are required (Haas et al., 2015). CE also encourages the adoption of cleaner production patterns, increased responsibility, and awareness among producers/consumers (Murray et al., 2017), the use of renewable technology and materials, and the adoption of adequate, clear, and stable policies and tools (Ghisellini et al., 2016). On the other hand, SC closed material loops (Reike et al., 2018) and BM are aligned with economic and industrial perspectives (Homrich et al., 2018). However, there are doubts as to whether new BM are the main driver of CE, given that only a few definitions explicitly refer to BM (Kirchherr et al., 2017).

#### SUB-CLUSTER 1B: NEW ORGANISATIONAL MODELS.

This sub-cluster includes 19 papers related to circularity input in BMs. Literature in this area has only recently focused on the meanings and implications of circularity from a BM perspective (Lüdeke-Freund et al., 2019; Ranta, Aarikka-Stenroos, & Mäkinen, 2018). The shift towards a CE depends on policymakers on the one hand and the introduction of circularity in BMs on the other hand (Lewandowski, 2016), along with design approaches and tools (Bocken et al., 2016). To create wealth, one must choose to enhance the technological, organisational, and managerial processes internal to the firm (Franco, 2017; Teece et al., 1997). Success requires the implementation of new organisational forms and models (Teece, 2007). From this perspective, BMs see themselves as a mediator of innovations that link production, consumption, encompass stakeholders (Boons and Lüdeke-Freund, 2013; Lüdeke-Freund et al., 2019). BM innovation provides an approach to align the firm's value creation logic (Zott et al., 2011) with circular principles (Nußholz, 2017). CBMs are analysed within broader sustainability principles and the SDGs range (Ferasso et al., 2020; Hofmann, 2019). Following this line, to implement CBM from the perspective of economic value creation and 3R principles, the following propositions should be followed: cost efficiency of circular operations; return and recycling system and services (Ranta, Aarikka-Stenroos, & Mäkinen, 2018). The literature identifies four types of CBM innovation: circular start-ups, CBM diversification, CBM transformation and CBM acquisition (Geissdoerfer et al., 2020). CBMs can provide significant revenue, resource productivity and business continuity benefits (Hopkinson et al., 2018) while contributing to SD (Geissdoerfer et al., 2018). For many companies, CBMs provide a good risk-adjusted return on investment (Linder and Williander, 2017). In addition, they provide superior customer value (Pieronì et al., 2019). Sustainable business models (SBM) are also important to implement corporate innovation for sustainability (Evans et al., 2017), and can drive competitive advantage (Bocken et al., 2014).

### 5.2. Cluster 2: Mediating factors for implementing CE strategies

Given the size and diversity of issues, this cluster (n = 41) was

divided into three sub-clusters: sub-cluster 2A - strategic agents; sub-cluster 2B - facilitators; and sub-cluster 2C - barriers (Table A2).

#### SUB-CLUSTER 2A: STRATEGIC ACTORS.

This subgrouping includes 12 articles around the strategic agents required to implement CE. Many firms implement circularity practices to restore the image to the buyer and comply with government regulations (Moktadir et al., 2018). Knowledge of CE is a decisive factor of circularity practices (Lahane et al., 2020). Policy interventions through economic incentives (Elia et al., 2017; Winans et al., 2017), environmental regulations (Mangla et al., 2018), top management support, and innovative strategies are also needed to ensure favourable systemic conditions when implementing CE (Lahane et al., 2020). In this case, simultaneous top-down and bottom-up strategies (Lieder and Rashid, 2016), would encourage the implementation of circularity (Govindan and Hasanagic, 2018). For, the governmental perspective has the maximum positive impact on implementing CE (Masi et al., 2018). On the other hand, consulting firms and non-governmental organisations represent the main actors driving CE adoption (Kalmykova et al., 2018). Also, a sustainable supply chain management (SSCM) approach (Farooque et al., 2019) and supplier relationships (Dubey et al., 2019) encourage companies to adopt CE, while economic implications represent the main challenge (Nasir et al., 2017).

#### SUB-CLUSTER 2B: FACILITATORS.

This sub-cluster includes 16 articles related to the factors that help implement CE. If firms are rational and seek to maximise profit, then recycling and reusing options should be adopted (Andersen, 2007; McDowall et al., 2017). Knowledge on CE (Liu and Bai, 2014), goal formulation, legislation, and policies (Jia et al., 2020) present themselves as measures promoting CE (Geng and Doberstei, 2008). CE is also stimulated by creative individuals, forward-thinking entrepreneurs, and emerging technologies (Goyal et al., 2018). These include the internet of things (IoT), Bigdata, and data analytics (Kristoffersen et al., 2020). Environmental engagement with consumers and suppliers are also enablers of CE (Patwa et al., 2021). Conjunctively, CE is promoted and supported by design strategies (Moreno et al., 2016; Singh and Ordoñez, 2016) and by creating BM that incorporate CE principles into their value propositions along value chains (Manninen et al., 2018). Product Service Systems (PSS) are considered one of the most effective instruments leading society towards an efficient CE (Tukker, 2015). Also, dynamic capabilities significantly facilitate the implementation of CEs and improve the overall performance of firms (Zhu et al., 2010). In practice, the focus on economic aspects paves the way for the more seamless implementation CE, as the language of business is economics (Kristensen and Mosgaard, 2020). Government support is therefore vital in establishing eco-industry initiatives (Mathews and Tan, 2011). If applied, a new target related to powerful governance elements increases circularity in economic systems and accelerates the transition towards a CE strategy (Morseletto, 2020).

#### SUB-CLUSTER 2C: BARRIERS.

The third sub-cluster includes 13 articles related to the challenges to implementing CE. Lack of expertise (Kumar et al., 2019), lack of technical and technological capacity, poor leadership, and management (Su et al., 2013), as well as lack of resources are all significant barriers that hinder the implementation of CE (Agyemang et al., 2019). Thus, communicative approaches should be adopted to improve knowledge about CE (Geng et al., 2012). For, in addition to innovation, the transition to CE requires knowledge development and dissemination (Van Buren et al., 2016). Similarly, information technology plays a central role in the transformation towards a CE (Tura et al., 2019). Several challenges that may delay/impede the implementation of CE have been recognised by various authors, such as reduced enforceability of legislation (Su et al., 2013); quality issues in recycling and recovery (Gregson et al., 2015); SC complexities (Park et al., 2010); coordination issues between companies, product design and production, inadequate resource and waste systems (Kumar et al., 2019); weak economic incentives (Su et al., 2013) and; high investment costs (Jaeger and



Upadhyay, 2020). Another impediment is product life, which can result in the need for premature replacements (Bakker et al., 2014). The lack of a standardised system for performance assessment that includes an index of economic development, green development, and human development has proven to be a barrier to CE development (Zhiyun & Nailing, 2007). To address these challenges, comprehensive and integrated strategies that include institutional, regulatory, and financial solution should be adopted (Pan et al., 2015). For, the regulatory pillar alone is insufficient for a successful CE (Ranta, Aarikka-Stenroos, Ritala, et al., 2018).

### 5.3. Cluster 3: drivers of CE strategies

This thematic group encompasses 12 documents that helped to understand which drivers make it possible to implement circular strategies (Table A3). In the CE debate, a group of strategies has been identified to facilitate the extraction of additional value and reduce the loss of value (Blomsma and Brennan, 2017). Supported by the resource-based theory, Hart (1995) commented that there is a relationship between a company supported by natural resources and competitive advantage. The triple bottom line remains useful for integrating sustainability and balancing economic goals with environmental and social concerns (McDonough et al., 2002). The integrated view of CLSC is another driving system that aims to maximise value creation and focus on the firm's viewpoint (Govindan et al., 2015; Guide and Wassenhove, 2009). Furthermore, EI is related to the success of the CE (Porter and Van Der Linde, 1995; Prieto-Sandoval, Jaca, et al., 2018). Environmental regulations, environmental management instruments, and general organisational changes are also relevant for the development of CE strategies (Horbach, 2008). This result is also postulated by Porter's famous hypothesis. Not least, to transition to a CE regime, systemic change is required at various levels. BMs and stakeholder collaboration serve as examples of this (Witjes and Lozano, 2016). In particular, CE is driven by social, regulatory, or institutional factors (de Jesus and Mendonça, 2018). However, the availability of technical solutions, financial factors (Rizos et al., 2016), lack of consumer interest and awareness, and hesitant business culture (Kirchherr et al., 2018) are barriers to the expansion of CE (de Jesus and Mendonça, 2018).

### 5.4. Cluster 4: determinants to promote CE

This cluster saw disparity between the objectives of the included studies (n = 24). These studies were therefore grouped into two sub-clusters: sub-cluster 4A - mechanisms to effect the circular transition; and sub-cluster 4B - key elements for a successful CE (Table A4).

#### 5.4.1. SUB-Cluster 4A: mechanisms to effect circular transition

This sub-cluster includes 10 papers discussing the mechanisms that interfere with firms' circular transition. Remanufacturing approaches are a subset of sustainable production that helps companies achieve sustainability goals (Bag et al., 2019). Companies seeking business opportunities should include CE in their organisational structure (Khan et al., 2020). Furthermore, CE should also be implemented outside of organisations through collaboration with stakeholders (Barreiro-Gen and Lozano, 2020). Companies should develop and apply dynamic competencies and capabilities to achieve CE objectives (Katz-Gerro and López Sintas, 2019). Conjointly, policy makers should shift from command and control to a market-based mechanism to positively influence enterprises to adopt CE practices (Jakhar et al., 2019). EI marks a transition towards CE, where firms implement standardized routines and control to introduce eco-innovative processes, i.e., a CBM (Scarpellini et al., 2020). But, for an EI there must be engagement in SSC, technology and market attraction and internal funding resources, while cooperation, organizational learning and green certification are obstacles (Kiefer et al., 2019). EI practices related to the implementation of CE rely on eco-design practices, investment and improvement in

equipment, and investment in R&D (Scarpellini et al., 2020). However, ecodesign innovation is the only one that produces significant growth returns for SMEs (Demirel and Danisman, 2019). Therefore, SMEs must develop in EI to gain competitive advantage and create value (Prieto-Sandoval et al., 2019). To do so, they must consider national and international regulations, market entry and technological feasibility (Chen et al., 2020).

### SUB-CLUSTER 4B: KEY ELEMENTS FOR A SUCCESSFUL CE

This group includes 14 articles analysing the key elements for a successful CE. Companies' perceptions of CE boil down to factors of material supply, resource reuse and financial advantage (Ormazabal et al., 2018). However, although a CE field of action is related to economic performance, only manufacturing and usage relate to environmental and social performance (Dey et al., 2020). In the transition from BM to CE several aspects should be considered, including the role played by policy makers and I4.0 that practically support value creation, transfer, and capture (Centobelli et al., 2020). Sustainable design strategies and EI are also essential in the CE development process (Prieto-Sandoval, Ormazabal, et al., 2018). Without them, it would be difficult, if not impossible, to achieve CE goals within the scope of the SD (Suárez-Eiroa et al., 2019). In this vein, companies that apply systems thinking to reshape product offerings and develop circular flows in BMs achieve better development of circularity (Perey et al., 2018; Zucchella and Previtali, 2019). With consumer attitude being a critical factor for the CE transition (Stewart and Niero, 2018), marketing strategies should be developed to shape their attitudes (Hazen et al., 2017). However, the success of CE is subject to several impediments, such as economic and financial viability (Ethirajan et al., 2021; Genovese et al., 2017), market barriers and competition, regulatory and technological challenges, and SC management (Bressanelli et al., 2019). The complexity of administrative procedures and compliance costs are also significant barriers (García-Quevedo et al., 2020). Finally, for the success of CE, management must play the role for full capacity utilization, satisfying customers and keeping in mind the return obtained for the investments made (Moktadir, Dwivedi, et al., 2020).

### 5.5. Cluster 5: emerging DIGITAL technologies to enable EC practices

Due to the complexity of the questions, this cluster (n = 20) was divided into two sub-clusters: sub-cluster 5A - connection between CE and I4.0; and sub-cluster 5B - digital enablers of CE (Table A5).

#### SUB-CLUSTER 5A: LINKING CE AND I4.0.

This sub-cluster includes 11 articles that discuss the elements that connect CE and I4.0. I4.0 has the power to transform organisational activities through technological innovations (Kouhizadeh et al., 2020). Thus, solution measures based on I4.0 and CE help companies to keep up to date with advanced technologies and penetrate the sustainability of existing SC (Yadav et al., 2020). Associated technologies have the potential to impact CE through environmentally sustainable production (Heyes et al., 2018; Massaro et al., 2021). This means that smart technologies (e.g., IoT, ICT, Bigdata, Blockchain, among others) can help in the transformation of waste management towards a CE, resulting in economic, social, and environmental opportunities for businesses (Dev et al., 2020; Fatimah et al., 2020). Indeed, economic opportunities are the main effective lever for companies to adopt the CE paradigm linked to I4.0 (Gusmerotti et al., 2019). However, companies are still hesitant and cautious about the technological revolution because of the risk associated with increased overheads, technological investment, and fewer short-term tangible financial benefits (Kouhizadeh et al., 2020). The implementation of I4.0 is also faced with some challenges, including a lack of knowledge of intelligent waste management, financial and cost challenges (Zhang et al., 2019), ineffective legislation and controls (de Angelis et al., 2018; Moktadir, Ahmadi, et al., 2020), ineffective performance framework, and short-term corporate targets (Kumar et al.,

2021).

SUB-CLUSTER 5B: DIGITAL ENABLERS OF THE CE.

This sub-cluster includes nine papers that are intended to present how emerging digital technologies support CE practices. Sustainability can be achieved through the integration of CE and I4.0 (Rajput and Singh, 2019). Different I4.0 technologies then underpin CE strategies (Jabbour et al., 2018). To migrate to a CE, companies should combine investments in artificial intelligence (AI) and analytical technologies as they provide favourable circumstances through which circular strategies can be reinforced (Rajput and Singh, 2019). Additive manufacturing, Bigdata, and IoT were the most frequently described I4.0 pillars in digital CE enablers (Jabbour et al., 2019; Rosa et al., 2020). 3D printing (3DP) can also facilitate CE (Nascimento et al., 2019), as it offers significant advantages in terms of design freedom, mass customisation, co-creation, and innovative BM (Despeisse et al., 2017). More specifically, digital technologies enable the transition to CE by improving product design and marketing activities, optimising product use, enabling control and monitoring of product activity, and improving the delivery of technical support (Bressanelli et al., 2018). However, the potential benefits of incorporating I4.0 tools into CE require collaborative relationships to be improved for all stakeholders (Awan et al., 2021; Gupta et al., 2019).

6. Discussion and future research directions

The concept of CE has influenced policy and innovation in some of the world’s largest economies. The transition to CE is underway. Therefore, understanding the nature and status of this transition is important for creating effective policy and business strategies. But while the literature provides a convincing theoretical explanation that investments in environmental practices can lead to increased profits, it offers little insight into what and how such initiatives can be implemented by companies (de Angelis, 2021; Park et al., 2010). This research, therefore, sought to pursue this path by answering three questions: i) What CE strategies exist? ii) What opportunities exist for firms as a result of CE strategies? and iii) What are the main research themes, geographical scopes, methodological approaches and industries in the field of CE research? Considering and integrating the existing literature the following integrative Framework is proposed (Fig. 7) that combines the discussions on CE in the strategic framework for the economic competitiveness of companies, regardless of the sector in which it operates. That said, it could be argued that CE is one possible way, among others, of achieving SD while not neglecting economic growth and competitive advantages.

The considerations on the link between CE and organisational strategies for industry competitiveness that characterise the structure of the

integrative model are reported below.

1. Looking at the specific groups that characterise the model, the CBM strategy is common to most dimensions, representing the core element for the industry to transition to circularity without compromising its productivity and opportunities for economic and competitive sustainability (Geissdoerfer et al., 2018; Hofmann, 2019; Hopkinson et al., 2018; Linder and Williander, 2017; Scarpellini et al., 2020).
2. Turning the attention to the regulatory perspective, government support and a simultaneous top-down and bottom-up strategy are considered relevant strategies in the literature to implement/boost CE (Jia et al., 2020; Lieder and Rashid, 2016; Masi et al., 2018). These results are in line with those of Govindan and Hasanagic (2018) and Morseletto (2020), who attested that CE could be promoted through laws, policies, and governance, while other authors highlighted that the absence of legislation is a barrier to its implementation (Jaeger and Upadhyay, 2020; Kumar et al., 2019; Moktadir, Ahmadi, et al., 2020). In parallel, de Angelis et al. (2018) and Moktadir, Ahmadi, et al., 2020 proved that ineffective legislation can be one of the biggest challenges to implementing I4.0 towards a CE.
3. Furthermore, the interface of I4.0 and CE technologies is recognised as an important category for achieving sustainability (Fatimah et al., 2020; Hennemann and Sehnem, 2022; Jabbour et al., 2018; Kouhizadeh et al., 2020; Silva and Sehnem, 2022) and implementing CE strategies in SC (Moktadir, Ahmadi, et al., 2020). In this context, it was realized that among all advanced technologies, Bigdata (Bressanelli et al., 2018; Gupta et al., 2019; Hennemann and Sehnem, 2022; Jabbour et al., 2019; Kristoffersen et al., 2020; Zhang et al., 2019) and IoT (Awan et al., 2021; Bressanelli et al., 2018; Despeisse et al., 2017; Fatimah et al., 2020; Zhang et al., 2019) were the most referenced by authors as an aid for companies to penetrate the CE of SC. Next appear Blockchain (Hennemann and Sehnem, 2022; Kouhizadeh et al., 2020; Zhang et al., 2019), ICT (Fatimah et al., 2020; Heyes et al., 2018; Zhang et al., 2019), AI (Awan et al., 2021; Bressanelli et al., 2018; Rajput and Singh, 2019), 3DP (Despeisse et al., 2017; Nascimento et al., 2019) and additive manufacturing (Hennemann and Sehnem, 2022). According to the work of some authors (e.g., Dev et al., 2020; Kumar et al., 2021), advanced technologies can result in economic, social, and sustainable opportunities for firms, while scarcity of advanced technology can have reverse effects (Chen et al., 2020; Jaeger and Upadhyay, 2020; Kumar et al., 2019). In this follow-up, it is also worth mentioning that authors Dev et al. (2020) commented that a lack of knowledge of smart waste management and financial and cost challenges continue to prevent companies from using digital technologies for a CE.

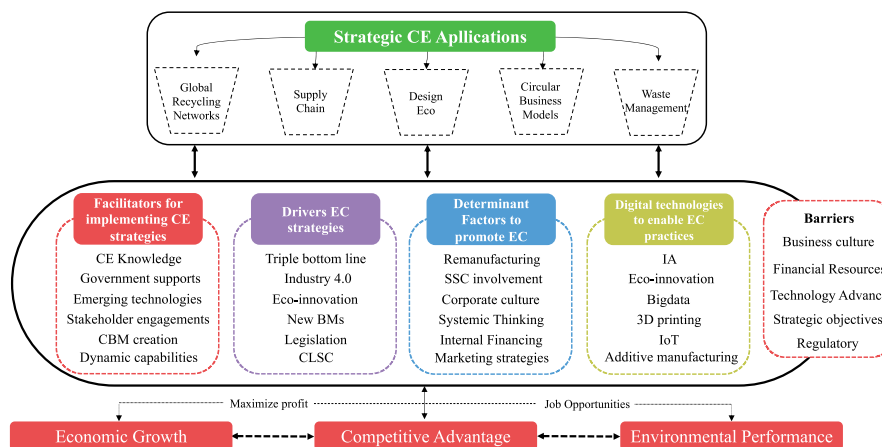


Fig. 7. Integrative framework for integrating CE strategies in companies.

The evaluation and assignment of examples of strategies in terms of CE have simultaneously shown that the use of other strategies enables the transition to CE, such as SC and producer/consumer responsibility and awareness (Kirchherr et al., 2018; Kumar et al., 2019; Murray et al., 2017). In the studies of widely recognised authors in the field (Acerbi and Taisch, 2020; Acerbi and Taisch, 2020; Liu et al., 2022; Lüdeke-Freund et al., 2019), it becomes clear that companies should rethink their SC because it allows them to develop several reverse cycles, but for this, they need to establish partnerships and cooperation with other companies, with customers and organisations in society. In addition, other authors have concluded that the circular management of SC through stakeholder engagement offers a promising vision to guide managers to achieve triple bottom-line economic benefits, innovative resource efficiency performance and competitiveness (Farooque et al., 2019; Gupta et al., 2019; Lahane et al., 2020). On the other hand, the lack of suitable partners and complexities in SC trigger barriers to adopting CE models (Jaeger and Upadhyay, 2020; Kirchherr et al., 2018; Kumar et al., 2019). Thus, companies must adapt their value network, organisational structure, and their relationship with SC partners to design a CBM and propose value to the customer. Authors Barreiro-Gen and Lozano (2020) and Ghisellini et al. (2016) noted in 2016 and 2020 that the transition to CE comes from connecting all actors in society and their ability to link and create appropriate patterns of collaboration.

Most studies in the sample focus on environmental regulations, legislation and policy interventions as strategic agents supporting the adoption/implementation of CE strategies, but Kalmykova et al. (2018) went further and mentioned consulting firms and non-governmental organisations as key actors. More examples are needed to encourage the gradual implementation of efficient circular processes and thus accelerate this transition.

Furthermore, theoretical discussions have suggested that knowledge about CE among academia, business and government may be decisive in the adoption/promotion of CE (Lahane et al., 2020; Liu and Bai, 2014; Moktadir et al., 2018; Tura et al., 2019), while lack of expertise may be a barrier to the transition to circularity (Kumar et al., 2019; Su et al., 2013). Communicative approaches should be prioritised better to understand CE on the different dimensions of action. On the other hand, in competitive terms, the level of application and implementation of CE can also be influenced by systemic thinking to understand the broader impact of changes in BMs (Bocken et al., 2016; Perey et al., 2018; Zucchella and Previtali, 2019).

As another example, the CE model involves fundamental building blocks focused on managing resource flows across the value chain, integrating innovation strategies into product sustainable design to improve performance should, to do so, anticipate social, economic and environmental challenges to realise CE objectives (Acerbi and Taisch, 2020; Goyal et al., 2018; Lewandowski, 2016; Liu et al., 2022; Moreno et al., 2016; Prieto-Sandoval, Ormazabal, et al., 2018; Scarpellini et al., 2020; Singh and Ordoñez, 2016). More specifically, without them, it would be almost impossible to achieve CE targets under SD (Suárez-Eiroa et al., 2019), in addition to Demirel and Danisman (2019) having advanced that eco-design is the only innovation strategy that produces significant growth returns for SMEs. As such, for companies - especially SMEs - to improve their performance and achieve a competitive advantage in the CE framework, they must build corporate strategies that fit their dynamic capabilities and level of maturity in environmental management (Katz-Gerro and López Sintas, 2019; Khan et al., 2020; Prieto-Sandoval et al., 2019; Seles et al., 2022). Not forgetting the economic aspect of business that inevitably paves the way for easier implementation of CE since the language of business is economics (Kiefer et al., 2019; Kristensen and Mosgaard, 2020). Scarpellini et al. (2020) also proved that new environmental management tools (e.g., environmental management accounting, environmental HR, and governance) apply to circular EI. On the other hand, it was mentioned by Kiefer et al. (2019) that for this, there has to be involved in SSC, technology and market attraction and internal funding resources.

So far, strategies that enable the transition to a green business have essentially been discussed; however, other factors inhibit companies from adopting circular practices. The literature has raised troubling issues of high financing costs on the one hand and weak economic incentives on the other (Chen et al., 2020; Jaeger and Upadhyay, 2020; Kumar et al., 2019; Moktadir, Ahmadi, et al., 2020). The same authors have also highlighted that inefficient coordination management, the lack of long-term strategic objectives, and the lack of a standard system to evaluate performance are obstacles to adopting circular business strategies (Su et al., 2013; Zhijun and Nailing, 2007).

These findings expand on previous studies such as that of Acerbi and Taisch (2020) and Acerbi et al. (2021), which focused on how CE principles were adopted to create circular manufacturing strategies and what information and data can support the manufacturer's decision-making process in adopting circular manufacturing strategies, respectively. The findings show that to adopt circular manufacturing strategies by manufacturers (including circular design, remanufacturing, disassembly, reuse, recycling, resource efficiency, cleaner production, BM, industrial symbiosis and CLSC) need support from technological measures, as well as evaluation methods and models both to assess circularity and to support the decision process are also confirmed in this study.

Although CE strategies are already widely used for environmental issues, only eight studies (Ethirajan et al., 2021; Evans et al., 2017; Hopkinson et al., 2018; Jia et al., 2020; Kumar et al., 2019; Lieder and Rashid, 2016; Ormazabal et al., 2018; Prieto-Sandoval et al., 2019) were found in our database where CE strategies were used to study economically competitive issues. Jia et al. (2020) state that CE strategies create advantageous and profitable opportunities for companies. In particular, the introduction of circularity in the BM generates significant revenues, creates value, business continuity benefits, reduces costs and generates employment opportunities (Hopkinson et al., 2018; Kumar et al., 2019), all resulting in a competitive and financial advantage (Ormazabal et al., 2018; Prieto-Sandoval et al., 2019).

This research goes further by contributing a sound strategic basis for companies to become more economically competitive by adopting, implementing and developing CE practices. Furthermore, the creation of new categorisations for the analysed examples (see section 5) provides a comprehensive overview of the strategic applications of CEs – during different stages of establishment – for the environmental and economic competitiveness of enterprises. In the future, the integrative conceptual framework can be used to categorise new examples of CE strategies appropriately distributed across adoption, implementation, and development phases to help companies respond to the highly competitive market. The proposed framework is based only on scientific literature, so further research is suggested to provide practical and empirical evidence for the results obtained.

Although the implementation of CE strategies worldwide is still in its early stages of development, it provides a credible framework for improving the current BM towards eco-industrial development, increasing economic well-being based on restored environmental integrity. However, a more robust commitment becomes necessary.

Based on the literature reviewed, some research deficiencies were identified, and as such, Table 4 proposes the main themes and delves into the unexplored dimensions to provide an inspiring ground for future researchers.

Given that studies so far have predominantly focused on strategies to implement CE in industry, topics such as sustainability and I4.0 require more attention. Furthermore, the results indicated that CE strategies have been mainly concentrated in companies in Europe and Asia. Future studies may shed light on CE approaches and strategies in Oceania, South America, and Africa. In methodological terms, a large amount of research has been conducted using qualitative approaches (i.e., key findings show that around 60% of authors use qualitative methods), especially qualitative literature reviews. More quantitative and mixed methods should be used to contribute to the paradigm. Indeed, it is

**Table 4**  
Future research agenda by cluster.

Clusters	sub-Clusters	Future Research	Emerging Research Issues
<b>Cluster 1</b> Strategic Applications of CE	<b>sub-Cluster 1A</b> Principles of the CE	Analyse the relationship between CE and emerging concepts, such as performance economics, and new forms of business, such as benefits resources.	What internal reasons lead companies' management teams to adopt or not adopt CE principles and overcome existing adoption barriers?
	<b>sub-cluster 1B</b> New organisational models	Develop methods to assess the environmental, social, and economic sustainability of CBM.	In practice, how does the transition process from a linear to a circular BM occur in existing companies?
	<b>sub-Cluster 2A</b> Strategic actors	To analyse the role of policy initiatives in promoting the diffusion of CE, as well as to ascertain the implications of different policies in different regions to determine which policies may be most effective.	What is the causal relationship between the adoption of CE practices and government support?
<b>Cluster 2</b> Mediating factors for implementing CE strategies	<b>sub-Cluster 2B</b> Facilitators	To analyse the relationship between a company's awareness and its actual behaviour in developing a CE by surveying different companies.	Do CBMs enable sustainable innovations? And do they relate to business success?
	<b>sub-Cluster 2C</b> Barriers	Outline how the identified drivers can help mitigate the barriers encountered during the implementation of CE and analyse whether these barriers have been met.	In practice, what barriers exist within companies when it comes to implementing circular strategies?
	<b>Cluster 3</b> Drivers of CE strategies	Explore drivers of CE strategies in specific sectors or business models.	What kind of techniques do companies need to adopt in terms of CE? What benefits do they derive from their behaviours?
<b>Cluster 4</b> Determinants to promote CE	<b>sub-Cluster 4A</b> Mechanisms to effect circular transition	Analyse how companies understand and implement CE.	What factors promote eco-design innovation capacities in SMEs?
	<b>sub-Cluster 4B</b> Key elements for a successful CE	To study the dynamic capabilities by which companies transform their core competencies (CE activities) to maintain or achieve a competitive advantage.	Does CE offer business opportunities to SMEs and should it be part of their corporate strategy?
<b>Cluster 5</b> Emerging digital	<b>sub-Cluster 5A</b> Linking CE and 14.0	Study success cases to inspire managers to seek new CE	How are CE and 14.0 principles applied in

**Table 4 (continued)**

Clusters	sub-Clusters	Future Research	Emerging Research Issues
technologies to enable CE practices	<b>sub-Cluster 5B</b> Digital enablers of the CE	solutions through 14.0. Include different 14.0 technologies, to provide a broad view on their role digital in transitioning to an CE.	practice by companies? How can different 14.0 technologies help implement and promote CE?

believed that such approaches can be beneficial because of the need for generalisations and deep insights into the field of research. Academics should fill the gap by seeking to develop a deep understanding of human behaviour by surveying key stakeholders (e.g., managers, suppliers, among others) to see how they adopt and explore CE practices in industry. Researchers in strategic management need to join forces with researchers from innovation and organisational behaviour to unravel the riddles behind both environmental and economic competitive advantages. A rather ambitious connection, in the field of social sciences, but one that can advance science from a theoretical and practical point of view.

**7. Conclusions**

As a result of rapid industrialisation, companies have faced several environmental challenges, including global warming, resource scarcity, and environmental pollution. Indeed, it has become vital to promote and adopt strategies that help to address environmental impacts. Among these, CE policies have been selected as a core dimension for the direction of SD. Decision-makers and researchers have recognised this as the way forward when attempting to achieve balanced development. Companies have become more aware of this concept, seeing it as a strategic mechanism that can be used to create a competitive advantage. The ambition is that the evolution of industrial production based on CE has a positive impact on the environment and contributes to economic growth. Indeed, a sustainable future requires systems-based thinking that involves society, the environment, and the economy in equal measure. However, enhancing global acceptance for circular economy is a great challenge that the world has to address.

Existing literature has specifically focused on the acquiescence of the concept, neglecting the field of investigation of CE strategies as opportunities for the economy and competitiveness for firms. As such, this article intended to bring debates surrounding CE from a strategic perspective for the economic competitiveness of companies to the heart of the matter. In other words, special attention was given to the adjacent economic implications which, in many cases, represent the main stimulus for implementing CE initiatives. It therefore contributes important elements to strategic management, business management and competitive advantage theory.

With the results obtained, it was perceived that this field of research is still in its construction phase because an expressive segment only adopts empirical methodologies. The trends in scientific production show an increase in academic interest in the year 2022 (with 143 publications), which raised some important questions: Is CE the future of companies? Fictional or reality? It remains for future investigations.

The scientific literature makes it clear that the shift to a CE requires the interaction and involvement of stakeholders, including actors, policies, and alliances, both in the adoption stage and in the implementation and development of CE strategies. Furthermore, it was found that with profit-driven companies and an increasingly competitive market, when implementing CE strategies, the first consideration focuses on an economic level and only then on environmental impacts. In this regard, managers should seek to act by recognising and considering the factors

that may facilitate or delay/impede the implementation of circular practices towards SD, without neglecting financial performance and competitive advantage – defined in sections 5 and 6.

The thematic map also provides promising information for CE researchers as it presents each topic's level of development and relevance. Thus, studies related to dynamic capabilities for BM innovation, and I4.0 strategies as new opportunities for CE performance and the competitive advantage of companies, correspond to the development trends of this research field.

In summary, this study contributes to the understanding of the CE paradigm as a strategic opportunity to respond to sustainability issues while elucidating its role in the competitiveness and profitability of companies. Therefore, it is relevant from the point of view of management studies. It also provides research guidelines for academics to further investigate CE as a business strategy for industry sustainability in the competitive marketplace. The research also presents findings relevant to multi-stakeholder groups seeking to identify the challenges and opportunities with potential CE presents when implemented. It also holds implications for policymaking, highlighting barriers to adopting and developing CE. Finally, with this article, there is also no doubt that institutional structures and financial systems need to be reshaped to largely support the shift from organisational BMs to CBM. In summary, this article aims to contribute to the current discussion on CE, adding to schools of thought on how it can be an environmental and economic strategy for businesses, as well as suggesting that asset reuse enables local businesses to generate new employment opportunities and improve economic performance.

However, this article has certain limitations, mainly due to its qualitative nature. The first limitation corresponds to the data collection process, which was restricted to the selected key words in the WoS database. While this is one of the most reputable databases, it may have left other relevant information out of the investigation. Another limitation was the screening process. The process focused only on peer-reviewed articles published in English from the categories of management, economics, and business to prevent knowledge loss. This was done to prevent knowledge loss. The fact that only a few terms were considered for the data search inevitably represents another limitation for papers that were very relevant in the field of CE but used another combination of keywords that were omitted from these results.

On the other hand, given the characteristics of the database of articles, namely its size, the bibliometric technique of co-citation was

selected to group the articles. This is undoubtedly a limitation, as recent but important articles may have been omitted. These limitations may play a promising starting point for future research on CE.

A lack of quantitative research has also limited causal research in this area of research, limiting our understanding of the economic and social implications of the circular economy. Scientists should focus on building a long-term, multi-year database that tracks CE over the years. Future research could also rely on methods such as randomized controlled trials and quasi-experimental approaches to understand user acceptance and the elements of public policy, business, and consumer behavior related to the circular economy. increase. The coverage of the whole value chain (procurement, design, production, distribution, use, re-use, refurbishing, remanufacture, recycling) will allow researchers the to take into account the needs and expectations of all actors and to develop proposals for CE funding measures accordingly.

Thus, given the nature of this work, it is intended to provide an effective reference framework for researchers, management and administration practitioners and policy makers operating in CE, as well as promising avenues for further scientific research. We encourage managers to delve deeper into the circular economy and change their business models to take advantage of these strategies. These new perspectives, in turn, help as CE evolves from partially implemented concepts to broader system-level concepts that include complex interactions with the surrounding environment, society, businesses, technology, etc. It is useful. It is not only limited to product or services sustainable development but it is also widely used in business strategies and organizational processes. Hence, future research should focus on CE practices and collaborations between advanced and developing countries.

#### Declaration of competing interest

I have nothing to declare.

#### Data availability

Data will be made available on request.

#### Acknowledgements

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## APPENDIX

**Table A.1**

Summary table of the studies comprising cluster 1: Strategic Applications of CE.

Sub-cluster 1A	Author	Journal	Objective	Methods	Key-findings	Citations
	<a href="#">Geissdoerfer et al. (2017)</a>	Journal of Cleaner Production	Distinguish the terms CE and sustainability and summarise the types of relationships between them.	Bibliometry	The CE, besides potentiating diversity and adapting to different contexts, also allows the combination of circular strategies with complementary strategies.	1978
	<a href="#">Ghisellini et al. (2016)</a>	Journal of Cleaner Production	Apprehend the main characteristics and perspectives of the CE.	LR	The transition to CE comes from connecting all actors in society and their ability to link and create appropriate patterns of collaboration. Also, the need for an economic return on investment, provides motivation for businesses.	1903
	<a href="#">Kirchherr et al. (2017)</a>	Resources, Conservation and Recycling	Create transparency regarding current views of the CE concept.	SLR (n = 114)	They defined SC at the micro, meso and macro level, with the aim of achieving SD, creating environmental and economic quality and social equity.	1754
	<a href="#">Murray et al. (2017)</a>	Journal of Business Ethics	Trace the origins of CE and discuss how CE has been applied in business and politics.	LR	CE involves production networks where there is diffusion of	857

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	Haas et al. (2015)	Journal of Industrial Ecology	Assess the circularity of global material flows.	Sociometabolic Approach	responsibility between producer and consumer. Two CE barriers: a large fraction of used materials still accumulates as in-use stocks and although a certain stabilisation trend of stocks is observed in industrialised countries, globally they continue to grow at high rates.	441
	Korhonen et al. (2018)	Journal of Cleaner Production	Analyse the concept of CE.	LR	The adoption of CE will transform economic activities from reliance on non-renewable, emissions-intensive carbon flows to more sustainable production and consumption.	439
	Merli et al. (2018)	Journal of Cleaner Production	To understand how academics approach CE, highlighting trends and gaps.	SLR (n = 565)	CE studies follow three lines: i) changing social and economic dynamics at the macro level; ii) supporting companies in implementing circular processes, at the micro level, to diffuse new forms of consumption and product design and iii) at the meso level, discusses industrial symbiosis.	422
	Reike et al. (2018)	Resources, Conservation and Recycling	Focus on developing the CE concept and value retention options for products/materials to increase circularity.	LR	Government and policy makers have a key role in enabling mechanisms for shorter loop value retention options, setting targets, and directing economic activities towards greater circularity.	407
	Urbinati et al. (2017)	Journal of Cleaner Production	To propose a taxonomy of CBM based on the degree of adoption of circularity across the dimensions: customer value proposition; and value network.	LR	CE is based on the deployment of closed production systems, where resources are reused and kept in a production and use loop, creating greater value over a longer period.	308
	Homrich et al. (2018)	Journal of Cleaner Production	To investigate trends and gaps in the convergence paths of the CE literature.	SLR (n = 39)	Although the SC research field is well established and the CE approach is relatively new, the theoretical bridge between the two research bodies needs to be improved.	266
<b>Sub-cluster 1B</b>	Teece et al. (1997)	Strategic Management Journal	The dynamic capabilities framework analyses the sources and methods of wealth creation and capture by private firms operating in rapidly changing technological environments.	LR	Private wealth creation in regimes of rapid industrial and technological change depends to a large extent on the enhancement of the firm's internal technological, organisational, and managerial processes.	13558
	Teece (2007)	Strategic Management Journal	Specify the nature and micro foundations of capabilities to sustain superior business performance in an open economy with rapid innovation.	LR	Companies with strong dynamic capabilities are intensely entrepreneurial. They not only adapt to business ecosystems, but also shape themselves through innovation and collaboration with other companies, entities, and institutions.	5088
	Bocken et al. (2016)	Journal of Industrial and Production Engineering	Create a framework of strategies to guide designers in the transition from a linear to a CE economy.	LR	The shift to CE is complex and systems thinking is essential to understanding the wider impact of changes in BM and design.	2431
	Zott et al. (2011)	Journal of Management	Examine the concept of BM through multiple subject lenses.	LR	The BM presents itself as a new unit of analysis, emphasising a holistic system-level approach to explaining how companies 'do business'.	1907
	Bocken et al. (2014)	Journal of Cleaner Production	Develop a categorisation of SBM archetypes to describe groupings of mechanisms and solutions.	LR	SBM help embed sustainability into business purpose and processes and serve as a competitive driver.	1380
	Boons and Lüdeke-Freund (2013)	Journal of Cleaner Production	Advancing the literature on sustainable innovation through the adoption of BM.	LR	While an innovation carries a supposed potential for sustainability, the BM is the market device that enables/hinders the sharing of that potential.	983
	Lewandowski (2016)	Sustainability	Identify characteristics of the CE according to a BM framework.	LR	The transition to CE involves materials and product design, new BMs, global reverse networks and enabling conditions.	550
	Evans et al. (2017)	Business Strategy and the Environment	To develop a theoretical perspective for understanding BM innovations that lead to improved organisational economic,	LR	BM innovation can be a major undertaking for a company and its stakeholders, with cascading effects across the entire value network.	378

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			environmental, and social performance.			
Linder and Williander (2017)	Business Strategy and the Environment	Examine what features of CBM create reluctance when considering their implementation.	Case Study - BM remanufacture (n = 1)	Often it may be necessary to devote significant effort to creating ways to reduce the likelihood and impact of product obsolescence.	341	
Geissdoerfer et al. (2018)	Journal of Cleaner Production	Discuss CBM sustainability performance and propose a framework to integrate CBM towards SD.	Case Studies (n = 4)	Different CBM are driving CSC in different loops: closing loops, deceleration loops, intensification loops, narrowing loops and dematerialisation loops.	335	
Pieroni et al. (2019)	Journal of Cleaner Production	Provide a review of approaches to BM innovation for CE and/or sustainability.	SLR (n = 56)	Providing superior customer value is a driver for both CE driven and sustainability driven BM innovation, as without this, value capture in monetary terms may not occur.	277	
Lüdeke-Freund et al. (2019)	Journal of Industrial Ecology	Define the main dimensions of the BM and identify the specific characteristics of these dimensions.	Morphological Approach	Moving to a CE requires companies to rethink their SC to develop various reverse cycles. To do so, they need to establish partnerships and cooperation with other companies, but also with customers and societal organisations.	267	
Franco (2017)	Journal of Cleaner Production	Assess the challenges to implementing CE at the micro level.	Case studies - textile industry (n = 5)	Implementing CE at the enterprise level is a challenging task given the linear mindset prevalent in most industries. Thus, a dynamic collaborative supplier-buyer understanding becomes crucial for the development of CE strategies.	149	
Nußholz (2017)	Sustainability	Clarify which resource efficiency strategies can be considered key strategies for CBM.	SLR (n = 44)	Circular strategies do not, by default, lead to greater resource efficiency. Therefore, the design of a CBM should be guided by assessing the life cycle impacts of its supply as well as considering potential rebound effects.	134	
Ferasso et al. (2020)	Business Strategy and the Environment	To investigate how CE and BMs are related in current business and management literature.	Bibliometry (n = 253)	The results highlighted emerging topics such as those related to managerial, supply-side, demand-side considerations, networks, performance, and CSC contexts.	123	
Ranta, Aarikka-Stenroos and Mäkinen (2018)	Journal of Cleaner Production	Examine the types of BM that CE-oriented firms operate in terms of their value proposition, value creation and delivery, and value capture.	Multiple case study - CBM	Studying CBM is vital to determine the real economic benefits that can result from adopting CE practices at the firm level.	103	
Hopkinson et al. (2018)	California Management Review	To detail the experiences of CBM practices over a 30-year period, highlighting the successes, difficulties, and conflicts of their adopting.	Case study - electronic industry (n = 2)	CBMs are a potential source of growth, market share and profit for individual companies.	96	
Geissdoerfer et al. (2020)	Journal of Cleaner Production	Systematise the state of the art of CBM and CBM innovation.	SLR (n = 51)	Different CBM innovation strategies can promote different CE outcomes (i.e., resource input and waste/emissions production).	93	
Hofmann (2019)	Journal of Cleaner Production	Systematically review the literature to critically reconstruct the theoretical foundations of CBMs.	SLR (n = 42)	The CBM concept promotes the reorganisation of current value creation and SC architectures towards a sustainable system of production and consumption.	80	

Table A.2

Summary table of the studies that include cluster 2: Mediating factors for implementing CE strategies.

Sub-cluster 2A	Author	Journal	Objective	Methods	Key-findings	Citations
	Lieder and Rashid (2016)	Journal of Cleaner Production	Provide an in-depth review covering aspects of resource scarcity, waste generation and economic benefits.	SLR (n = 158)	To implement CE, a simultaneous top-down and bottom-up strategy is useful to maintain the interests of stakeholders, i.e., policy makers and government bodies.	942
	Kalmykova et al. (2018)	Resources Conservation and Recycling	Develop tools to implement the CE.	LR	Stock optimisation, eco-efficiency, waste reduction and the 4Rs are the main strategies to achieve CE.	491

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	Govindan and Hasanagic (2018)	Journal of Production Research	Provide an analysis of the drivers, barriers and practices influencing the implementation of CE in SC.	SLR (n = 60)	The governmental perspective has a positive impact on the implementation of CE in SC. CE can be promoted through laws, policies, risk reduction and governance.	373
	Winans et al. (2017)	Renewable and Sustainable Energy Reviews	Review the history of the CE concept to provide a context for critical examination of how it is currently applied.	LR	The evaluation of CE initiatives highlights barriers to sustained circularity due to material flows exceeding demand and transport and infrastructure.	349
	Elia et al. (2017)	Journal of Cleaner Production	Analyse the effectiveness of environmental assessment methodologies for measuring the application of CE strategies to firms, products, or services.	LR	Energy analysis and eXergy analysis can provide information on the quantity/quality of energy. This feature can make a valuable contribution to evaluate CE strategies, given the importance of sustainable energy supply and use.	316
	Mangla et al. (2018)	Production Planning & Control	Identify barriers to adopting CSC.	Interpretative structural modelling	The extension of CBM or CSC concepts enables organisations to make efficient use of resources and results in greater customer value.	204
	Nasir et al. (2017)	International Journal of Production Economics	Show the environmental gains that can be achieved through CE principles compared to linear production systems.	Case studies - construction industry (n = 2)	An integration of CE principles into the sustainable management of CS can provide clear advantages from an environmental perspective.	185
	Moktadir et al. (2018)	Journal of Cleaner Production	Assess, prioritise, and rank the drivers of sustainable manufacturing practices.	Graph Theory and Matrix Approach	Industries are trying to implement sustainable manufacturing practices as part of green SC initiatives to remedy their image to the buyer and comply with government rules.	174
	Farooque et al. (2019)	Journal of Cleaner Production	Classify various terminologies related to SSC and conceptualise a definition of circular supply chain management (CSCM).	LR	CSCM offers a promising vision to guide SC managers to achieve breakthrough performance in resource efficiency and, consequently, profitability.	167
	Masi et al. (2018)	Production Planning & Control	Investigate the shift towards CE using a taxonomy of practices and barriers.	Survey in company (n = 77)	Companies favour practices related to resource and energy use efficiency, while practices related to investment recovery, green procurement and customer cooperation are less prevalent.	130
	Lahane et al. (2020)	Journal of Cleaner Production	Conduct a review of the state of the art of CSCM.	SLR (n = 125)	The implementation of CSCM has notable benefits: improving the efficiency of SC, economic growth, value propositions, end-of-life strategy, and creates competitiveness.	88
	Dubey et al. (2019)	Management Decision	Explain how top management mediates the relationship between external pressures and supplier management practices for CE.	Survey to sustainable companies (n = 123)	Top management commitment positively mediates the effect of external institutional pressures on supplier relationship management practices for CE.	79
<b>Sub-cluster 2B</b>	Tukker (2015)	Journal of Cleaner Production	To review the literature on SSP and compare the findings with those of a previous review.	LR	PSS can provide greater tangible and intangible value to the user, can be created with lower system costs, and improve a company's market position.	820
	Geng and Doberstein (2008)	International Journal of Sustainable Development and World Ecology	Describe measures that are implemented to promote CE.	LR	The CE provides a viable way for governments to seek sustainable forms of development by increasing the overall eco-efficiency of economic systems.	360
	Andersen (2007)	Sustainability	Introduce the environmental economics approach, indicating its potential to achieve a sound and efficient CE.	LR	Environmental economics can be an aid in identifying net benefits to the economy.	348
	Mathews and Tan (2011)	Journal of Industrial Ecology	Demonstrate common themes across case studies: transition to CE and evolutionary processes where dynamic linkages are established over time.	LR	Eco industrial initiatives need to be ratified by the government for companies to get various financial supports like low-rate loans and tax reduction.	276
	McDowall et al. (2017)	Journal of Industrial Ecology	Present a comparative analysis of CE policy approaches in China and Europe.	LR	The CE perspective in China is structured as a response to environmental challenges created	266

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Table A.2 (continued)

					by industrialisation. In Europe, CE focuses on resources and opportunities for business.	
	Zhu et al. (2010)	Journal Environmental Management	Investigate the role and importance of dynamic capabilities to implement CE.	Survey to manufacturing companies (n = 334)	They highlight the importance of intensifying cooperation with upstream and downstream SC partners for an CE initiative to be successful.	251
	Morseletto (2020)	Resources, Conservation and Recycling	Examine the goals that can facilitate the transition to CE.	SLR (n = 72)	Existing targets for recovery and recycling do not necessarily promote a CE, although they are the most widely applied targets.	247
	Moreno et al. (2016)	Sustainability	To analyse the literature on design for sustainability and link these approaches to current literature on CBM.	LR	For a CE to thrive, products must be designed for closed cycles and tailored to generate revenue. It must be supported by low-cost chains, reprocessing structures and effective regulations.	202
	Singh and Ordoñez (2016)	Journal of Cleaner Production	Discuss how designers and manufacturers can help move towards a CBM.	Interviews - waste management professionals and designers (n = 25)	Today's product design is facing a new challenge of anticipating social, economic, and environmental challenges to realise the objectives of a CE.	199
	Manninen et al. (2018)	Journal of Cleaner Production	Outline a framework for assessing the environmental value propositions of CBM.	BM case study (n = 3)	With the framework, companies can plan and design new CBM. The biggest challenges are related to estimating the environmental benefits obtained from environmental value propositions.	180
	Kristensen and Mosgaard (2020)	Journal of Cleaner Production	Provide a consistent analysis of CE indicators at a micro level from literature and practice.	SLR (n = 27)	The sustainability benefits of CE are not yet understood in practice, although CE is highlighted as having potential to support SD.	169
	Liu and Bai (2014)	Resources, Conservation and Recycling	Investigate on the awareness and behaviour of companies in the development of CE.	Survey to manufacturing companies (n = 157)	Companies have good knowledge about CE and a strong willingness to operate a CE. However, there is a gap between knowledge and actual behaviour of companies when developing a CE.	145
	Jia et al. (2020)	Journal of Cleaner Production	To find out the current state of research on SSCM for a CE.	SLR (n = 109)	The increasing number of government funding and regulation is the driving force for companies to adopt JVs because they have rules and guidelines to follow and can get the necessary financial assistance from the government.	120
	Kristoffersen et al. (2020)	Journal of Business Research	Develop a smart CE framework to understand the link between digital technologies and CE.	2 SLR (n = 32; n = 98)	The intelligent use of resources in CE can be supported by the creation, extraction, processing and sharing of data from digital technologies.	110
	Goyal et al. (2018)	Thunderbird International Business Review	Examine CE-oriented BM.	LR	The CE model focuses on managing resource flows across the value chain, integrating reverse logistics, design innovation, collaborative ecosystem, and BM innovation.	95
	Patwa et al. (2021)	Journal of Business Research	Investigating the adoption of CE principles among emerging economies.	Consumer Survey (n = 183)	Consumer behaviour influences the uptake of remanufactured products and use of products-as-a-service to encourage the adoption of CE practices in emerging economies.	89
Sub-cluster 2C	Su et al. (2013)	Journal of Cleaner Production	Provide an overview of how the CE strategy has been developed and implemented.	LR	Technology is a key factor in developing CE. Each of the three CE principles requires advanced technology and development and the upgrading of facilities and equipment.	612
	Geng et al. (2012)	Journal of Cleaner Production	Present CE indicators.	LR	The policy of developing indicators creates incentives for local governments to pay more attention to environmental issues. Economic, environmental, and social benefits can be obtained by implementing such indicators.	437
	Bakker et al. (2014)	Journal of Cleaner Production	Explore how product design can more proactively address	Secondary database	They showed that for refrigerators and laptops, product lifetime is the determining factor for overall	325

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Table A.2 (continued)

			product life extension and recycling.		environmental impacts. Therefore, extending product life is the best strategy.	
Agyemang et al. (2019)	Management Decision	Identify the drivers and barriers to implementing CE in the automotive industry.		Survey (n = 112) and interviews (n = 28)	Many of the drivers and barriers to CE in companies are internal rather than external factors. To overcome barriers, it is suggested that companies consider the internal factors that limit their potential to transition to CE.	116
Zhijun and Nailing (2007)	Sustainability	Propose a framework for practical implementation of CE.		LR	The CE requires compliance with ecological laws and the good use of natural resources to achieve economic development.	194
Pan et al. (2015)	Journal of Cleaner Production	Illustrate the portfolio options of technologies for different types of waste-to-energy (WTE) SC to achieve the CE system.		LR	WTE implementation strategies for CE should establish government policies and responsibilities; provide economic incentives and price supports and define comprehensive performance programme.	292
Gregson et al. (2015)	Economy and society	Highlight the challenges faced by CE in the EU.		Case study - Resource recovery (n = 2)	Resource recovery in the EU is framed by moral economies, driven by discourses of ecological modernisation, environmental justice, and resource (in)security.	290
Park et al. (2010)	Journal of Cleaner Production	Investigate the challenges and opportunities for achieving a balance between economic growth and environmental stewardship.		Case studies - technology companies (n = 3)	Adopting an SSC management approach is becoming a key business challenge and opportunity.	193
Ranta, Aarikka-Stenroos, Ritala et al. (2018)	Resources, Conservation and Recycling	Identify and compare motivators and barriers to implementing CE.		Case studies - different industries (n = 6)	To improve institutional support for CE and enable it to realise its potential as a sustainable growth model, diversified institutional support is needed to reduce the products produced and materials used and increase reuse.	191
Tura et al. (2019)	Journal of Cleaner Production	Analyse the drivers and barriers that inhibit design and business development around CE.		Interviews with managers (n = 45)	Reducing barriers to CE requires collaborative actions, sharing of resources and knowledge between academia, business, and government.	178
Van Buren et al. (2016)	Sustainability	Analyse the impact of the transition to a CE and the consequences for strategic changes in logistics.		Case studies - logistics industry (n = 2)	For a CE to materialise, an integrated approach that focuses on long-term system change or transition is required.	169
Kumar et al. (2019)	Management Decision	Identify barriers and opportunities of CE through a socio-political, economic, legal, and environmental perspective.		Survey to manufacturing companies (n = 200)	Opportunities include business development, investments, value creation, employment opportunities, improved profitability, reducing costs, and opening new markets for recycling. Barriers centre on low level of public awareness about CE, lack of appropriate partners in SC and inadequate waste resource system.	80
Jaeger and Upadhyay (2020)	Journal of Enterprise Information Management	Present the barriers to CE adoption and address the specific challenges faced by manufacturers.		Case study - manufacturing companies (n = 10)	Recycling and waste reduction policies have low CE effects. High CE effect policies, such as maintenance and reuse aiming at the CE ideal of no waste, are almost non-existent.	63

Table A.3

Summary table of the studies that include cluster 3: Drivers of CE strategies.

Author	Journal	Objective	Methods	Key-findings	Citations
Porter and Van Der Linde (1995)	Journal of Economic Perspectives	Trade-off between environmental regulation and competitiveness increases costs and slows environmental progress.	LR	Appropriately crafted environmental standards can trigger innovation trade-offs, enabling firms to improve productivity and competitiveness.	4315

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**Table A.3** (continued)

Author	Journal	Objective	Methods	Key-findings	Citations
Hart (1995)	Academy of Management Review	Propose a theory of competitive advantage based on the relationship of the firm with the natural environment.	LR	There is a relationship between a natural resource-backed enterprise and competitive advantage, driven by pollution prevention, product management and SD.	3262
Govindan et al. (2015)	European Journal of Operational Research	To present a comprehensive literature review of recent articles and the state of the art in reverse logistics.	SLR (n = 382)	Professionals can focus on the profitability and value of reverse logistics and SC rather than cost efficiencies or other expensive objectives.	1018
Horbach (2008)	Research Policy	Explore the determinants of environmental innovations.	Econometric estimation	Environmental regulation, environmental management instruments and organisational changes stimulate environmental innovation.	827
Guide and Wassenhove (2009)	Operations Research	To present the field of CLSC as a strong business perspective.	LR	Product recovery and re-use serves as a basis for the development of industrial systems that are economically and environmentally sustainable.	801
Mcdonough et al. (2002)	Corporate Environmental Strategy	Verify whether the triple bottom line is still a useful tool to integrate sustainability into the business agenda.	LR	When the principles of ecologically intelligent design are widely applied, nature and commerce can thrive and grow.	510
Kirchherr et al. (2018)	Ecological Economics	Present the first study on CE barriers in the EU.	Interviews - experts in CE (n = 47); EU governments (n = 208)	Cultural barriers and a hesitant corporate culture, are considered the main CE barriers by companies and policy makers.	452
Blomsma and Brennan (2017)	Journal of Industrial Ecology	Articulate the role that CE plays in the waste and resource management debate.	LR	The CE to the waste and resources debate has articulated the capacity for strategies to extend the life of resources as a means of facilitating value extraction.	390
Prieto-Sandoval, Jaca, et al. (2018)	Journal of Cleaner Production	To propose a consensus view of the basic notions of CE and show its relationship with EI.	SLR (n = 162)	EI facilitates CE and represents benefits for environmental regeneration and creates value for nature and humans. The success of CE is related to the EI developed for this purpose.	354
Rizos et al. (2016)	Sustainability	To increase knowledge and understanding about barriers and facilitators experienced by SMEs in implementing CBM.	Case study - SME (n = 32)	European and national policies should strengthen their focus on consumer preferences, market value chains and greener business cultures, and support the recognition of SMEs' green BM.	332
de Jesus and Mendonça (2018)	Ecological Economics	Map the motivators that promote a CE and the barriers that delay it.	SLR (n = 141)	The combination of innovation systems can provide an appropriate perspective for understanding the transition to a CE.	314
Witjes and Lozano (2016)	Resources, Conservation and Recycling	Address the relationship between purchasing and supply practices and propose a change from a traditional process to a service-oriented system.	Grounded Theory	Collaboration between the public procurement process and CBM development serves as a basis for suppliers and buyers to improve their contribution to CE, while ensuring economic benefits for both parties.	290

**Table A.4**

Summary table of the studies included in cluster 4: Determinants to promote CE.

Sub-cluster 4A	Author	Journal	Objective	Methods	Key-findings	Citations
	Kiefer et al. (2019)	Business Strategy and the Environment	Analyse the role of resources, competencies, and dynamic capabilities as determinants of different types of EI.	Survey to industrial SMEs (n = 197)	Policymakers to encourage EI in SMEs should focus on specific policies: improving the availability of physical resources, encouraging the formation of CSCs, and promoting environmental proactivity in companies.	107
	Jakhar et al. (2019)	Management Decision	Explore the impact of stakeholder pressures on company CE initiatives.	Survey to manufacturing companies (n = 276)	The development of innovative capabilities over time plays a key role in guiding firms to adopt CE practices.	77
	Demirel and Danisman (2019)	Business Strategy and the Environment	Examine the impact of circular EI and external financing available for CE activities on the growth of European SMEs.	European Survey (n = 5100)	A significant threshold investment in circular EI is needed for SMEs to benefit from investment in CE.	75
	Bag et al. (2019)	Management Decision	Investigating the role of remanufacturing capacity in influencing SC resilience.	Survey for administrators (n = 150)	Market factors, management factors and technical factors positively influence dynamic remanufacturing capacity.	74
	Khan et al. (2020)	Business Strategy and the Environment	Exploring micro-foundations of dynamic resources in successful CBM cases.	Case studies (n = 4)	Dynamic capabilities contribute positively to the implementation of CE.	74
	Prieto-Sandoval et al. (2019)	Corporate Social Responsibility and Environmental Management	To identify the main strategies and resources that can favour the implementation of CE in SMEs.	Expert interviews (n = 12)	SMEs should implement strategies that fit their dynamic capabilities and their level of maturity in environmental management, to build a corporate strategy that allows	70

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Table A.4 (continued)

	Katz-Gerro and López Sintas (2019)	Business Strategy and the Environment	Clarify the conditions under which SMEs engage in five specific CE activities.	Panel data	them to have a competitive advantage within the CE framework. Waste minimisation is the most likely activity to be implemented in SME, followed by replanning energy use, redesigning products, and using renewable energy.	64
	Barreiro-Gen and Lozano (2020)	Business Strategy and the Environment	Analyse how organisations implement the 4 Rs (reduce, repair, remanufacture and recycle).	Survey to different industries (n = 256)	Organisations are using the 4Rs to contribute to CE, but not all are aware that they are applying CE principles.	59
	Scarpellini et al. (2020)	Business Strategy and the Environment	To analyse and measure formal and informal environmental management systems used in EI and CE within the framework of dynamic capabilities.	Survey to EI companies (n = 89)	Environmental management accounting, environmental HR, and corporate governance are effective in promoting circular EI, while traditional environmental management systems have lost their effectiveness in supporting new circular EI developments.	46
	Chen et al. (2020)	Business Strategy and the Environment	Provide a framework to link CBM typologies, CE transition process and tools for CBM development.	LR	The environmental impacts of business, complements business transition decisions with the information gained from identifying opportunities to improve resource use.	37
<b>Sub-cluster 4B</b>	Genovese et al. (2017)	International Journal of Management Science	Compare the performance of traditional and circular production systems.	Case studies -food and chemical industry (n = 2)	CE goes beyond the boundaries of environmental sustainability, emphasising the idea of transforming products in such a way that there are viable relationships between ecological systems and economic growth.	536
	Ormazabal et al. (2018)	Journal of Cleaner Production	Explore the potential of implementing CE in SMEs and barriers/opportunities that can be recognised.	SME Survey (n = 95)	Companies tend not to commit to environmental issues because they do not think it will increase profits and competitiveness.	171
	Suárez-Eiroa et al. (2019)	Journal of Cleaner Production	To propose operational principles that link the theoretical objectives of CE within SD to practical implementation strategies.	LR	Principles for implementing CE strategies: adjust system inputs to regeneration rates and outputs to absorption rates; close the system; maintain the value of resources within the system; reduce system size; design and educate for CE.	166
	Hazen et al. (2017)	Business Strategy and the Environment	Exploring consumers' willingness to switch from new to remanufactured products.	Survey for academics (n = 445)	Shaping consumer attitudes towards remanufactured products is a key micro-level factor that will enable higher levels of switching.	165
	Bressanelli et al. (2019)	International Journal of Production Research	Identify and systematise 24 challenges that can hinder CSC.	Case studies (n = 4)	The severity of the challenges and their interconnections depend on the configuration of SC and the role of the specific actor promoting SC initiatives.	162
	Centobelli et al. (2020)	Business Strategy and the Environment	Provide a systematic review on the design of the business model in the context of CE.	SLR (n = 133)	To design a CBM, companies must implement specific management practices for each dimension of the BM: value creation, value transfer and value capture.	139
	Stewart and Niero (2018)	Business Strategy and the Environment	Explore how companies incorporate the CE concept into their sustainability agenda.	LR of sustainability reports (n = 46)	CE-related activities needs to be explored and the systemic dimension of CE is rarely present in companies' narratives on CE.	112
	Zucchella and Previtali (2019)	Business Strategy and the Environment	To provide a better understanding of a CBM.	Case study - agriculture industry	The exchange relations between actors, costs and revenues make profit compatible with the preservation and even restoration of the environment.	88
	Dey et al. (2020)	Business Strategy and the Environment	To understand the problems, challenges, and opportunities of adopting CE in SMEs.	Case studies - SMEs (n = 130)	To implement SC in SMEs, social and environmental aspects need to be strengthened, which will result in greater sustainability across the entire SC of SMEs.	76
	Perey et al. (2018)	Business Strategy and the Environment	Identify companies that have changed their BMs to address the tension of waste as a burden and/or resource.	Interviews -waste management companies (n = 8)	Organisations have changed BMs to address pressing sustainability issues and resolve the tension between burden and resources. The focus of change has been to reconceptualise the understanding of the role of	68

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Table A.4 (continued)

Prieto-Sandoval, Ormazabal, et al. (2018)	Business Strategy and the Environment	Establish the key-elements necessary to assess the level of implementation of the CE.	Delphi Method –13 participants	waste in the value chain of their products/services. The importance of EI and the need to measure it as part of the implementation of CE was evident.	67
García-Quevedo et al. (2020)	Business Strategy and the Environment	Identify the main barriers that companies face in promoting CE.	Panel data	The lack of human resources is perceived as an obstacle by companies involved in CE.	59
Moktadir, Dwivedi, et al. (2020)	Business Strategy and the Environment	Recognise the key performance indicators of operational excellence for sustainability.	LR	Implications that help advance operational performance: production monitoring system management; develop stock management system; strong product marketing management resource; maximise return on investment; improved customer satisfaction.	45
Ethirajan et al. (2021)	Business Strategy and the Environment	Identify and analyse risks to promote effective circular initiatives in the SC.	LR	Financial risk was found to be the most vulnerable to CSC and brand the least significant risk.	32

Table A.5

Summary table of the studies included in cluster 5: Emerging digital technologies to enable CE practices.

Sub-cluster 5A	Author	Journal	Objective	Methods	Key-findings	Citations
	de Angelis et al. (2018)	Production Planning & Control	To present propositions on the implications for SC management in CSCs.	SLR (n = 55)	Scaling up BM for CSC depends on funding to enable investment in infrastructure, new technologies and research into alternative and renewable materials.	174
	Yadav et al. (2020)	Journal of Cleaner Production	Develop a framework to overcome SSCM challenges through I4.0 and CE	Case study - automotive industry	Managerial, organisational, and economic challenges emerge as the most critical to adopt SSCM. However, lack of financial, technical, and human resources restrict the adoption of sustainability.	171
	Kouhizadeh et al. (2020)	Production Planning & Control	Examine how blockchain technology can transform and promote the realisation of CE.	Case studies - Blockchain (n = 10)	Blockchain offers a transparent, decentralised, and secure transaction process and can regenerate resources, reduce costs, improve efficiency and responsiveness.	147
	Heyes et al. (2018)	Journal of Cleaner Production	To analyse the potential of service-oriented companies in the information and communication technology (ICT) area to implement CBM.	Case study - ICT microenterprise	ICT companies can support the deployment of a CE in the service-oriented technology sector.	130
	Dev et al. (2020)	Resources Conservation and Recycling	Propose a roadmap to operations excellence for SSC implementing I4.0 and CE.	Data online	The relationship between I4.0 and CE principles are established in the context of managing the operations of a reverse logistics system.	129
	Zhang et al. (2019)	Journal of Cleaner Production	Select the main barriers to smart waste management for a CE.	Interviews - stakeholders (n = 3)	Rapidly evolving smart enabling technologies can catalyse and support the transformation of waste management into true CE.	117
	Fatimah et al. (2020)	Journal of Cleaner Production	Investigate the issues and opportunities of developing a national waste management system in the I4.0 era.	Case study in urban cities (n = 4)	Through the implementation of IoT, digitalisation and ICT, achieving sustainability in waste management is becoming more possible, efficient, and ideal in the I4.0 era.	113
	Gusmerotti et al. (2019)	Journal of Cleaner Production	Study how to get companies to adopt more circular practices.	Survey to manufacturing companies (n = 821)	Business case logic is the only driver that is currently able to move a company from a linear to a circular approach.	99
	Kumar et al. (2021)	Resources Conservation and Recycling	Analyse barriers in the age of I4.0 and CE to improve the sustainability of a CS.	LR	Organisations need to integrate CE and I4.0 principles into manufacturing processes to be competitive and sustainable.	88
	Moktadir, Ahmadi, et al. (2020)	Journal of Cleaner Production	Propose a decision support framework to assess challenges for CE practices.	Expert opinions (n = 6)	Advanced technology can assist decision makers in implementing CE strategies in SC.	67
	Massaro et al. (2021)	Business Strategy and the Environment	Investigate the link between I4.0 and CE, understanding how I4.0 impacts CE in companies.	LR	Technologies associated with I4.0 have the potential to unlock environmentally sustainable production.	46
Sub-cluster 5B	Jabbour et al. (2018)	Annals of Operations Research	Propose a roadmap to improve the application of CE principles through I4.0.	LR	I4.0 can underpin CE strategies as these technologies are the basis for sustainable operations management decisions.	392

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Table A.5 (continued)

Nascimento et al. (2019)	Journal of Manufacturing Technology Management	Explore how I4.0 technologies can integrate into CE practices to establish BM that reuse/recycle.	Focus Group - 3D experts (n = 19)	Socio-technical aspects are directly impacted by the circular smart production system management model, as they create a culture of reuse using 3DP technologies, and I4.0 concepts to increase production and automate manufacturing processes.	261
Despeisse et al. (2017)	Technological Forecasting and Social Change	Determine the facilitators and barriers for 3DP to achieve a CE.	LR	The combination of 3DP with other emerging manufacturing technologies and systems, such as I4.0, IoT, and new materials, are changing the industrial landscape for a sustainable industry.	202
Bressanelli et al. (2018)	Sustainability	Like IoT, Bigdata act on deploying usage-focused BM to achieve CE value drivers.	Case study - household appliances industry (n = 1)	Digital technologies can accelerate the implementation of servitised BM and the transition to CE.	181
Jabbour et al. (2019)	Technological Forecasting and Social Change	Integrate trends and practices related to CBM, stakeholder roles and 4V's of Bigdata management.	LR	The integration of CE and LD involves not only includes new CBM and the 4Vs of Bigdata management, but also understands the needs of stakeholders.	181
Rajput and Singh (2019)	International Journal of Information Management	Understand the hidden connection between CE and I4.0 in the context of CS.	Survey - I4.0 specialists (n = 161)	AI, Service and Policy Framework and CE are significant enablers that connect CE and I4.0.	175
Rosa et al. (2020)	International Journal of Production Research	Identify the relationship between I4.0 and CE.	SLR (n = 158)	I4.0 technologies have a positive effect on product lifecycle management, except Bigdata.	173
Gupta et al. (2019)	Technological Forecasting and Social Change	Identify the ways in which Bigdata analytics can be used to facilitate the adoption of CE.	Interviews - key position holders (n = 10)	Stakeholder support, along with sharing throughout the SC network, can create a basis for achieving the triple bottom line of economic, ecological, and social benefits.	129
Awan et al. (2021)	Business Strategy and the Environment	Identify the interests and expectations of I4.0 stakeholders on how IoT can be part of CE management.	SLR (n = 81)	Managers and CE professionals must develop an IoT with AI tools to accurately predict usage, production, and material requirements.	97

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