



Mapping the Circular Economy in the Small and Medium-sized Enterprises field: An exploratory network analysis^{☆,☆☆}

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ABSTRACT

The literature on the Circular Economy (CE) has shown considerable expansion over recent years, with various studies striving to guide corporate entities in transitioning from linear to circular production paradigms. While larger businesses and multinational corporations have been a central focus, a significant gap exists in understanding the transformation journey of Small and Medium-sized Enterprises (SMEs) towards circularity. This research aims to enhance the existing body of knowledge by mapping the knowledge at the intersection of SMEs and the CE. This study utilizes an exploratory approach and leverages network analysis and content analysis to scrutinize 126 academic papers indexed on Scopus. The findings indicate that the field is bifurcated into nascent and early-growth stages. Although CE appears as the prevalent theme in most of the papers surveyed, an emerging group of academics has begun to delve into the domain of SMEs and CE. Further to identifying thematic clusters, this research explores the main references from these two phases by exploring their contents. The study provides a series of recommendations for future research alongside methodological guidelines for theoretical and empirical investigations.

1. Introduction

A growing interest in the Circular Economy (CE) is seen among government, society, businesses, and academia. As an evolution of the Supply Chain, CE was based on the need to close the loops and gain efficiency to maximize economic advantages (Stahel, 2016; Khan et al., 2022). Adopting a Closed Loop Supply Chain (CLSC) strategy enables enterprises to amplify benefits, minimize overall energy-related costs, and decrease overall emissions (Kumar and Satheesh Kumar, 2013; Morseletto, 2020; Lotfi et al., 2022). Similarly, the CE embraces analogous principles, seeking to optimize resource utilization by augmenting the overall efficiency of the Supply Chain (Pomponi and Moncaster, 2017).

The Ellen MacArthur Foundation's (MacArthur, 2013) contribution emerged to redefine the current industrial model, which values

extractive collection and waste, aiming to reshape growth, focusing on positive societal benefits. The CE gradually decouples economic activities from consuming finite resources and eliminating waste from the entire system. Four main actions toward recovery normally represent CE (Urbanati et al., 2017), also known as 4Rs: (1) to reduce, (2) to repair, (3) to remanufacture, and (4) to recycle. Furthermore, CE activities focus on three levels: the first one, the *micro level*, focuses on the performance of particular companies or consumers; the second is the *meso level*, focusing on inter-organizational relationships, and the *macro level* encompasses a city or region (Ghisellini et al., 2016; Kirchherr et al., 2017; Prieto-Sandoval et al., 2018). This study expands the literature on CE theoretical framework by shedding light on SMEs, that is, the micro level of CE.

The importance of SMEs for countries' economies is widely known, and the Management theory and principles were adapted to address the

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specificness of SMEs and their environment (D'Amboise and Muldow-ney, 1988). The relevance of SMEs is noticeable, especially for the countries that form the OECD. According to an OECD report, SMEs correspond to more than 70% of all existing companies; in some countries, they represent more than 95% (OECD, 2017). SMEs are important in generating employment and responsible for a substantial percentage of the GDP of the said OECD members (Prabawani, 2013; Yadav et al., 2018). Even though the underlined relevance of SMEs to developed and economies under development, these companies are struggling when implementing actions toward sustainability.

Despite the field of study focusing on sustainability in SMEs being numerous, some researchers underlined that it is necessary to understand how SMEs are collaborating and depending on externalities, i.e., the context in which they are operating, as well as at their internal level, i.e., how the SMEs are adapting and implementing actions to become sustainable-oriented companies (Yadav et al., 2018; Cariola et al., 2020; Mani et al., 2020; Malesios et al., 2018). Prior studies have discerned that SMEs rely heavily on external factors to generate 'sustainable value' (Prabawani, 2013; Martins et al., 2022; Broccardo and Zicari, 2020). While many SMEs perceive sustainability as a cost, the work of Burlea-Schiopoiu and Mihai (2019) has illustrated that these enterprises can indeed reap financial gains from sustainability-oriented actions, for instance, by integrating corporate social responsibility into their operations.

Some initial studies on sustainability targeting SMEs date back to the 2000s, when the CLSC perspective was more addressed. Medina-Muoz and Medina-Muoz (2000), when analyzing the SMEs from the Canary Islands, identified that these companies demonstrated to be more willing to implement sustainable actions when they receive governmental support from public policies narrowing environmental activities. Another study by Lawrence et al. (2006) evidenced that New Zealand's economy is almost all formed by SMEs. Moreover, most surveyed SMEs affirmed that they do not formalize their environmental practices on reports. Moreover, participants reported that little pressure from the government led SMEs to undertake sustainable practices (Lawrence et al., 2006). The third study by Williams and Schaefer (2013) underlined that, in the English SMEs, managers already noticed the relevance of environmental actions, and their implementations depend on the manager's values.

Although the sustainability subject is already studied in the context of SMEs in the last twenty years, under several approaches and identifying numerous barriers, Johnson and Schaltegger (2016) noticed that the available tools for implementing sustainability are still perceived to be little or not fully applicable to SMEs. Then, despite the interest of scholars in addressing 'sustainability & SMEs', research and practical gaps remain.

The contribution of CE for SMEs is that CE is already enhancing the performance of organizations that are targeting sustainability in some manner. For example, in the study of Dey et al. (2020), the focus was the 'CE field of actions,' i.e., the taking, making, distributing, using, and recovering actions. As per the authors' knowledge, this study identifies that SMEs are tightly focused on their economic performance when addressing CE transition. In another study, Dey et al. (2020), using the same CE field of actions perspective, identified that SMEs involved in CE implementation improved their environmental performance, mainly in energy and resource efficiency and waste reduction. However, recovery actions contribute less to SMEs achieving environmental performance. Thus, it is clear that the SME, when incorporating some of the CE actions, is aiming and focusing on its economic performance improvement. In turn, this represents that some CE actions could not be implemented due to not providing direct or short-term benefits to the SME. These inferences align with the need for a better understanding of the SMEs' practices toward CE, as underlined by Holzer et al. (2021).

Specifically addressing CE, this theme needs to be studied more in the field. One fact that reinforces the need to explore this subject in the SME context was demonstrated by a special issue launched in the second

semester of 2020 entitled 'Circular Economy in SMEs' by the journal Sustainability, having as guest editors the profs. Drs. Carmen Jaca, Tatiana Reyes, and Marta Ormazabal (Ormazabal et al., 2016). This call is justified because SMEs face even more difficulties with technological, financial, and human resources towards CE implementation (Rizos et al., 2016).

This research is narrowing the emergent stage of literature considering the CE actions within SMEs, departing from contributions such as Ferasso et al. (2021), Howard et al. (2022), Pereira et al. (2022), Sohal et al. (2022), and Sharma et al. (2021). Beyond considering this specific context (Johnson and Schaltegger, 2016), SMEs were chosen due to their challenge in implementing CE due to resources asymmetries (like technology, financial, and human) (Ormazabal et al., 2016; Rizos et al., 2015; Demirel and Danisman, 2019).

CE literature has grown and has been established as a prominent research field in the last decades (Ferasso et al., 2020; Prieto-Sandoval et al., 2018; Bocken et al., 2017). In many countries, SMEs play a key role with numerous contributions to the gross domestic product. Even though both themes are well developed in the literature, the interrelations between CE and SMEs still need to be explored. However, there is no bibliometric/scientometrics study relating the terms CE and SMEs, resulting in the body of scientific knowledge in this field being unknown. This research intends to fill this gap and is considered by the authors as the first to explore the gaps in the CE in SMEs.

The relevance of the CE to contemporary society cannot be overstated. Confronted with the escalating crisis of resource depletion and environmental degradation, transitioning from a linear to a circular economic model is considered a compelling strategy for achieving sustainable growth. By promoting resource efficiency, waste minimization, and value creation, the CE offers a paradigm shift to reconcile economic growth with environmental stewardship (Ikram, 2022).

Considering the above-presented context, we were guided by the following research question: *How CE in the context of SMEs is studied in the Business Management literature?* This network analysis aims to unfold the knowledge structure of CE and SMEs field of study. In doing so, this research used network analysis as an exploratory stage to identify the knowledge structure of the field, key references, and turning points.

According to the authors, this research can be considered the first network analysis to address the CE and SMEs themes under this exploration methodology. This study is motivated by the need to understand how this field evolves and identify key literature associated with specific themes. The network analysis technique via CiteSpace allows the identification of promising research themes according to thematic clusters and mapping of the knowledge structure of the field.

This research offers several contributions. Firstly, it elucidates the knowledge structure of existing literature by probing into the significant characteristics, central themes, key references, and pivotal moments in the evolution of the interplay between the CE and SMEs. Secondly, it unfolds a promising area of research that simultaneously beckons for practical solutions from real-world organizations addressing CE. This study also highlights broader topics within SMEs that warrant further exploration.

Thirdly, this research employs a unique blend of three distinct methodological techniques related to the network analysis of intricate data, thereby pinpointing key references, thematic clusters, and progression in the context of CE and SMEs. Such techniques – network analysis, global map visualization of networks, and content analysis – pave the way for researchers to forge ahead with future theoretical and empirical research utilizing qualitative, quantitative, or Mixed Methods Research. The choice to use exploratory network analysis stems from the fact that a comprehensive understanding can be gained when exploring a field of study through network analysis techniques. By mapping these relationships, we can better understand a wider array of research themes and topics related to SMEs when addressing CE. These combined techniques offer an innovative way to visualize and analyze the diffusion of CE within the SME community, which can provide valuable insights into

the mechanisms that facilitate or hinder this process.

This study aims to fulfill the gap in the literature in several ways. Much of the existing research on the CE is focused on large corporations and industries. The specific challenges and opportunities related to the CE in SMEs might have been overlooked or understudied. Prior research might have concentrated on SMEs and the CE in specific regions or countries. There could be a need for a more global perspective or studies focusing on regions that have not been studied extensively.

There might be a lack of research considering the sector-specific dynamics of the CE in SMEs. Different sectors may have different challenges, opportunities, or strategies for the CE. Few studies may have used network analysis to understand the CE in SMEs. Network analysis can offer valuable insights into the relationships and interactions between different actors in the field. There may be a limited understanding of how policy measures and institutional support can help or hinder the adoption of CE practices in SMEs. Most existing studies might have used cross-sectional designs, providing a snapshot of the situation at one point. Longitudinal studies could be needed to understand the evolution of the circular economy in SMEs.

2. Research design

The approach adopted in this research is an exploratory network analysis of CE and its relations with SMEs. Data collection considered all publications available on Scopus scientific database up to 2021. This scientific database was chosen because it is considered the most comprehensive database in Business Management (Mongeon and Paul-Hus, 2016).

In this exploratory strand, we used Boolean search keywords “Circular economy” AND “SME*” (to include SMEs). Then, the search parameters comprised the terms “Circular economy” AND “SME*” by searching on title, abstract, and keywords. The decision to use ‘circular economy’ as the main term was the widely used term for addressing the CE (Ghisellini et al., 2016; Pietro-Sandoval et al., 2018; Lieder and Rashid, 2016). The decision to use ‘SME*’ term was because it is the widely used abbreviation for Small and Medium-sized Enterprises according to the recommendations of European Commission¹ and OECD.² Additionally, only articles written in English were considered, and no period restriction was used. These procedures returned 126 papers that were considered as final sample, i.e., no quality-check procedure was adopted to journals in order to obtain the vastest number of contributions possible. All the papers were considered, and the metadata was stored for further inspection by downloading the *.RIS and *.CSV files.

Data analysis was conducted in the second strand of the research. We used the network bibliometric approach of Ferasso et al. (2020) and the qualitative analysis procedures of Beliaeva et al. (2022). To better explore the knowledge structure of sampled documents, a co-citation network was built using the software CiteSpace 5.8.R1 version (Chen, 2006, 2014; Chen et al., 2012; Cui et al., 2018). After running exploratory procedures, networks of citations allowed the identification of key references, the strongest linkages, clusters of references, turning points, and the shape of each cluster.

The *.RIS file served as an input file in CiteSpace for data conversion. The software recognized 7486 references from the 126 papers in the sample. From these, 7246 were successfully converted at an acceptable rate of 96.0%, considering the loss range between 1% and 5% from the original *.RIS file. The converted data was scanned using the frame period from December 1970 to December 2021. The text processing parameter was the title, abstract, author keyword, and node types were references. The best configuration for data visualization was the Cosine links parameter, showing a within-slice scope and g-index. The scale

factor (k) value was 25, and the top N level of the most cited references in each slice was 50 (top N% = 10.0%). No pruning procedures were selected, and the chosen visualization was the cluster view static and the merged network. After the adjustments, CiteSpace identified the empty periods, and the new range was automatically changed to the 2010–2021 period.

The network analysis revealed that the top-five most cited papers in the sample were: Ghisellini et al. (2016) (count: 19; centrality: 0.22); Lieder and Rashid (2016) (count: 16; centrality: 0.11); Kirchherr et al. (2017) (count: 14; centrality: 0.12); Ormazabal et al. (2018) (count: 9; centrality: 0.27); and Prieto-Sandoval et al. (2018) (count: 7; centrality: 0.07).

The first result was the network of references (Fig. 3), and the nodes represent the references that were the most cited by the sampled documents. According to the CiteSpace commands, the bigger the network's nodes, the higher the number of citations. The second result obtained with CiteSpace (Fig. 4) is the timeline view of the sampled references. In this representation, the software separates the clusters of references according to key elements (thematic clusters), presenting the references by cluster, by year, and to which other references are related. The last result is the time-zone perspective (Fig. 4), where it is possible to identify the turning points and evolution in the field by each year. This procedure uses the Direct Acyclic Graph (DAG) criterion by creating topological ordering of references with transitive closure (Bang-Jensen and Gutin, 2008; Beliaeva et al., 2022). The timeline view was explored in detail, specifically the subnetworks formed by key references in the co-citation analysis, resulting in the visualizations shown in Fig. 6.

To identify the authors' geographical location in the sample, additional exploration was performed with CiteSpace software. The geographical network visualization is built with the input *.RIS file with the command ‘Google Earth KML Generator’ version 2.2 (2023). The period for generating the map comprised 2010–2021; the scale selected was ‘small.’ Of 1500 records processed, 97% were considered valid (error = 37 records). CiteSpace considers as input information the authors' affiliations to convert them into geographical locations (geospatial data) that are stored in a KML file (Chen, 2014). The KML file is input for another application, Google Earth Pro (version 7. June 3, 9345 of 12/29/2022). This application runs with the data provided by 3D images from NASA Landsat, the EU Copernicus Program, and the International Bathymetric Chart of the Arctic Ocean (IBCAO). The results are shown in Fig. 2.

After identifying key references from network analyses, the full texts were inspected and analyzed according to their content related to CE and SMEs. This qualitative analysis procedure followed the recommendations presented by Ferasso et al. (2020) and Beliaeva et al. (2022), aiming to identify the most common interrelated topics and most promising research directions. The content analysis allowed a deeper and more comprehensive understanding of selected references from the sampled papers.

3. Results and discussion

3.1. Descriptive and visual analysis results

The initial analysis this study embarks on is predicated on bibliometric information. The selection of papers was scrutinized based on the annual count of citations (Fig. 1). As anticipated, the increasing interest in this area is reflected in the distribution, which spans the years 2017–2021. There was a significant growth of citations in 2019 (totaling ~200 citations), continuous growth in 2020 (with ~500 citations), and almost 600 by July 2021.

Analyzing the journals in which the sampled papers most appeared, the Journal of Cleaner Production is first (with 22 papers), followed by the Business Strategy and the Environment journal (with eight papers), and Resources, Conservation and Recycling (with seven papers), and

¹ https://single-market-economy.ec.europa.eu/smes/sme-definition_en.

² <https://www.oecd-ilibrary.org/sites/51269556-en/index.html?itemId=/content/component/51269556-en>.

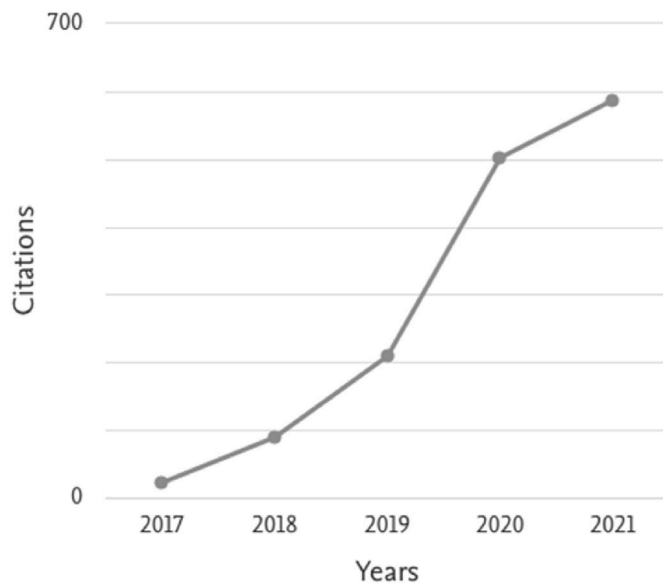


Fig. 1. Citations (excluding self-citations) over the years related to CE and SMEs.

Source: Scopus data.

Journal of Sustainable Metallurgy (with five papers).

The global map provided by the Google Earth Pro application (Fig. 2), considering the authors' affiliation from the sampled papers. This visualization tool allows a comprehensive understanding of research collaborations, represented by the red lines in the map.

The results shown in Fig. 2 revealed that most collaborations came from European countries. Also, European authors are those that collaborate with authors based in selected Asian countries. There are incipient connections with American authors and only one connection with an African author. This result evidenced that European-based authors are those in the front line of the field of CE and SMEs. Although most collaborations occurred among European authors, the second highest set of collaborations belongs to the partnerships between European and Asiatic authors.

3.2. Network analysis results

The ensuing discussion pivots toward the results derived from the CiteSpace analysis. As depicted in Fig. 3, the standard network analysis lays out the knowledge structure concerning the CE and SMEs as gleaned

from the selected papers. This analysis discerns two distinct clusters. The larger cluster, positioned centrally, manifests connections among the cited references that meet the threshold, signifying that this cluster is formed by three distinct subclusters (depicted in yellow, orange, and red). The configuration of this network enables the inference that the field represents a nascent area of study anchored by key references, such as those identified in Section 2.

Intrigued to understand more about the structure of this network, the authors applied the timeline view to exploring how the threshold is structured regarding thematic clusters. This CiteSpace function organizes the network of references according to thematic adherence. It forms different layers of clusters, as seen in Fig. 4. The first cluster (cluster #0) received the automatically generated label of 'case study.' Despite this general label, all the most addressed themes can be consulted for deeper analysis.

This cluster #0 grouped the papers with the most recurrent meaningful features and included: CE, translating principle, disposition decision perspective, multi-method study, CE ecosystem, CE practice, case study, industrial symbiosis, local CE system, and Spanish SME. Then, it is possible to notice that this first cluster is formed with most papers dealing with themes and fundamentals of CE. In this cluster, the work of Ghisellini et al. (2016) is the most cited reference and was a key reference for the authors that came after. This layer (or subcluster) is the most long-existing cluster (counting references from 2010) because this group of references is the most focused on the CE than on SMEs. Other key authors may be noticed in this layer. Therefore, future studies are needed to explore the relations between CE actions and the reality of SMEs, to unfold what is called 'CE ecosystem' to identify the main actors and relations in promoting the CE from the ecosystemic perspective and the local CE system. The theme of industrial symbiosis needs further development to identify how SMEs develop or implement it.

The key influential reference in this layer (cluster #0) is Ghisellini et al. (2016), influenced by authors from clusters 0, 1, 2, and 4; and influenced the authors. This reference was the most influential of the authors that came after it in the same cluster #0. This layer represents the orange cluster of Fig. 3, which is the cluster that has the higher centralities measures of the network.

The second cluster (cluster #1) grouped the references comprising: CE, entrepreneurial ecosystem, sustainable business model, emerging economy, circular agriculture, circular business model, fashion industry, circular agriculture, and Dutch farmer. We conclude that this cluster brings the notion of the circular business model and the notion of entrepreneurship. Among the co-cited papers in this cluster, the most influential reference is Lieder and Rashid (2016), influenced by earlier authors from clusters 0, 1, 2, and 4. Therefore, more research must address the CE relations in the entrepreneurial ecosystems and how

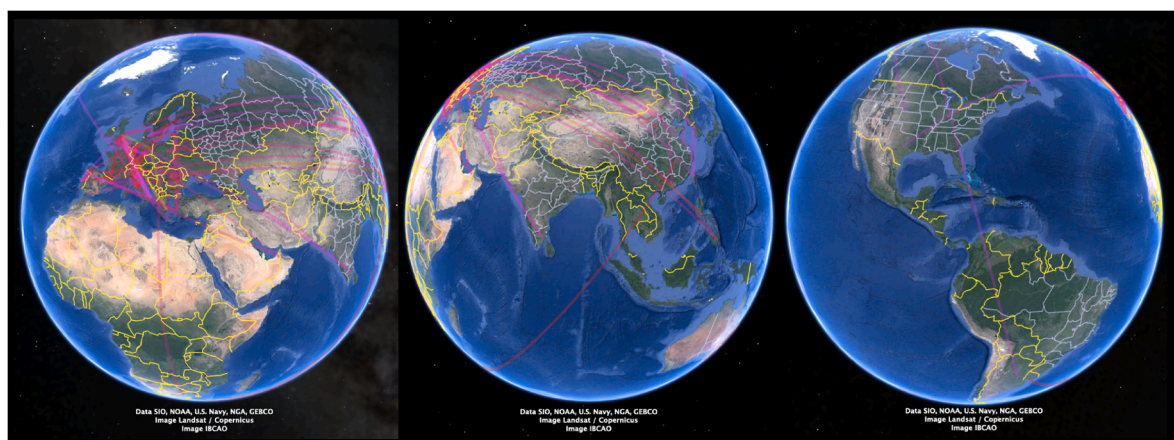


Fig. 2. Global map of authors' collaborations according to geographical distributions of affiliations.

Source: own elaboration with CiteSpace and Google Earth Pro.

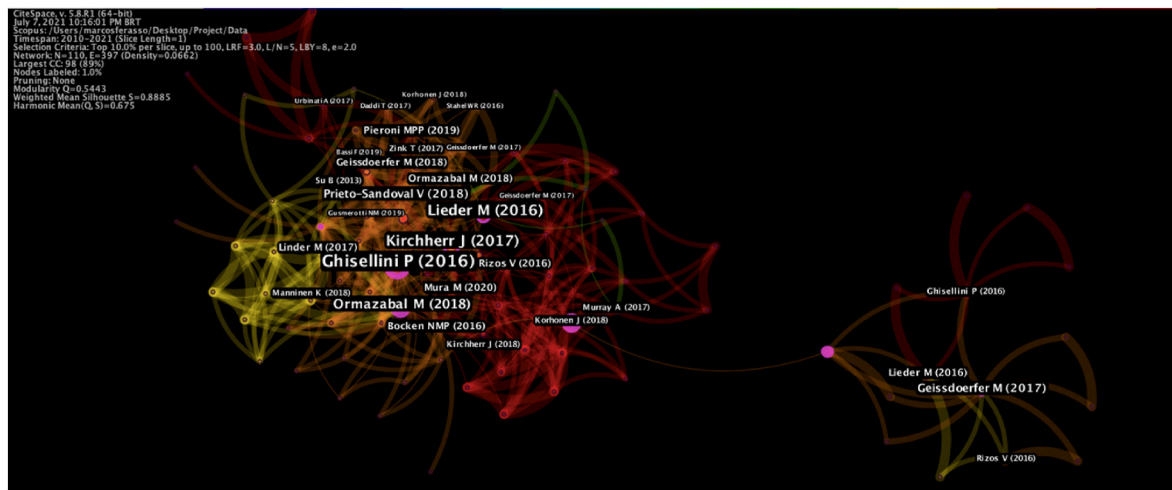


Fig. 3. Structure of scientific contributions related to Circular Economy and SMEs.
Source: own elaboration with CiteSpace.

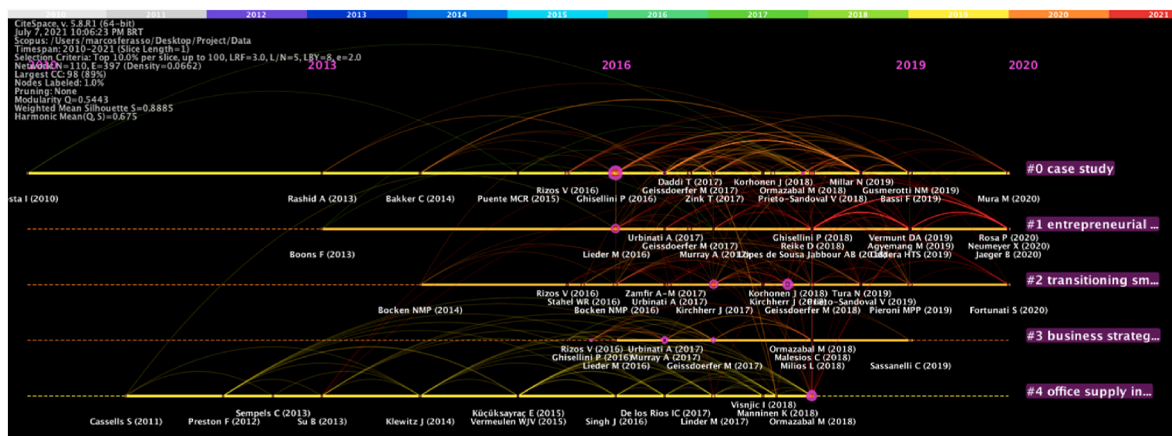


Fig. 4. Timeline view of scientific contributions according to thematic clusters.
Source: own elaboration with CiteSpace.

SMEs transition or implement sustainable business models. Despite the first developments regarding agriculture and fashion industries, two of the main impacted industries regarding sustainability issues, other industries/sectors where SMEs operate need further development.

The third cluster (cluster #2) showed the agglomeration of the following themes: CE, transitioning SME, organizational learning, translating principle, disposition decision perspective, sustainability, disposition decision perspective, medium-sized companies, and proposing CE ecosystem. Interestingly, the findings provided novel keywords such as the transitioning SME and CE ecosystem. Three co-cited references are key in this layer, those of Kirchherr et al. (2017) – influencing late authors in clusters 0, 2, and 4; followed by Geissdoerfer et al. (2018) and Korhonen et al. (2018). Novel research can depart from the notion of organizational learning in the CE precepts by exploring, for example, how an SME can implement transitions from a linear to a circular business model.

The fourth cluster (cluster #3) provided the following themes: network interaction, business strategy, sustainable development, European Union, CE practice, sustainable development, medium-sized firm, and CE. This thematic cluster provides evidence of the business strategy and network interactions toward CE. Two co-cited references stand out in this layer: Geissdoerfer et al. (2017) and Urbinati et al. (2017). Thus, future research can delve deeper into the nexus between business strategy and CE practices within the framework of SMEs. There is a

pressing need for additional inquiries to decipher how network interactions or relationships within the CE ecosystem could recalibrate SMEs in their transition toward circular business models.

Lastly, the fifth cluster (cluster #4) allowed the identification of the themes: office supply industry, managerial practice, designing CE business model, Italian SME, value creation, medium-sized companies, systematic CE encouragement, and managerial practice. These findings underlined some key aspects for SMEs, such as the CE business model and value creation, that are core for the shift towards CE. In this cluster, the co-cited reference of Ormazabal et al. (2018) was influenced by several previous authors presented in clusters 0, 2, and 4 and influenced several authors that came after it in clusters 0 and 1.

More studies are needed to identify how SMEs can create value through new CE business models and how these CE business models are affected by supply chains in which SMEs are embedded. The managerial practices towards CE in various analyses are also needed by exploring, for example, the role of the manager's personality towards CE, green leadership in SMEs, and CE strategies implemented in SMEs.

Aiming to identify turning points in the threshold, we explored the time-zone view with CiteSpace. This function allowed the distribution of references according to the year of publication and according to the co-citations formed by the DAG graph. The structure of co-citations over the years revealed two distinct periods in the field. The first, called the 'nascent stage,' comprises the first appearance of references from 2010

to 2015. The second comprises the ‘early-growth stage’, the period 2016–2020, where it is noticed a higher number of publications and high co-citations among the references in this period if compared with the co-citations in the ‘nascent stage.’ These links are shown in [Fig. 5](#).

The time-zone view provided by CiteSpace is useful for identifying turning points in a field of study. The results from this technique revealed interesting findings. The existence of two well-defined periods in the literature on CE and SMEs is noticeable. The identified turning point was in 2016, which divided the co-cited references into the 'nascent stage' (in yellow and green) and the 'early-growth stage' (in orange and red). At the nascent stage, the works of [Su et al. \(2013\)](#), [Khaliq et al. \(2014\)](#) as well as [Rizos et al. \(2015\)](#) are located and represent some of the early appearance references in this period. The early-growth stage grouped the most cited references discussed earlier in this section. Despite the most citing references of the early-growth stage, comprising the period of 2015–2020, the time-zone allowed the identification of seminal papers in the nascent state. This is particularly useful for researchers to frame their future research when addressing seminal research on CE and SMEs.

After identifying the key references in the network analyses, they were selected for further qualitative analysis as presented in the next section.

3.3. Content analysis of nascent and early-growth key references

After identifying the key literature in the field of CE and SMEs with the aid of network analysis, the key selected references are now analyzed in detail. Since the networks generated by CiteSpace were based on co-citations, it refers to the frequency at which one specific reference is cited by two or more documents (Beliaeva et al., 2022). Then, the co-citations reveal the most cited references in a given sample. The most representative references were analyzed qualitatively according to the content analysis (Ferasso et al., 2020; Beliaeva et al., 2022). The results are presented in Table 1.

Cross-checking the two network analysis techniques (the timeline and the time-zone views), the key co-cited references were grouped according to the two identified stages in the time-zone view, i.e., the nascent and early-growth stages. The references were presented chronologically in [Table 1](#), and the specific topics related to CE and SMEs were described. The analyses revealed interesting findings as presented and discussed as follows.

The nascent stage is characterized by fewer co-cited references in the sample, evidencing that those located in this stage are references that extensively address both the CE and SMEs. Except for the book on CE published by [Preston \(2012\)](#), the remaining references were dedicated

to analyzing CE in the context of SMEs. Only the research of [Cassells and Lewis \(2011\)](#) is based on empirical quantitative study that comprised the environmental management practices led by SMEs. [Cassells and Lewis \(2011\)](#) underlined SMEs' vision over environmental issues and impacts by mainly considering the environmental actions and the resources involved. Additionally, they focused on the SMEs' owner/manager attitudes to reduce the environmental impacts of SMEs' activities.

The theoretical study of [Su et al. \(2013\)](#) revealed how SMEs depend on public policies to engage CE, because SMEs are still focused on the cost-benefits assessment of environmental actions. Among the topics, [Su et al. \(2013\)](#) covered the CE strategies and how CE can be implemented at the city level.

The last key reference in the nascent stage is the book chapter of [Rizos et al. \(2015\)](#). Although this book chapter is devoted to underlining the CE fundamentals and implementation in the SMEs context, the authors underlined interesting and promising topics for future research directions, like SMEs' circular business models and the environmental culture SMEs can foster. Additionally, the authors identified extensive barriers for SMEs to adopt CE, representing a must-read reference in the field.

Therefore, at the nascent stage, the three key co-cited references that are properly relating the CE and SMEs topics were the works of [Cassells and Lewis \(2011\)](#), [Su et al. \(2013\)](#), and [Rizos et al. \(2015\)](#). These references were the most co-cited by the sampled papers and represent key references to be addressed in future research. Also, these references belong to the thematic cluster #4 ([Fig. 4](#)), evidencing the references that were grouped by CiteSpace according to the homogeneity of key topics the references were addressing. Cluster #4 ([Fig. 4](#)) is the less-developed cluster, evidencing the need to consider the themes related to CE and SMEs in future research.

Regarding the early-growth stage, as depicted in Fig. 5, more co-cited references stand out in this period compared to the previous one. One out of nine co-cited references in this early-growth stage addressed CE and SMEs as core topics, referring to Ormazabal et al. (2018) research. All the remaining references address CE in theoretical and fundamentals views, like Ghisellini et al. (2016), Lieder and Rashid (2016), Kirchherr et al. (2017), Geissdoerfer et al. (2017), Urbinati et al. (2017), Korhonen et al. (2018), and Pietro-Sandoval et al. (2018). Although not addressing SMEs, one empirical case study addressed the CE business model and its integration with supply chain management in the context of the businesses (Geissdoerfer et al., 2018).

It is possible to notice how the most co-cited references influenced later studies when inspecting the links of subnetworks in Fig. 6. In order of most influential works, Fig. 6(a) shows the most diversified set of links for Ghisellini et al. (2016), Fig. 6(e) for Lieder and Rashid (2016), Fig. 6

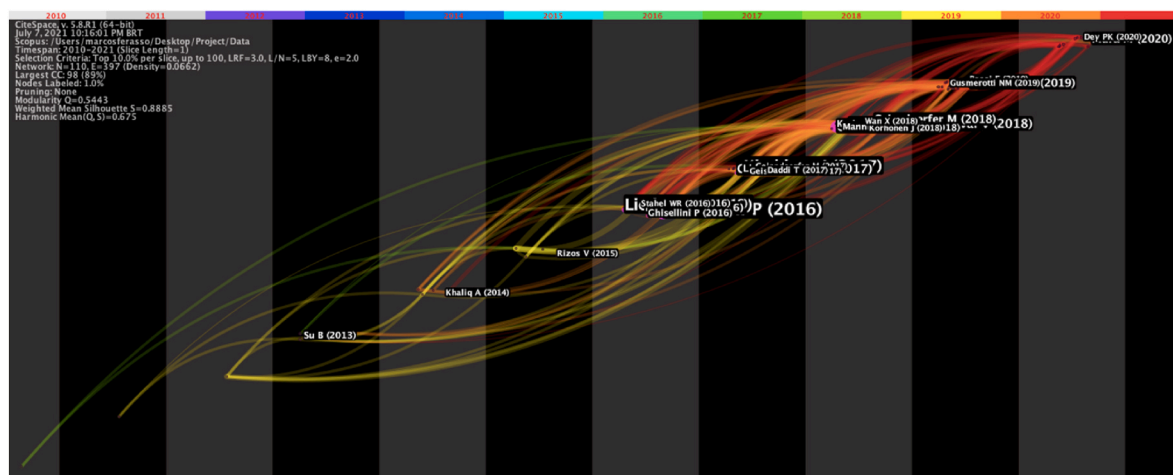


Fig. 5. Time-zone view of scientific contributions and turning points. Source: own elaboration with CiteSpace.

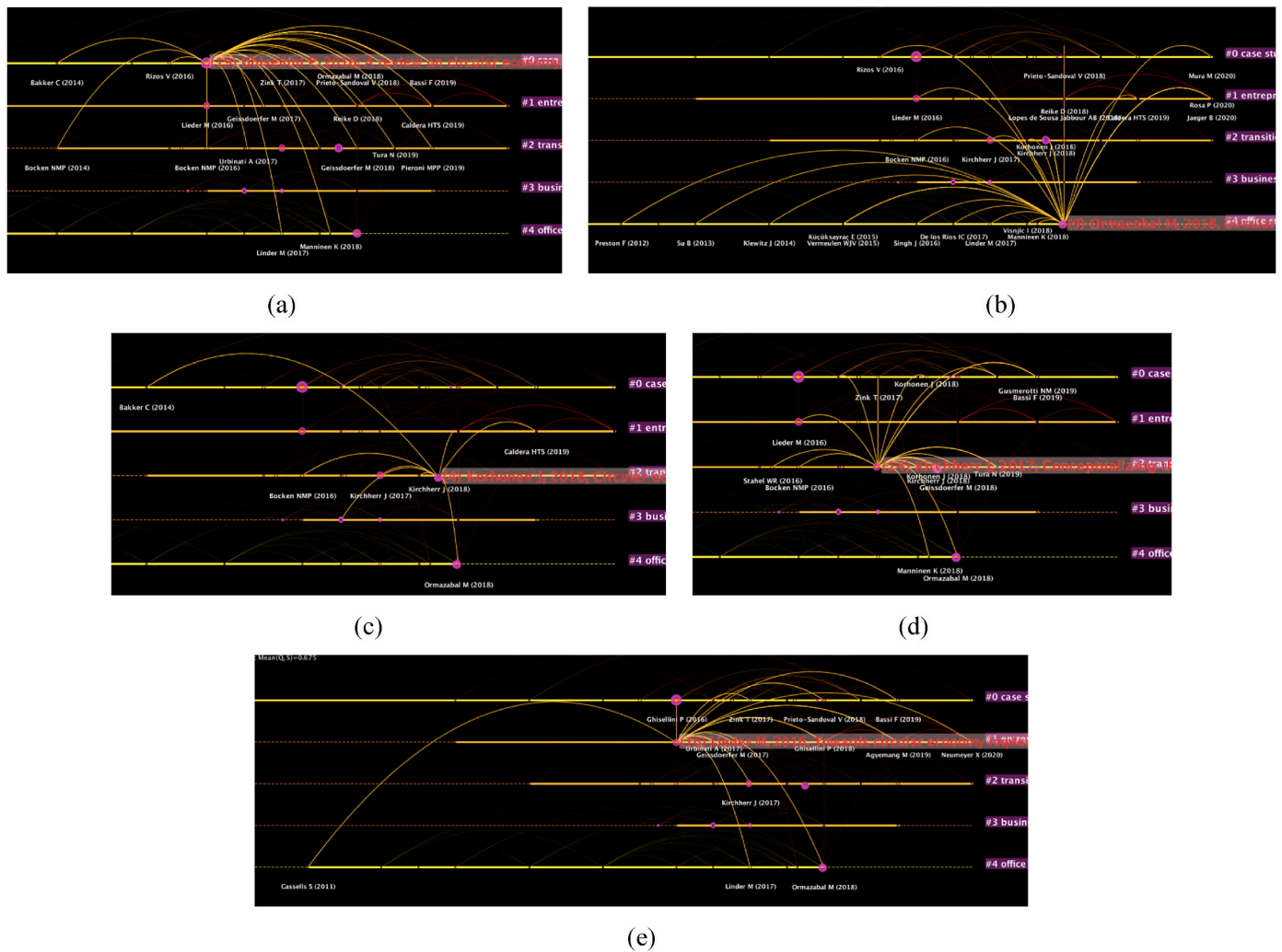


Fig. 6. Subnetworks of most influential references according to the timeline view and thematic clusters.
Source: own elaboration with CiteSpace.

(d) for Kirchherr et al. (2017), and Fig. 6(c) for Korhonen et al. (2018). These results show how the sampled papers addressed the leading references purely dedicated to CE to better address the CE topic. Another interesting finding shown in Fig. 6(d), representing the subnetwork of Kirchherr et al. (2017) study, is that these authors cited references such as Lieder and Rashid (2016) and were then cited by Ormazabal et al. (2018).

Therefore, although the most co-cited references are grouped in the early-growth stage (Fig. 5), these references are the most co-cited by the sampled papers, and it is explained by the need to gain a better understanding of the CE fundamentals, concepts, taxonomies, implementations, business models, barriers, challenges, and opportunities. Interestingly, only one reference linking both topics of CE and SMEs appeared in this stage, i.e., Ormazabal et al. (2018), covering topics of CE implementation and the environmental strategies and circular business models for SMEs. The research of Ormazabal et al. (2018) was influenced by the most of previous research in the same cluster (#4), as seen in Fig. 6(b), the same cluster that grouped several references dedicated to CE and SMEs. This is the most comprehensive subnetwork when comparing the links of influential references for the research conducted by Ormazabal et al. (2018).

Thus, from the exploration of the selected literature, it is possible to notice that the edge of CE and SMEs is built on topics such as:

- SMEs' environmental management and resources;

- SMEs' owner/manager attitudes toward environmental impacts;
- Waste management actions in SMEs' context;
- Public policies and incentives for SMEs to engage in CE;
- Cost-benefit assessments of environmental engagement;
- Circular business models for SMEs; and
- CE strategies for SMEs.

3.4. Promising research directions and themes

The findings revealed several research directions to be further developed. From the perspective of CE, more research is needed to broaden the understanding of CE practices in the SMEs context and represent promising research directions such as:

- How SMEs are engaging in *reducing, repairing, remanufacturing, and recycling* activities in their daily tasks;
- Identifying the barriers and drivers of *reducing, repairing, and remanufacturing* by SMEs;
- How SMEs are enacting with their CE ecosystem (micro, meso and macro levels) to engage in CE activities;
- What kind of public policies at the local level can leverage SMEs to engage in CE actions;
- How SMEs can build sustainable value with key stakeholders for reaching eco-innovations in a collaborative way;

Table 1

Content analysis of key references in the field of CE and SMEs.

Stage (Fig. 5)	Belonging cluster (Fig. 4)	Reference	Specific topics addressed to CE	Specific topics addressed to SMEs	Main contributions or novelties
Nascent stage	4	Cassells and Lewis (2011)	Operational, waste management, design, and environmental management practices to reduce SME's environmental impact.	SMEs' issues related to management and resources. SMEs' owner/managers attitudes. Environmental engagement, attitudes, and actions. Waste management. SMEs' owners/managers attitudes.	Empirical quantitative research of New Zealand manufacturers SMEs regarding environmental practices. Most common SMEs' environmental management practices were identified.
	4	Preston (2012)	CE fundamentals. Resources consumption and environmental constraints.	None.	Book on CE fundamentals.
	4	Su et al. (2013)	China's public policies toward CE. CE strategies. CE at city level.	Most SMEs have few or no incentives from public policies to incorporate greener activities. Cost-benefits assessment for equipment update.	Holistic literature review on CE in Chinese context.
	4	Rizos et al. (2015)	CE fundamentals. CE implementation. Green Action Plan for SMEs.	SMEs' circular business models. SMEs' environmental culture. Barriers: financial, lack of government support and effective legislation, information, administrative burden, lack of technical skills, lack of support from supply and demand network.	Book chapter describing the literature review on CE barriers and enablers for business practices. Provides insights for supporting SMEs in adopting CE and public policies.
Early-growth stage	0	Ghisellini et al. (2016)	CE origins, principles, advantages and disadvantages, economic development models, and implementation.	None.	Comprehensive theoretical study on CE covering the period of 2004–2014.
	1	Lieder and Rashid (2016)	Reduce, reuse, and recycle activities (3R). CE framework (environmental impact, economic benefits, resource scarcity). CE implementation strategy.	None.	Comprehensive review of CE literature on resources scarcity, waste generation, and economic advantages.
	2	Kirchherr et al. (2017)	CE taxonomy. Reduce, reuse, and recycle activities (3R).	None.	Theoretical study on 114 CE definitions.
	3	Geissdoerfer et al. (2017)	CE fundamentals, taxonomy, and definitions.	None.	Extensive literature review that provides conceptual clarity of CE terms and types.
	3	Urbiniati et al. (2017)	CE fundamentals. CE adoptions. CE business models.	None.	Extensive literature review of CE that proposes a CE business models taxonomy.
	2	Geissdoerfer et al. (2018)	CE fundamentals. Circular business models. Circular supply chain.	None.	Four case studies and literature review, the study proposes an integrated view of circular business models and circular supply chain management for businesses.
	2	Korhonen et al. (2018)	CE fundamentals. CE challenges and limitations.	None.	Provides CE definitions and a critical review of the concept in the environmental sustainability field.
	4	Ormazabal et al. (2018)	CE implementation. Industrial symbiosis. Recirculation of resources.	Environmental strategy. Economic costs view of environmental issues. Circular business models. Short-term vision of environmental management.	Case studies that identified barriers and opportunities of CE implementation in SMEs.
	0	Pietro-Sandoval et al. (2018)	CE framework. CE at micro, meso, and macro levels. CE implementation. Eco-innovations determinants (regulation and policy, supply side, demand side).	None.	Systematic literature review that provides unified notions of CE framework and relationships with eco-innovations.

Source: own elaboration.

- How governments can reduce the costs for SMEs to incorporate CE practices as an incentive for their transition to CE;
- How SMEs can benefit from renewable energy sources, implement resource efficiency, and foster waste reduction in their operations/manufacturing processes;
- How to address the several lacks SMEs face, such as technology, financial, and human resources, to incorporate CE practices in a faster way;

- How to foster collaborations toward eco-innovations among SMEs and the actors pertaining to the local CE ecosystem;
- To identify which kinds of skills and knowledge are needed for SMEs to incorporate CE practices;
- How to promote access to green investments to SMEs to acquire new equipment and greener technologies that can help SMEs to reduce their environmental impacts; and
- How SMEs can be more societal-devoted organizations by promoting social inclusion through supportive CE actions in local communities.

These are some of the promising research suggestions we underline to be addressed by future research based on the qualitative analysis of selected literature.

4. Concluding remarks

This study examined how the CE is addressed within the context of SMEs in Business Management literature. We discerned a research gap by executing exploratory network analyses and content analysis of indexed studies within the Scopus scientific database.

It was identified that SMEs constitute the backbone of many economies, accounting for a significant proportion of employment and GDP. Their involvement is thus indispensable to making the CE a reality. However, compared to large corporations, SMEs face unique challenges in implementing the CE, including limited resources, lack of awareness, and access to technology. These factors underscore the importance of studying the adoption of CE among SMEs (Rizos et al., 2015, 2016).

The CE and SMEs field of study proved to be at the initial stage of development, and many research directions are possible to increase the academic and practitioners understanding of the CE in the context of the SMEs. This research aimed to shed some light on the vast array of possibilities for scholars and practitioners to address the discussed topics in this manuscript.

4.1. Summary of the findings

Our findings highlight those scholarly investigations about the CE and SMEs that emerged approximately a decade ago, with a surge in progress noted over the past six years. Utilizing network analyses and content analysis, we identified five thematic clusters and the turning point in the field. Longitudinal and thematic cluster examinations indicate that a substantial proportion of academic works in this field predominantly focus on the CE theme, compared to SMEs. Notably, the most considerable collection of papers relating to the themes of the CE was amassed within Cluster #0.

What stands out in the early-growth stage is the reference of Ormazabal et al. (2018), the sole reference in this subcluster dedicated to CE and SMEs, resulting in a key reference in the field. Exploring cluster #1, the themes of CE and business model are noticed, whilst cluster #2 is the cluster that more relates the CE and SMEs. Then, key references that explored both CE and SMEs and could be further explored are Geissdoerfer et al. (2018), followed by Kirchherr et al. (2017), and Korhonen et al. (2018).

4.2. Study's limitations and opportunities for researchers

This research presented some limitations. Including or parallel comparisons with other scientific databases may lead to different results, which could also be a suggestion for future bibliometrics studies. As the authors carried out the initial exploratory strand of wider, another limitation is that we were focused on identifying key references not only by total citations but by influence degrees in the network in the field. Then, an in-depth qualitative or Mixed Method study is needed to identify concepts, taxonomies, elements, and contexts where CE is studied in the context of SMEs. This limitation can also be converted into a suggestion for any future research.

Additionally, this research did not explore some promising searching terms to be addressed in a more general overview of Business Management, such as a) CE and family firms, and b) CE and entrepreneurship. These limitations serve as suggestions for future research for systematic literature review, network analysis, and/or bibliometrics studies.

Another limitation that needs to be addressed is the data interpretation from the qualitative data analysis (content analysis). Interpretations can vary from author to author, even though the authors of this research inspected all the stages of the qualitative analysis. Lastly, using other scientific databases (in conjunction or in isolation) like Web

of Science, Science Direct, or EBSCO may report different findings, depending on the journals indexed to each database. We adopted Scopus because it is the most comprehensive scientific database for the Business Management field of study, as underlined in the research design section. Including books in the analyses can also be considered and advance the understanding of the established field, like what occurred with the exemplary of Preston (2012) in the references of sampled papers.

4.3. Future research and methodological directions

Beyond the suggestions for future research addressed in the results and discussion section, we can recommend some final suggestions. This research aimed to contribute to the literature by mapping the knowledge structure of CE and SMEs. Suggestions for further qualitative, quantitative, or Mixed Methods Research were provided. The findings described in this research permit suggest future research. First, definitions of CE and SMEs should be explored and developed. Second, the field of research is characterized by theoretical studies and case studies (as seen in the first layer of Fig. 3). Third, quantitative and Mixed Methods Research are also encouraged for analyzing the CE in the context of SMEs.

More research is also recommended to cover new contexts addressing empirical research for cross-comparisons. Authors from different continents can collaborate more to understand the different realities of SMEs around the globe (as evidenced in Fig. 2). There is also a need for scholars and policymakers to address public policies for incentivizing SMEs to engage in CE actions.

The research directions proposed in the qualitative analysis of key co-cited literature provide extensive suggestions on how academia can help SMEs owners/managers address practical problems in CE implementation. Further studies are needed to address the specific topics addressed, which is urgent for SMEs to incorporate CE actions. Another relevant aspect identified is the role of governments in finding ways to incentivize SMEs to engage in environmental actions on the findings future research can provide according to the suggested topics in this research.

Declaration of competing interest

The authors declare no conflict of interest.

Data availability

Data will be made available on request.

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