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Scientometric Analysis of Circular Innovation: A Novel Approach for Sustainability

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Abstract: This paper aimed to explore the current research trends in circular innovation (CI) through scientometric analysis of data, acquired from the Web of Science (WoS) database, using the VOSviewer program. By applying some filters to draw boundaries, this paper found 917 journal articles related to CI in the Social Sciences Citation Index. Tables and maps were used to visualize and illustrate the keywords occurrence, leading journals, authors, and countries that made the greatest contribution to the research field. As the first scientometric analysis of CI research, this paper provided an up-to-date and inclusive big picture of related literature, indicating its unique and primary value. In addition, this paper understood and visualized research patterns and trends and identified main topics, countries and journals, which added value to the innovation and sustainability literature. The research results showed that the number of citations and publications about CI increased rapidly after 2010, and the most prominent issues related to CI were circular economy (CE), circular business models, sustainability, and sustainable development. Finally, the paper presented future research directions of CI linked to business management.

Keywords: İnnovation; Circular innovation (CI); Circular economy (CE), Sustainability; Scientometric analysis; Web of Science (WoS) database

1. Introduction

The concept of CE has become prominent globally among countries, policymakers, organizations, scientific institutions, and firms in the 21st century (Merli et al., 2018). It is increasingly regarded as a solution to environmental, social, and economic challenges, stemming from increasing waste generation, pollution, consumption of non-renewable resources, and resource scarcity (Lieder & Rashid, 2016). The linear economy that has prevailed until today adopts the "take-make-consume-and-throw away" approach, including over-exploitation of natural resources and accumulation of waste products polluting the environment, which is now about to be ineffective, because it is insufficient in combating climate change and ensuring sustainability. However, the CE, a newly developing phenomenon, endeavors to minimize raw materials per unit of output and recycle wastes as much as possible to reuse them as production inputs. The CE approach recycles wastes or used materials by creating added value, and reuse them in ways that benefit the economy. Therefore, companies need to make radical changes in their manufacturing processes. Transforming the production processes into a circular manner necessitates research and development (R&D) and implementation of novel activities, which requires companies to innovate by adopting circular principles. Inherently, it is more inclusive to use the concept of CI, compared with sustainable, eco, or green innovation in the literature.

Innovation is key to accelerating CE because it runs across the entire CE process and value chain, ranging from business production and delivery of products or services to the end user. After completing its economic life, a product is thrown away and turned into garbage in linear economic model. On the contrary, the end user focuses on maximizing the life of the product by repairing it, delivering it to collection centers for recycling or different creative uses in CE. Therefore, CI refers to a model, in which the end user adopts the open innovation model and all value chain members have sustainability awareness and responsibility, including redesign and production processes of an enterprise.

A joint report prepared by the World Business Council for Sustainable Development & the Boston Consulting Group (2018) asserted that three types of CI with varying degrees of complexity could be considered, namely, process, product, and business model CI. First, circular process innovation focused on developing and implementing new or significantly improved production, logistics, or recycling methods, involving production as well as collecting and recycling waste created during the manufacturing process, which was the easiest to implement and achieve, because it dealt with operational areas under direct control of the organization. These innovations also had lower risks because changes in manufacturing processes were unlikely to affect customers directly. However, strategic planning and change management were required to ensure employees seamlessly adjusted to the new processes. Second, circular product innovation concentrated on developing and implementing new or significantly improved products or services and covered more value chain areas, including procurement, product development, use of products by customers, and ways of "collecting and recycling" products at the end of their life cycle by the firm. This required thorough research on technologies, skills, market trends, and consumer behavior. Success depended on several factors, such as commitment to recruit and train employees, coordination and cross-functional cooperation among employees with different skills across departments, and inclusion of external partners with different skills and/or resources to produce circular products. Circular product innovation may seem more complex and difficult to initiate and achieve as it required the buy-in and active involvement of various divisions in the organization. Third, circular business innovation was the most complicated, because it involved significant changes in the entire value chain, including marketing and sales of products, which required considerable time and resources to educate customers, influence and change consumption habits, disrupt conventional market practices, pricing strategies, etc. This was the most challenging to implement, because it demanded new logic of value generation of a firm, new ways of thinking by designers, new research insights, and collaboration between multiple parties across the organization and from the marketplace.

CI is highly attractive for firms, mainly because it creates and captures lost and hidden value for a firm, the environment, and society (Konietzko et al., 2020). In addition, implications of CI often are beyond the individual firm and affect the value chain. Therefore, examining CI, a significant and newly developing concept in the literature, is crucial. This study aimed to answer these following research questions (RQ):

RQ 1: What are the topics discussed extensively in the literature?

RQ 2: What concepts are associated with CI?

RQ 3: What research gaps exist in the field?

This study attempted to assess the CI literature using the scientometric analysis (SA) methodology. However, due to lack of SA in CI, there was a lacuna in objectively and comprehensively understanding the literature, which was solved by critical assessment and analysis using co-occurrence and bibliographic coupling (BC) document analysis methods. This paper was the first to provide an up-to-date and inclusive big picture of CI literature and added value to the innovation and sustainability literature. CE, circular business models, sustainability, and sustainable development were found to be the most prominent issues related to CI.

To answer the above questions, the research framework of this paper included RQs and reasons in Chapter 1, source of data and research method in Chapter 2, and co-occurrence and BC document analysis of CI in Chapter 3. Finally, Chapter 4 and 5 interpreted and summarized the above results and identified the limitation of this paper. Furthermore, the paper presented future research directions of CI concerning business management.

2. Methodology

Scientometrics is defined as an informational process where a scientific area is quantitatively studied, using bibliometric links, co-citation, and cognitive structure mapping of scientific knowledge, and is considered as one of the essential disciplines of science. Being first used by Pritchard (1969) as early as 1969, bibliometrics has been accepted as a mathematical and statistical method for publications and is also considered a division of scientometrics (Iancu et al., 2022). Unlike conventional literature review, whose research framework is based on the subjective experience of authors, bibliometrics analyzes objective scientific data (Pan et al., 2022).

Bibliometric analysis provides valuable, chronological, and practical statistical information, which can further be used by those assessing such systematic progress in the research area (Duque Oliva et al., 2006; Katoch, 2022). Furthermore, quantitatively, scientometric research using bibliographic data (Broadus, 1987) presents a common overview of a scientific area according to various indicators. By adopting a scientometric methodology, this study aimed to determine the most relevant literature and different streams in the field and identify the leading journals, primary authors, and countries at the forefront of CI, which is helpful to get a quick overview of state of the art in a particular area. Moreover, the key results can be precious for newcomers in the field and for identifying research gaps for future CI studies.

The first step in scientometric research involves choosing the databases of documents ("articles" in this study). This study selected the WoS database, because it is widely acknowledged for collecting integrated and reliable data. Furthermore, it provides multidisciplinary research from multiple sources based on impact assessments, meeting the highest quality standards (Podsakoff et al., 2008). The next step is to select meaningful keywords that

clearly return articles on this topic. Two primary keywords “circular” and “inno*” (the symbol * allows for the inclusion of the plural) were selected, because innovation can be written in various forms, such as innovation, innovative, innovativeness, etc. This paper obtained 917 net results between 1975-2022 after searching the database and applying some filters to the search results. To focus on the most revealing parts of the research, merely “journal articles” were selected. In addition, these articles should be written in English and restricted to Social Sciences Citation Index (SSCI). The results showed that the first article in this field was written in 1992. The study was conducted in October 2022, and excluded publications in 2022, because all related articles were categorized in a full year period.

Developed by Van Eck and Waltman (2010), the VOSviewer is a popular visualization tool that utilizes the VOS (visualization of similarities) for cluster analysis. It was used for bibliometric mapping and visualization of publications, because it allowed algorithmic and automatic analysis of the publications, co-authorship, keyword cluster exploration, and the most productive authors in literature.

3. Data Analysis

The research data was processed by VOSviewer software, which visualized and illustrated authors contributed the most, journals, countries, and most cited articles in tables and maps. Figure 1 demonstrates that the first article found was published in 1992. However, the number of publications and citations about CI increased rapidly since 2010, particularly 2018.

The first ten categories with the largest number of articles in the total 917 WoS articles are presented in Table 1. Accordingly, it was determined that the studies related to CI were mostly in the categories of “Environmental Sciences”, “Green Sustainable Science Technology”, and “Environmental Studies”.

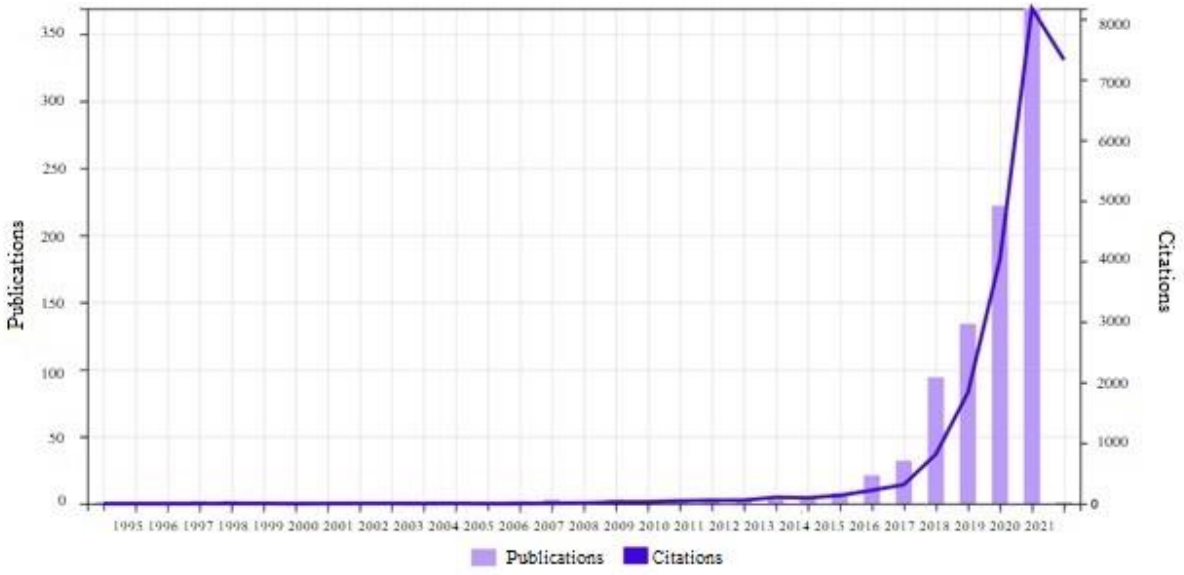

Figure 1. Number of publications and citations from 1992 to 2022
Note: this figure was prepared by the author using WoS tools.

Table 1. Number of articles in WoS categories

WoS categories	Number of arcitles	Percentage (%)
Environmental Sciences	512	55.834
Green Sustainable Science Technology	448	48.855
Environmental Studies	367	40.022
Engineering Environmental	228	24.864
Management	121	13.195
Business	110	11.996
Economics	49	5.344
Regional Urban Planning	37	4.035
Energy Fuels	25	2.726
Operations Research Management Science	25	2.726

Note: the author prepared this table by using WoS data.

Figure 2 shows the countries with the most publications in the WoS database. In addition, Turkey was also included in the graph to determine its status in the world ranking. According to the figure, Italy ranks first with 127 CI publications (13.8%); England is second with 118 publications (12.9%); the People's Republic of China ranks third with 105 publications (11.4%); Turkey is in the 25th place with 13 publications (1.4%).

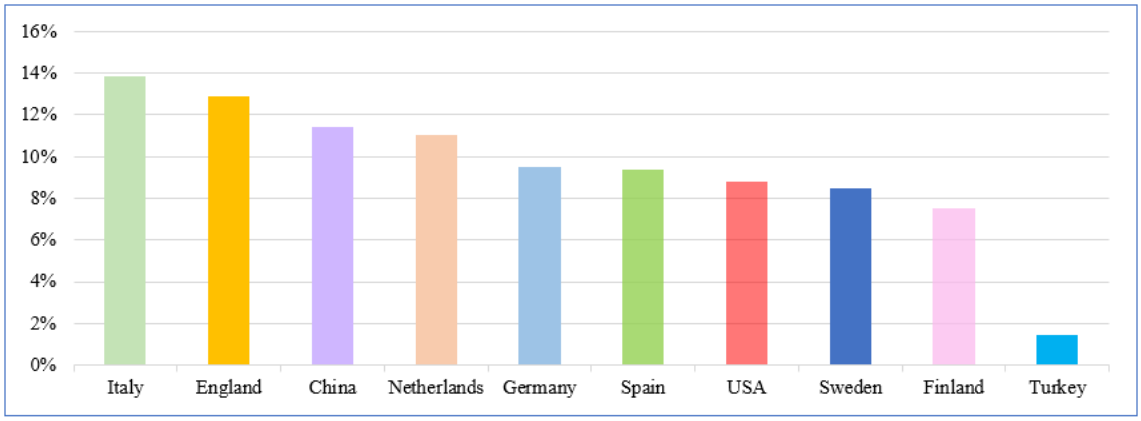

Figure 2. Top countries with the highest WoS articles, including Turkey
Note: this figure was prepared by the author.

Table 2. The most cited CI articles

Authors/Year	Title	Journal	Total citations	Annual average citations
(Kirchherr et al., 2018)	"Barriers to the Circular Economy: Evidence from the European Union (EU)"	Ecological Economics	443	88.6
(D'Amato et al., 2017)	"Green, circular, bio economy: A comparative analysis of sustainability avenues"	Journal of Cleaner Production	365	60.83
(Prieto-Sandoval et al., 2018)	"Towards a consensus on the circular economy"	Journal of Cleaner Production	346	69.2
(Linder & Williander, 2017)	"Circular Business Model Innovation: Inherent Uncertainties"	Business Strategy and the Environment	337	56.17
(Geissdoerfer et al., 2018)	"Business models and supply chains for the circular economy"	Journal of Cleaner Production	329	65.8
(Rizos et al., 2016)	"Implementation of Circular Economy Business Models by Small and Medium-Sized Enterprises (SMEs): Barriers and Enablers"	Sustainability	327	46.71
(Helkkula et al., 2012)	"Characterizing Value as an Experience: Implications for Service Researchers and Managers"	Journal of Service Research	320	29.09
(Huang et al., 2018)	"Construction and demolition waste management in China through the 3R principle"	Resources Conservation and Recycling	310	62
(De Jesus & Mendonça, 2018)	"Lost in Transition? Drivers and Barriers in the Eco-innovation Road to the Circular Economy"	Ecological Economics	305	61
(Urbinati et al., 2017)	"Towards a new taxonomy of circular economy business models"	Journal of Cleaner Production	305	50.83

Among the publications in the WoS database, the top ten most cited articles are presented in Table 2. Accordingly, the most cited article was written by Kirchherr et al. (2018), which examined four types of CE barriers in the European Union (EU), namely, cultural, market, regulatory, and technological barriers. The second most cited study was written by D'Amato et al. (2017), which comprehensively analyzed the diversity within and between the CE, green economy, and bio-economy.

Keywords are the words mentioned after the abstract section in an article and some other index terms associated with the document, which are the principal terms used throughout the article and directly involved with the article's perspective. Co-occurrence analysis is a preferred method in bibliometric analysis and is made based on the keywords specified by authors in the article in order to understand popular and potential future topics.

Keyword association was created according to the number of times that keywords were repeated in the

documents (Van Eck & Waltman, 2013). In the co-occurrence map, the circle size indicated the repetition times of keywords. That is, the larger the circle, the more frequent the keywords in that field were repeated. This paper emphasized the relative distance of one concept from another, and the proximity of keywords between points meant that the two concepts were more relevant. Furthermore, the shorter and thicker the lines, the stronger the bond between keywords.

In keyword co-occurrence map in Figure 3, each cluster of the CI thematic area is identified with a different color. The concept repeated the most in each cluster was shown in the larger dimension representing the central concept. Thematic clusters were determined and named by examining the keywords in each cluster.

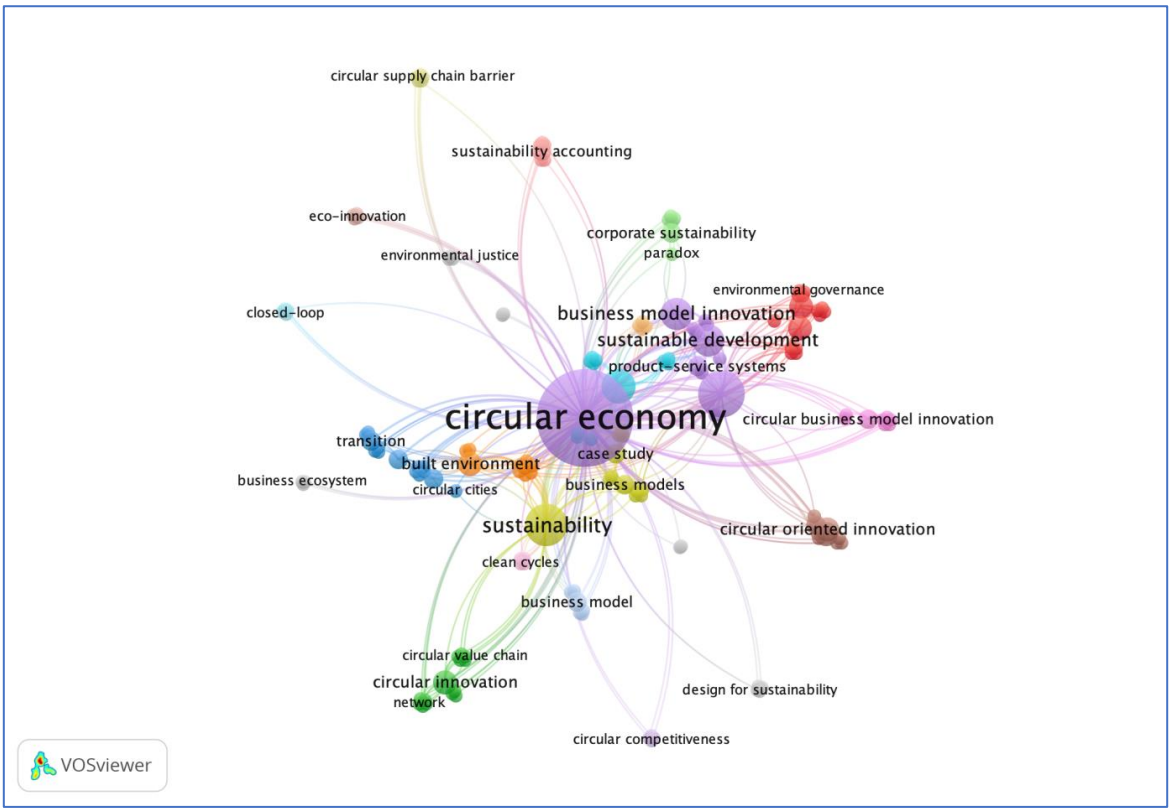

Figure 3. Keyword co-occurrence
Note: this figure was prepared by the author using VOSviewer.

This paper evaluated the results produced by the VOSviewer program and named the clusters. Accordingly, the themes covered in the articles were classified into thirteen clusters, which were created by the keyword co-occurrence, namely, CE & environment, business models, open innovation, circular urbanization, innovation orientation, institutional & managerial & strategical issues, circular production management, system design, supply chain management, marketing issues, paradigms, entrepreneurship, decision making & methodologies. Clusters and featured keywords are presented in Table 3.

According to the findings, it is noteworthy that the concept of CE is the most studied subject in the field and has the largest circle size. The second most discussed topics in the articles were "circular business models, sustainability, and sustainable development", shown in purple and yellow.

As the analysis unit, the BC document analysis method offers opportunities to interpret and decipher the intellectual structure of the research field comprehensively and objectively (Patil & Rahman, 2022; Zupic & Čater, 2015). BC links papers referencing an identical set of papers and evaluates the similarity among citing documents, which is forward-looking and suitable for capturing current research trends and studying emergent literature fields within a research area (Boyack & Klavans, 2010; Vogel & Güttel, 2013). In addition, BC associates documents with similarities in their reference lists, indicating the probability of a shared topic (Maseda et al., 2022).

BC uses citations to explain the similarities between two authors, documents, countries, or institutions, under the assumption that two documents referencing the third paper are highly related and should concentrate in a cluster solution of the visualization map (Mas-Tur et al., 2021). On the one hand, BC document analysis generates groups of recent documents based on the shared references they carry, representing the current knowledge. On the other hand, the document co-citation analysis clusters old documents cited in recent research, representing basic knowledge (Mukherjee et al., 2022; Patil & Rahman, 2022).

Table 3. Contents of the clusters

Cluster name	Featured keywords
Circular economy & environment	Circular economy, sustainable development, nature-based solutions, circular business models, circular drivers and barriers, circular competitiveness, economy-ecology reintegration, industrial ecology, environmental governance, environmental policy, European Union, biological cycle, closed-loop
Business models	Business model innovation, business ecosystems, business model design, business models, circular business models, sustainable business models
Open innovation	Open circular innovation, stakeholder collaboration, crowdsourcing, open innovation, network, circular collaboration canvas, collaborative innovation, collaboration, stakeholder engagement, circular ecosystems
Circular urbanization	Regional planning, buildings, built environment, construction industry, urban circular economy, circular cities, urban landscape design, urban metabolisms, historic cities, port cities, transition, future imaginaries
Innovation orientation	Circular innovation, circular-oriented innovation, circular business model innovation, sustainable oriented innovation, responsible innovation, eco-innovation
Institutional & managerial & strategical issues	Business strategy, bank finance, innovation finance, corporate social responsibility, corporate sustainability, environmental management accounting, sustainability accounting, environmental justice
Circular production management	Circular design, cleaner production, digital technology, digitalization, idea selection, new product development, circular product, product life extension, product obsolescence, process model, manufacturing, manufacturing company, product-service systems, servitization
System design	Systemic design, system thinking, design for sustainability, policy design
Supply chain management	Circular supply chain, circular value chain, supply chain management, short food supply chains, local food system, direct food purchasing, circular supply chain barrier, clean cycles
Marketing issues	Customer's attitude, customer's behaviour, ethical purchase intention, retail
Paradigms	Environmental paradigms, sustaincentrism, paradigm shift, orchestration
Entrepreneurship	Circular entrepreneurship, start-up, entrepreneurial orientation
Decision-making & methodologies	Multicriteria decision making, the unit of analysis, social indicators, data envelopment analysis, fuzzy logic, decision-making and trial evaluation laboratory (DEMATEL), indicators, metrics, comparative case study research, systematic literature review, decision trees, sustainable business decisions, tool development, project selection

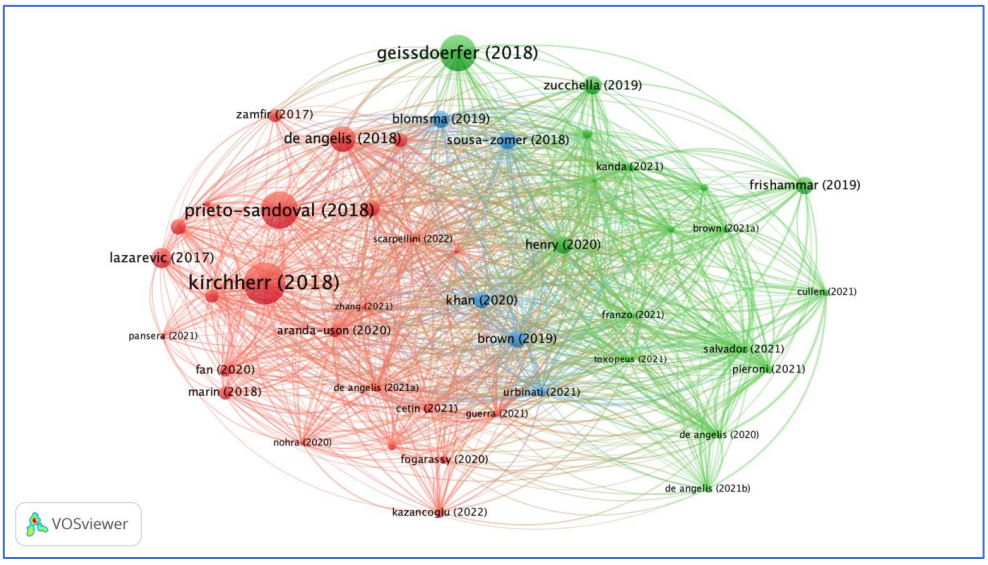

Figure 4. BC (documents)
Note: this figure was prepared by the author using VOSviewer.

BC occurs when two documents cite the same paper (Mulet-Forteza et al., 2018), which illustrates the strength of specific article in relation to a set of other articles. The BC documents analysis possibly shows what authors and documents are correlated through multiple citations (Cavalcante et al., 2021). This paper made BC analysis with at least two citations using VOSviewer's full counting method for documents, which were the unit of analysis. Figure 4 presents the BC of documents and allows us to measure and observe their connection intensity.

The map in Figure 4 reveals three well-defined clusters and concomitant citations between the documents drawn in lines. Topics of the highest-cited authors in the green cluster mostly focus on circular business models, circular supply chains, and circular start-ups. In the second cluster in red, the topics are mainly about CE barriers, EU policies towards CE, and circular supply chains. Finally, the third cluster in blue has the least citation density, whose topics are about circular-oriented innovation.

4. Discussion

This study aimed to investigate how CI was handled in the WoS articles because CE needed more systemic innovation approaches. In addition, business and innovation ecosystems rarely shaped around CE or sustainability issues. Therefore, scientometric analysis was made to examine this issue.

The research results showed that CI studies were less cited than other subjects, because CI is an emerging field, and related publications have only begun in the last few years. In other words, very few research has studied CI. WoS-based articles discussed different types of innovation and the concept of CE. Prominent innovation types in CE were business model innovation, collaborative innovation, product and process design, and eco-innovation.

CE is necessary to separate economic growth from resource consumption and environmental impacts. However, its effective implementation requires a systemic change in supply chains, including both technological and non-technological innovations (Mendoza et al., 2017). Thus, there is a need for innovations beyond enterprises. Apart from eco-innovation, CI requires adopting an open CI approach, with all stakeholders participating in the value chain. Circular-oriented innovation research is nascent (Brown et al., 2021). Instead of examining CI in depth, Eisenreich et al. (2021) only mentioned the necessity of collaborating with external partners, such as research institutions, suppliers, customers, or technical experts. Therefore, research gaps exist in open CI, which needs to be explored.

In addition, Nyström et al. (2021) pointed out that little effort concentrated on combining adaptable design with CE research. Innovation instruments in most existing circular business models are qualitative and focus on creating initial concepts (Bocken et al., 2019). However, adaptable design techniques are inverse: detailed-oriented and quantitative (Fletcher et al., 2009; Li et al., 2008). Thus, the quantitative and technical approaches required in adaptable design may be prohibitively challenging for use in circular business model development (Nyström et al., 2021).

5. Conclusions

CI, or circular-oriented innovation mentioned in the literature, is an emerging field, and more research is needed. The so-called collaborative, networked, or ecosystem innovations essentially fall under the umbrella of open innovation. It is essential to study open CI, because CE requires co-creation and collaboration of different stakeholders in the value chain. In addition, it is important to specifically study both circular product innovation to carry out R&D activities of redesign and remanufacturing, which are elements of CE, and transformation of the used materials and remanufacturing of these transformed materials.

This study made the following contributions by applying the scientometrics method to the CI:

(1) Helping newcomers to rapidly know the situations of present research;

(2) Helping experts to understand the research trends in a data-driven way;

(3) Helping scientists to make reasonable plans for prospective studies.

This paper made the keyword co-occurrence analysis in order to respond to RQ 1. The themes of CI articles in the WoS database were classified into thirteen clusters and named, such as CE & environment, business models, innovation orientation, open innovation, circular urbanization, circular production management, system design, institutional & managerial & strategical issues, supply chain management, marketing issues, paradigms, decision-making & methodologies, and entrepreneurship.

Then this paper made BC document analysis using VOSviewer software in order to investigate RQ 2. The most cited articles were reviewed and highlighted in three clusters: circular business models, circular supply chains, and circular start-ups in the first cluster; CE barriers, EU policies towards CE, and circular supply chains in the second cluster; circular-oriented innovation in the third cluster.

As a result of applied analysis, this paper examined the less covered and cited topics of articles. A research gap was observed in several areas in response to RQ 3, such as circular strategies, circular product and process innovation, open CI (also including crowdsourcing, circular ecosystem innovation), digital technology and CE, circular design, case study methodology in CE, product-service systems, circular entrepreneurship, circular supply chain management, circular business models, manufacturing companies, ethical purchase intention, customers' attitude, nature-based solutions, circular cities/buildings, food supply chains, and sustainable business decisions. In addition, future studies can explore how to apply innovation in CE in various industry sectors using case study methodology and different decision-making techniques, as well as what type of CI is needed in specific sector and product groups.

The research samples of this study are limited to articles listed in the WoS Core Collection database, excluding publications in databases like Scopus and Pubmed, sources not available online, and other publication types. It is suggested that future studies can overcome this limitation by analyzing other publications instead of articles, including publications in different international databases.

Data Availability

The data used to support the research findings are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflict of interest.

References

Bocken, N., Strupeit, L., Whalen, K., & Nußholz, J. (2019). A review and evaluation of circular business model innovation tools. *Sustain., 11*(8), 2210. https://doi.org/10.3390/su11082210

Boyack, K.W. & Klavans, R. (2010). Co-citation analysis, bibliographic coupling, and direct citation: Which citation approach represents the research front most accurately? *J. Am. Soc. Inf. Sci. Technol., 61*(12), pp. 2389– 2404. https://doi.org/10.1002/asi.21419

Broadus, R. N. (1987). Toward a definition of "bibliometrics". *Sci., 12*, 373-379. https://doi.org/10.1007/BF02016680

Brown, P., Von Daniels, C., Bocken, N. M. P., & Balkenende, A. R. (2021). A process model for collaboration in circular oriented innovation. *J. Clean. Prod., 286*, 125499. https://doi.org/10.1016/j.jclepro.2020.125499

Cavalcante, W. Q. D. F., Coelho, A., & Bairrada, C. M. (2021). Sustainability and tourism marketing: A bibliometric analysis of publications between 1997 and 2020 using vosviewer software. *Sustain., 13*(9), 4987. https://doi.org/ 10.3390/su13094987

D'Amato, D., Droste, N., Allen, B., Kettunen, M., Lähtinen, K., Korhonen, J., Leskinen, P., Matthies, B. D., & Toppinen, A. (2017). Green, circular, bio economy: A comparative analysis of sustainability avenues. *J. Clean. Prod., 168*, 716-734. https://doi.org/10.1016/j.jclepro.2017.09.053

De Jesus, A. & Mendonça, S. (2018). Lost in transition? Drivers and barriers in the eco-innovation road to the circular economy. *Ecol. Econ., 145*, 75-89. https://doi.org/10.1016/j.ecolecon.2017.08.001

Duque Oliva, E. J., Cervera Taulet, A., & Rodríguez Romero, C. (2006). A bibliometric analysis of models measuring the concept of perceived quality inproviding internet service. *Innovar*, *16*(28), 223-243.

Eisenreich, A., Füller, J., & Stuchtey, M. (2021). Open circular innovation: How companies can develop circular innovations in collaboration with stakeholders. *Sustain., 13*(23), 13456. https://doi.org/10.3390/su132313456

Fletcher, D., Brennan, R.W., & Gu, P. (2009). A method for quantifying adaptability in engineering design. *Concurr. Eng., 17*(4), 279–289. https://doi.org/10.1177/1063293X09352123

Geissdoerfer, M., Morioka, S. N., de Carvalho, M. M., & Evans, S. (2018). Business models and supply chains for the circular economy. *J. Clean. Prod., 190*, 712-721. https://doi.org/10.1016/j.jclepro.2018.04.159

Helkkula, A., Kelleher, C., & Pihlström, M. (2012). Characterizing value as an experience: Implications for service researchers and managers. *J. Serv. Res., 15*(1), 59-75. https://doi.org/10.1177/1094670511426897

Huang, B., Wang, X., Kua, H., Geng, Y., Bleischwitz, R., & Ren, J. (2018). Construction and demolition waste management in China through the 3R principle. *Resour. Conserv. Recycl., 129*, 36-44. https://doi.org/10.1016/j.resconrec.2017.09.029

Iancu, T., Tudor, V. C., Dumitru, E. A., Sterie, C. M., Micu, M. M., Smedescu, D., Marcuta, L., Tonea, E., Stoicea, P., Vintu, C., Jitareanu, A. F., & Costuleanu, L. C. (2022.) A scientometric analysis of climate change adaptation studies. *Sustain., 14*(19), 12945. https://doi.org/10.3390/su141912945

Katoch, R. (2022). IoT research in supply chain management and logistics: A bibliometric analysis using vosviewer software. *Mat. Today: Proc., 56*, 2505-2515. https://doi.org/10.1016/j.matpr.2021.08.272

Kirchherr, J., Piscicelli, L., Bour, R., Kostense-Smit, E., Muller, J., Huibrechtse-Truijens, A., & Hekkert, M. (2018). Barriers to the circular economy: Evidence from the European Union (EU). *Ecol. Econ., 150*, 264-272. https://doi.org/10.1016/j.ecolecon.2018.04.028

Konietzko, J., Bocken, N., & Hultink, E. J. (2020). Circular ecosystem innovation: An initial set of principles. *J. Clean. Prod., 253*, 119942. https://doi.org/10.1016/j.jclepro.2019.119942

Li, Y., Xue, D., & Gu, P. (2008). Design for product adaptability. *Concurr. Eng., 16*(3), 221–232. https://doi.org/10.1177/1063293X08096178

Lieder, M. & Rashid, A. (2016). Towards circular economy implementation: A comprehensive review in context of manufacturing industry. *J. Clean. Prod., 115*, 36-51. https://doi.org/10.1016/j.jclepro.2015.12.042

Linder, M. & Williander, M. (2017). Circular business model innovation: Inherent uncertainties. *Bus. Strat.*

Environ., *26*(2), 182-196. https://doi.org/10.1002/bse.1906
Maseda, A., Iturralde, T., Cooper, S., & Aparicio, G. (2022). Mapping women's involvement in family firms: A review based on bibliographic coupling analysis. *Int. J. Manage. Rev*., *24*(2), 279-305. https://doi.org/10.1111/ijmr.12278
Mas-Tur, A., Roig-Tierno, N., Sarin, S., Haon, C., Sego, T., Belkhouja, M., Proter, A., & Merigó, J. M. (2021). Co-citation, bibliographic coupling and leading authors, institutions and countries in the 50 years of Technological Forecasting and Social Change. *Technol. Forecast. Soc. Change*, *165*, 120487. https://doi.org/10.1016/j.techfore.2020.120487
Mendoza, J. M. F., Sharmina, M., Gallego-Schmid, A., Heyes, G., & Azapagic, A. (2017). Integrating backcasting and eco-design for the circular economy: The BECE framework. *J. Ind. Ecol.*, *21*(3), 526-544. https://doi.org/10.1111/jiec.12590
Merli, R., Preziosi, M., & Acampora, A. (2018). How do scholars approach the circular economy? A systematic literature review. *J. Clean. Prod.*, *178*, 703-722. https://doi.org/10.1016/j.jclepro.2017.12.112
Mukherjee, D., Lim, W. M., Kumar, S., & Donthu, N. (2022). Guidelines for advancing theory and practice through bibliometric research. *J. Bus. Res.*, *148*(5), 101–115. https://doi.org/10.1016/j.jbusres.2022.04.042
Mulet-Forteza, C., Martorell-Cunill, O., Merigó, J. M., Genovart-Balaguer, J., & Mauleon-Mendez, E. (2018). Twenty five years of the Journal of Travel & Tourism Marketing: A bibliometric ranking. *J. Travel Tourism Mark.*, *35*(9), 1201-1221. https://doi.org/10.1080/10548408.2018.1487368
Nyström, T., Whalen, K. A., Diener, D., den Hollander, M., & Boyer, R. H. W. (2021). Managing circular business model uncertainties with future adaptive design. *Sustain.*, *13*(18), 10361. https://doi.org/10.3390/su131810361
Pan, L., Wang, L., & Feng, Q. Q. (2022). A bibliometric analysis of risk management in foreign direct investment: insights and implications. *Sustain*., *14*(12), 7078. https://doi.org/10.3390/su14127078
Patil, T. & Rahman, Z. (2022). Mapping the Cause-Related Marketing (CRM) field: document co-citation and bibliographic coupling approach. *Int. Rev. Public Nonprofit Mark.*, 1-30. https://doi.org/10.1007/s12208-022-00347-1
Podsakoff, P. M., MacKenzie, S. B., Podsakoff, N. P., & Bachrach, D. G. (2008). Scholarly influence in the field of management: A bibliometric analysis of the determinants of university and author impact in the management literature in the past quarter century. *J. Manage*., *34*(4), 641-720. https://doi.org/10.1177/0149206308319533
Prieto-Sandoval, V., Jaca, C., & Ormazabal, M. (2018). Towards a consensus on the circular economy. *J. Clean. Prod.*, *179*, 605-615. https://doi.org/10.1016/j.jclepro.2017.12.224
Pritchard, A. (1969). Statistical bibliography or bibliometrics. *J. Doc.*, 25, 348.
Rizos, V., Behrens, A., Van der Gaast, W., Hofman, E., Ioannou, A., Kafyeke, T., Flamos, A., Rinaldi, R., Papadelis, S., Hirschnitz-Garbers, M., & Topi, C. (2016). Implementation of circular economy business models by small and medium-sized enterprises (SMEs): Barriers and enablers. *Sustain.*, *8*(11), 1212. https://doi.org/10.3390/su8111212
Urbinati, A., Chiaroni, D., & Chiesa, V. (2017). Towards a new taxonomy of circular economy business models. *J. Clean. Prod*., *168*, 487-498. https://doi.org/10.1016/j.jclepro.2017.09.047
Van Eck, N. J. & Waltman, L. (2013). VOSviewer manual. *Leiden: Univeristeit Leiden*, *1*(1), 1-53.
Van Eck, N. & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Sci.*, *84*(2), 523-538. https://doi.org/10.1007/s11192-009-0146-3
Vogel, R. & Güttel, W. (2013). The dynamic capability view in strategic management: A bibliometric review. Int. *J. Manage. Rev.*, *15*(4), 426-446. https://doi.org/10.1111/ijmr.12000
World Business Council for Sustainable Development, & The Boston Consulting Group (2018). *The New Big Circle. Achieving growth and business model innovation through circular economy implementation*. http://docs.wbcsd.org/2018/01/The_new_big_circle.pdf, 28 Nov 2022.
Zupic, I. & Čater, T. (2015). Bibliometric methods in management and organization. *Organ. Res. Methods*, *18*(3), 429-472. https://doi.org/10.1177/1094428114562629