A Bibliometric Analysis on the Link between Circular Economy and Supply Chain

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Abstract

Circular economy and supply chain are two topics that have aroused the interest of researchers in recent years, which we can find in a relationship of interdependence in the literature. The aim of this paper is to make a review using the technique of bibliometric analysis, on the interconnections in the literature between the concepts of circular economy and supply chain. In this sense, papers published on those subjects indexed in Web of Science (WoS) - 473 publications and Scopus - 633 publications were analysed, while identifying the most influential journals and authors in this area of study. The results highlighted an upward trend of publications on this topic, a top of the journals with the most published papers, a top of the most influential journals based on the number of citations received, the most influential papers depending on the number of citations received and a keywords co-occurrence mapping using VOSviewer software. Those results are useful in terms of identifying the most prolific journals regarding the volume of articles published, but also the most influential in terms of the volume of citations received, while drawing a clearer path for future research that may include in an integrated manner the circular economy and supply chain to identify ways to achieve superior economic performance in a sustainable manner.

Keywords: *Circular economy, supply chain, sustainability, bibliometric analysis, VOSviewer.*

JEL classification: *M21, Q20.*
DOI: 10.24818/RMCI.2021.4.555

1. Introduction

In the context of the current competitive environment, which can be described by dynamism, technological development, a high level of competition and the presence of multiple challenges, companies feel the pressure of survival among competitors. To this end, organizations are trying to adapt to dynamic processes in order to respond to changes that will occur both in their external environment and in their internal environment. This adaptation, which is expected to be necessary, does not circumvent the supply activity.

At the same time, in recent decades, increasing consumption around the world has put pressure on the environment, causing climate change and intensifying competition for resources. The growing demand for resources makes the industry and

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society dependent on imports as well as vulnerable to high prices and market volatility (Europe et al., 2018). All this makes procurement play a particularly important role, in a context where the need to meet these challenges is increasingly clear by promoting an economy that is equally sustainable, efficient, and circular.

While the abovementioned context is still an emerging subject for researchers, to contribute to filling this research gap, the aim of this paper is to study the existing connections in the literature between the concepts of circular economy and supply chain through articles published on those subjects which are indexed in Web of Science (WoS) and Scopus by identifying the most influential journals and authors in this area. The structuring of the paper considered the realization of a bibliometric analysis, through techniques specific to this type of analysis, described in the section dedicated to research methodology. Thus, articles published until 2020 were analysed within the two major databases, namely WoS and Scopus. To begin with, we turned our attention to the temporal evolution of published articles that contained the keywords: circular economy and supply chain. In terms of results, the paper presents a top 10 of journals by number of articles containing the two keywords and a top 10 of journals by number of citations of those articles, followed by a comparative approach by indexing WoS, respectively Scopus to determine the impact on the literature. Additionally, with the help of VOSviewer (version 1.6.17) we created a keywords map. In the end, the conclusions and limitations of the research were highlighted.

2. Literature review - the importance of the concepts

In a circular economy, the value of products and materials should be maintained for as long time as possible. Waste as well as resource use are kept to a minimum, and at the time a product reaches the end of its lifecycle, it is used to create further value again (World Bank Group, 2018). This approach can bring some major economic benefits, while contributing to innovation, growth, and the creation of new jobs (Morseletto, 2020). A circular economy encourages long-term sustainability and competitiveness. In a circular economy, economic activity builds and rebuilds the overall health of the system. The concept recognizes the importance of the economy having to function efficiently at all levels - for large and small businesses, for organizations and individuals, globally and locally (Ellen MacArthur Foundation, 2017).

Increased global competition has an impact on manufacturing companies, as intense competition puts pressure on scarce resources, which affect their availability and cost. Therefore, many companies have investigated the opportunity to develop a business model based on the circular economy. Such business models can minimize the use of scarce natural resources and can also reduce the volume of waste generated (Bag et al., 2020).

Procurement plays an important role in circular economy-based operations, as supplier selection, strategic partnerships with suppliers, environmental certifications and the ecological process adopted by suppliers are all activities that

enable the supplier to support an organization's sustainability objectives. Uncertainty and complexity are the key words when it comes to product recovery and / or recycling. Therefore, the success of a firm adopting such practices largely depends on how the firm manages the supply and the appropriate logistics flows (GarcíaRodríguez et al., 2013). According to recent studies (Telukdarie et al., 2018; Jabbour et al., 2019; Bouchery et al., 2016) digitization will help reduce uncertainties by ensuring greater transparency of information between supply chain partners. Also, the automation of the supply process can significantly reduce the time required for the supply cycle and contribute to optimizing the use of resources, thus allowing the development of the capacity to adhere to the requirements of the circular economy.

In the face of a turbulent economic environment and a global recession, companies' sales are no longer experiencing the increases known from previous periods. Moreover, for most areas of activity, the COVID-19 pandemic has caused them to stagnate or even register particularly significant decreases. Thus, the companies sought to adapt their activity to the new realities, including by adjusting the costs according to the volume of revenues. In this context, there is increasing pressure to streamline activities, which does not bypass supply activity.

Determining supply needs begins with substantiating customer market demand. In the conditions of a volatile economic climate, most companies have gone from the principle "produce and then sell", to the principle "produce what has already been sold" (Cârstea, 2000). Thus, the supply activity is closely related to the production and sales activities, which substantiate the supply needs (Florea et al., 2016; Corboș, 2011).

The external environment of the organization has direct implications on the supply activity. According to research (Priem, 2012), in many companies an important factor in creating value is the establishment of unique relationships with suppliers, who: have special capabilities, represent established brands, have access to a global market or benefit from other competitive advantages. Procurement is responsible for identifying, establishing, and continuing such partnerships, thus influencing the level of competitiveness of the organization.

Managers consider time as a critical element separate from elements such as human resources or company capital. Reducing waste in the provision and management of material resources can eliminate delays and even increase customer satisfaction by reducing delivery times, which can be a competitive advantage for companies. Therefore, firms can reap benefits by reducing total cycle time in all operational activities, such as reducing design time, reducing supply time, reducing production time, and so on. (Bag et al., 2020). Bag et al. (2020) noted that research has paid less attention to reducing cycle times in procurement activities. The selection of suppliers ultimately plays a key role, as it can influence delivery times. Finally, the time of the supply cycle may also vary depending on the nature of the collaborative relationships with suppliers. Strategic procurement and strategic flexibility of the firm can significantly improve the agility of the supply chain (Chiang et al., 2012).

Thus, based on the relevance of the concepts of circular economy and supply chain, we see the importance of maintaining a state of competitiveness of the organization, the need to move to a circular economy, but also the role of supply in this context. Also, the circular economy, supply in this context, and how organizations can be competitive are emerging research areas that need further investigation. In this sense, this paper will shed light on the evolution of research in matters regarding circular economy and the supply chain.

3. Research methodology

The global literature on the circular economy and supply chain published in 2010-2020 was analysed in the WoS and Scopus databases, both considered to provide quality content. The search terms used to identify the most relevant scientific papers included "circular economy" and "supply chain", provided that they are present in the keywords of the paper.

Thus, only article or review papers were considered, the language in which they were written being English. Information on the scientific papers that met these criteria included the year of publication, the language in which they were published, the academic journal, titles, authors, affiliation, document type, keywords, and number of citations, all of which were exported in txt format from Web of Science, respectively CSV from Scopus. From the WoS database we found 473 papers that met the selection criteria, while from Scopus a number of 633 article and review papers were extracted. Data were collected on August 10, 2021, and VOSviewer (van Eck and Waltman, 2011) (version 1.6.17) was the software used for keyword co-occurrence analysis, resulting in a keywords map, in a manner similar to other works of this type (Gora, 2019).

As a result of the process of selection and extraction of data on scientific records from both top indexers we comparatively analysed the distribution of papers by year of publication, top 10 most productive journals by number of published articles, top 10 journals by number of citations, the results being highlighted by means of figures containing suggestive tables and graphs. The paper also compares the top 10 most influential papers, based on the number of citations received in the two databases we have used.

4. Results

From the point of view of the evolution over time of the publications on circular economy and supply chain in the two analysed databases, Figure 1 shows that 2017 is the point from which the number of articles dealing with both concepts begins to grow significantly. In the 2010–2015-time frame, the number of articles is small in both databases, while in 2012, 2013 and 2014 we do not have any publication containing the two keywords in WoS. It should be noted that ¾ of the articles are published in the 2017–2020-time frame.

WOS			SCOPUS		
Publication Year	**Count**	**Rank**	**Publication Year**	**Count**	**Rank**
2020	212	1	2020	243	1
2019	129	2	2019	163	2
2018	84	3	2018	112	3
2017	33	4	2017	48	4
2015	6	5	2016	21	5
2016	5	6	2014	15	6
2010	2	7	2015	9	7
2011	2		2010	7	8
-	-	-	2011	6	9
-	-	-	2013	5	10
-	-	-	2012	4	11

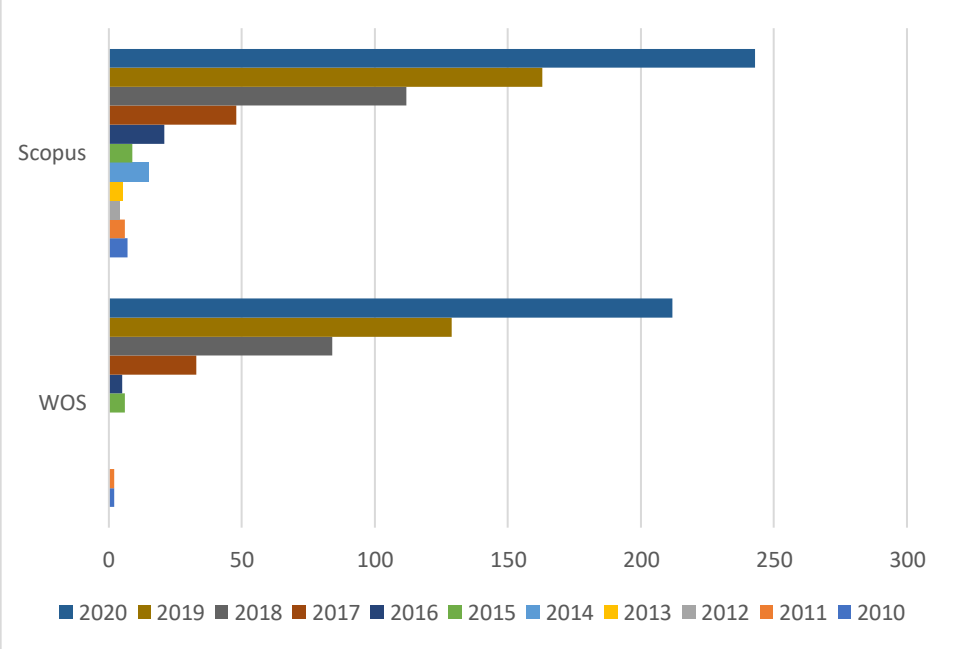

Figure 1. Publications between 2010-2020
Source: author analysis based on data retrieved from WoS and Scopus

Figure 2 illustrates the top journals with the most published papers containing the keywords circular economy and supply chain. We notice that the journals in the top 5 as the number of papers published on our interest subject are the same in both WoS database and Scopus database, occupying the first five

places in the same order. Therefore, the scientific journal with most publications is the *Journal of Cleaner Production* followed by *Sustainability, Resources Conservation and Recycling, International Journal of Production Research* and *Business Strategy and The Environment*, in both databases.

WOS			SCOPUS		
Source Title	**Count**	**Rank**	**Source Title**	**Count**	**Rank**
Journal of Cleaner Production	101	1	Journal of Cleaner Production	97	1
Sustainability	77	2	Sustainability	44	2
Resources Conservation and Recycling	43	3	Resources Conservation and Recycling	42	3
International Journal of Production Research	24	4	International Journal of Production Research	25	4
Business Strategy and The Environment	23	5	Business Strategy and the Environment	14	5
Production Planning & Control	15	6	Production Planning and Control	13	6
Technological Forecasting and Social Change	10	7	Science of the Total Environment	11	7
International Journal of Production Economics	9	8	Sustainable Production and Consumption	8	8
Management Decision	9				
Science of the Total Environment	8	9	Smart Innovation, Systems and Technologies	7	9
			Journal of Industrial Ecology	7	
Journal of Enterprise Information Management	6	10	Journal of Enterprise Information Management	6	10
Journal of Industrial Ecology	6		Management Decision	6	
Journal of Manufacturing Technology Management	6				
Sustainable Production and Consumption	6				
Thunderbird International Business Review	6				

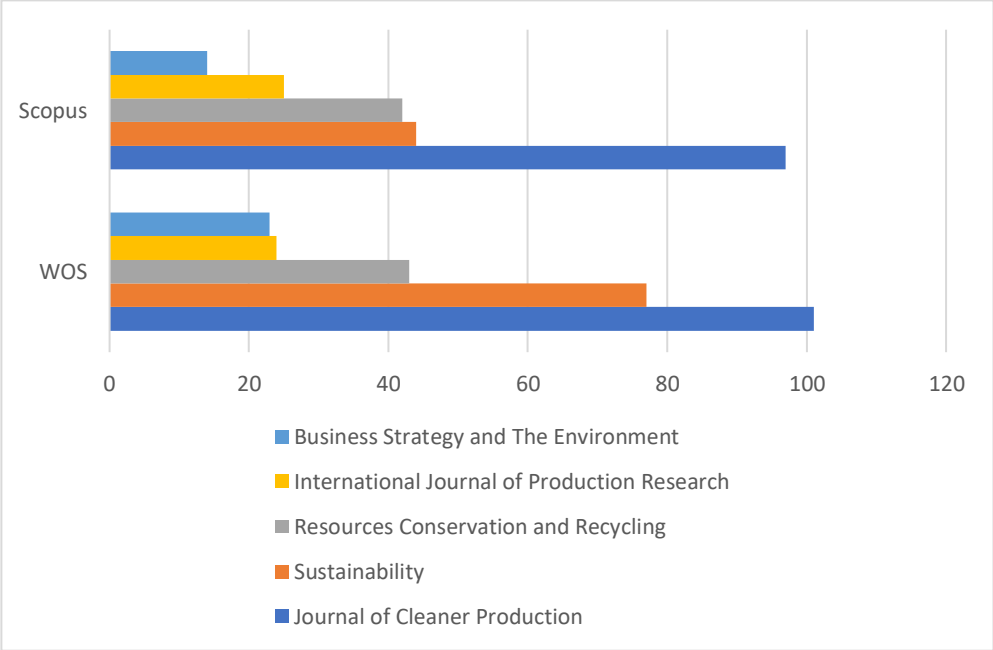

Figure 2. Top journals based on number of published articles
Source: author analysis based on data retrieved from WoS and Scopus

The number of articles available in a journal does not implicitly reflect the impact they have. To have a clearer picture of the most influential journals that have published papers we can look at Figure 3 which ranks the most influential journals by the number of citations received. We can note that the top does not suffer major changes in terms of first place, and from this point of view, the first position is occupied by the *Journal of Cleaner Production* in both databases, with 3410 (55.18%) citations in WoS and 2439 (44.31%) citations in Scopus.

Also, table 1 shows the top 10 most influential works in WoS and Scopus according to the number of citations received. We note here that the first two positions are occupied by the same research articles, both in the WoS database and in Scopus. Also, in this top 10, we can see papers published in journals that were not part of the top of journals depending on the number of articles published or the number of citations received. These are papers published in the *Omega-International Journal of Management Science*, *Journal of Environmental Management*, *Annals of Operations Research* and *Renewable & Sustainable Energy Reviews*.

WOS		SCOPUS	
Source Title	**No of times cited**	**Source Title**	**No of times cited**
Journal of Cleaner Production	3410	Journal of Cleaner Production	2439
Sustainability	726	Resources Conservation and Recycling	945
Resources Conservation and Recycling	662	Sustainability	538
International Journal of Production Research	361	International Journal of Production Research	384
Production Planning and Control	329	Production Planning and Control	383
Business Strategy and The Environment	229	Journal of Industrial Ecology	332
International Journal of Production Economics	218	Science of the Total Environment	176
Technological Forecasting and Social Change	114	Business Strategy and the Environment	151
Management Decision	150	Management Decision	105
Science of the Total Environment	71	Sustainable Production and Consumption	51

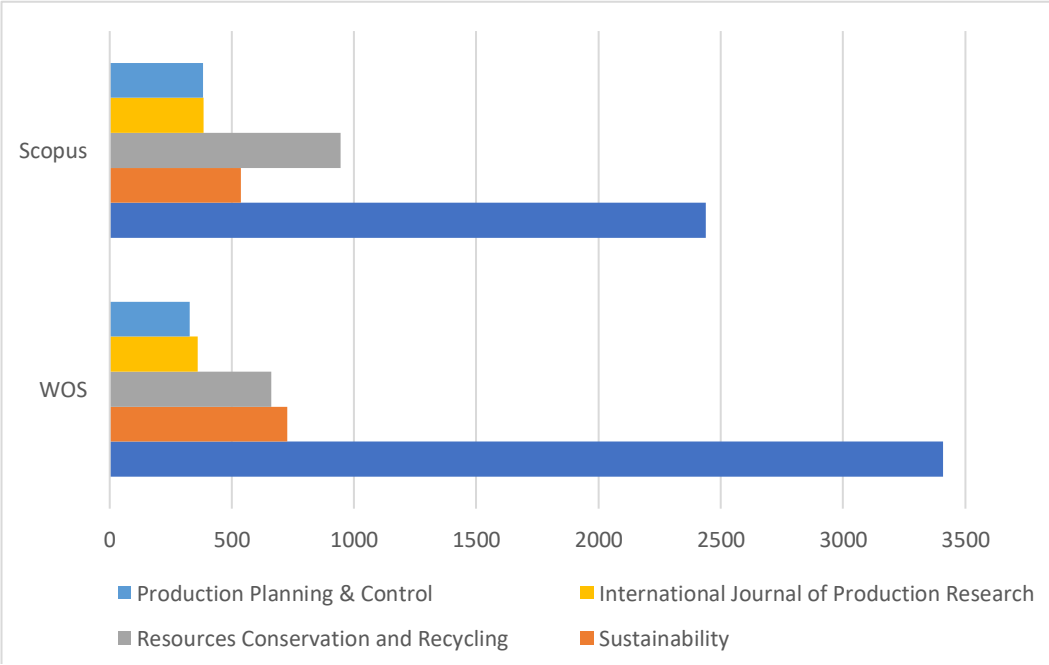

Figure 3. Top journals by number of citations
Source: author analysis based on data retrieved from WoS and Scopus

Top 10 most influent papers based on total citations

Table 1

WOS				
Title	**Authors**	**Source Title**	**Total Citations**	**RANK**
The Circular Economy A new sustainability paradigm?	Geissdoerfer, Martin; Savaget, Paulo; Bocken, Nancy M. P.; Hultink, Erik Jan	Journal of Cleaner Production	1245	1
Sustainable supply chain management and the transition towards a circular economy: Evidence and some applications	Genovese, Andrea; Acquaye, Adolf A.; Figueroa, Alejandro; Koh, S. C. Lenny	Omega-International Journal of Management Science	270	2
Progress Toward a Circular Economy in China The Drivers (and Inhibitors) of Eco-industrial Initiative	Mathews, John A.; Tan, Hao	Journal of Industrial Ecology	200	3
Strategies on implementation of waste-to-energy (WTE) supply chain for circular economy system: a review	Pan, Shu-Yuan; Du, Michael Alex; Huang, I-Te; Liu, I-Hung; Chang, E-E; Chiang, Pen-Chi	Journal of Cleaner Production	187	4
The history and current applications of the circular economy concept	Winans, K.; Kendall, A.; Deng, H.	Renewable & Sustainable Energy Reviews	186	5
How do scholars approach the circular economy? A systematic literature review	Merli, Roberto; Preziosi, Michele; Acampora, Alessia	Journal of Cleaner Production	163	6
Circular economy practices among Chinese manufacturers varying in environmental-oriented supply chain cooperation and the performance implications	Zhu, Qinghua; Geng, Yong; Lai, Kee-hung	Journal Of Environmental Management	163	
The circular economy: New or Refurbished as CE 3.0? - Exploring Controversies in the Conceptualization of the Circular Economy through a Focus on History and Resource	Reike, Denise; Vermeulen, Walter J. V.; Witjes, Sjors	Resources Conservation and Recycling	144	7

WOS				
Title	**Authors**	**Source Title**	**Total Citations**	**RANK**
Value Retention Options				
Creating integrated business and environmental value within the context of China's circular economy and ecological modernization	Park, Jacob; Sarkis, Joseph; Wu, Zhaohui	Journal of Cleaner Production	141	8
Industry 4.0 and the circular economy: a proposed research agenda and original roadmap for sustainable operations	Lopes de Sousa Jabbour, Ana Beatriz; Chiappetta Jabbour, Charbel Jose; Godinho Filho, Moacir; Roubaud, David	Annals of Operations Research	135	9
Business models and supply chains for the circular economy	Geissdoerfer, Martin; Morioka, Sandra Naomi; de Carvalho, Marly Monteiro; Evans, Steve	Journal of Cleaner Production	126	10
The Circular Economy A new sustainability paradigm?	Geissdoerfer, Martin; Savaget, Paulo; Bocken, Nancy M. P.; Hultink, Erik Jan	Journal of Cleaner Production	1423	1
Sustainable supply chain management and the transition towards a circular economy: Evidence and some applications	Genovese A., Acquaye A.A., Figueroa A., Koh S.C.L.	Omega (United Kingdom)	316	2
Circular economy - From review of theories and practices to development of implementation tools	Kalmykova Y., Sadagopan M., Rosado L.	Resources, Conservation and Recycling	242	3
Strategies on implementation of waste-to-energy (WTE) supply chain for circular economy system: a review	Pan S.-Y., Du M.A., Huang I.-T., Liu I.-H., Chang E.-E., Chiang P.-C.	Journal of Cleaner Production	221	4
Circular economy practices among Chinese manufacturers varying in	Zhu Q., Geng Y., Lai K.-H.	Journal of Environmental Management	200	5

WOS				
Title	**Authors**	**Source Title**	**Total Citations**	**RANK**
environmental-oriented supply chain cooperation and the performance implications				
Industry 4.0 and the circular economy: a proposed research agenda and original roadmap for sustainable operations	Lopes de Sousa Jabbour A.B., Jabbour C.J.C., Godinho Filho M., Roubaud D.	Annals of Operations Research	175	6
Creating integrated business and environmental value within the context of China's circular economy and ecological modernization	Park J., Sarkis J., Wu Z.	Journal of Cleaner Production	168	7
Business models and supply chains for the circular economy	Geissdoerfer M., Morioka S.N., de Carvalho M.M., Evans S.	Journal of Cleaner Production	156	8
A systematic review on drivers, barriers, and practices towards circular economy: a supply chain perspective	Govindan K., Hasanagic M.	International Journal of Production Research	150	9
The circular economy umbrella: Trends and gaps on integrating pathways	Homrich A.S., Galvão G., Abadia L.G., Carvalho M.M.	Journal of Cleaner Production	139	10

Source: author analysis based on data retrieved from WoS and Scopus

The bibliometric analysis of the keywords in the publications on circular economy and supply chain involved the use of VOSviewer software to perform the keywords co-occurrence analysis, the results being illustrated in the figures below. The size of the nodes showed the frequency with which these keywords appeared in the papers used for the analysis. The curved lines between the resulting nodes represent the co-occurrence of the keywords in the same journal, and the smaller the distance between two nodes, the greater the number of co-occurrences for the two keywords used for this study.

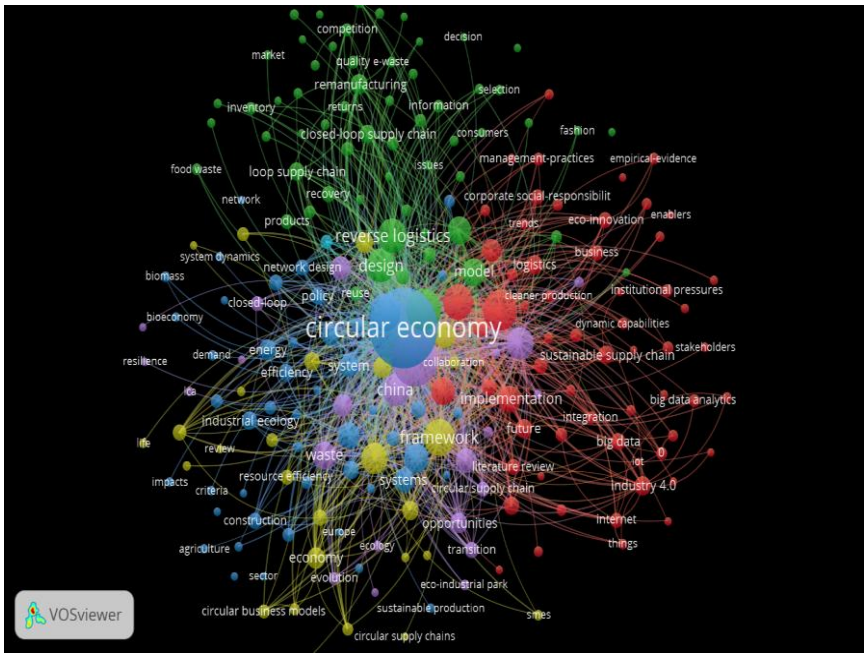

Figure 4. Keyword Co-Occurrence Map Using Wos Database
Source: author analysis using VOSviewer based on data retrieved from WoS

Figure 4 illustrates the keywords provided by the authors of the analyzed papers, which, appeared 5 or more times in the WoS database and which were used for the keyword co-occurrence analysis. Of the 2392 keywords, 221 met the threshold. The keywords that stood out were “circular economy” (total link strength 2840), “sustainability” (total link strength 1471) and “supply chain management” (total link strength 804). It is also noted that the distance between the node formed by the keyword "circular economy" and the keywords "supply chain" and "sustainability" is the smallest compared to the other keywords, which indicates that the three keywords have high co-occurrence in the same publications.

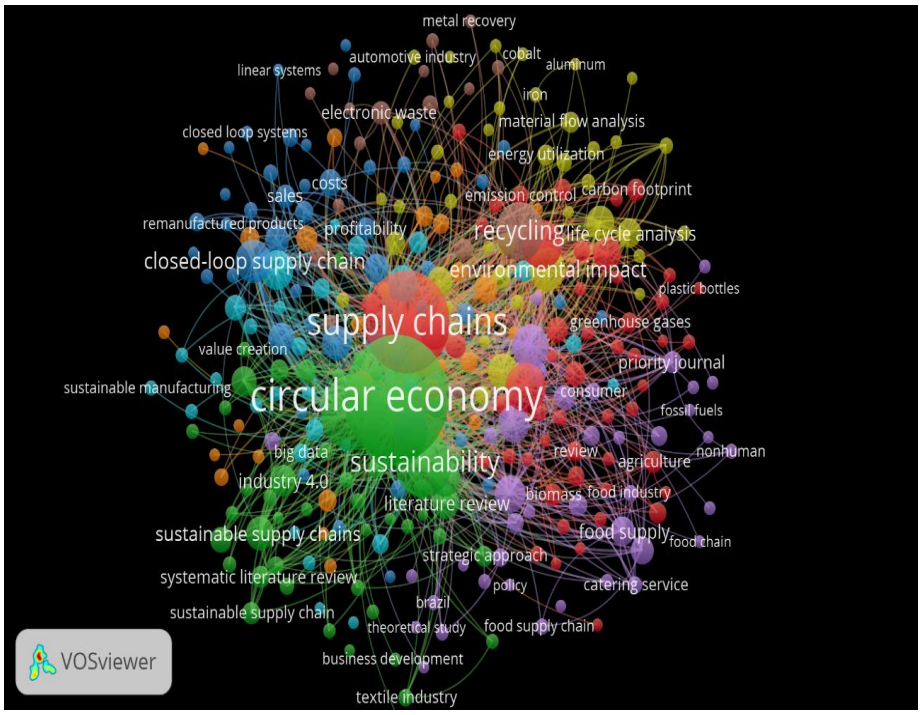

Figure 5. Keyword Co-Occurrence Map Using Scopus Database
Source: author analysis using VOSviewer based on data retrieved from Scopus

Figure 5 illustrates the keywords provided by the authors of the analysed papers, which have appeared 5 or more times in the Scopus database, and which have been used for keyword co-occurrence analysis. Of the 4532 keywords, 310 met the threshold. The keywords that stood out were “circular economy” (total link strength 3402), “supply chains” (total link strength 2853), “sustainable development” (total link strength 1797) and “supply chain management” (total link strength 1536). At a closer look, we can find that the distance between the node formed by the keyword "circular economy" and the keywords "supply chain management" and "sustainable development" is the smallest compared to the other keywords, which indicates that the three keywords have a high rate of co-occurrence within the same publications.

5. Conclusions

This paper aimed to study the connections in the literature between the concepts of circular economy and supply chain through articles published on those subjects indexed in Web of Science (WoS) and Scopus, by identifying the most influential journals and authors in this area. The results of the research based on the bibliometric analysis showed that in the last 4 years an increasing number of scientific papers on the circular economy and supply chain have been published. The most prolific and influential journals containing papers published on these two

major topics were ranked in the results section of this paper, along with the most influential papers written on these topics, based on the number of citations received over time. Also, the results obtained with the help of VOSviewer, indicated that both in the WoS database and in Scopus the most keyword co-occurrence were related to circular economy, supply chain, and sustainability.

In terms of the impact of the results presented in this paper, we can say that they are useful to researchers from this specific research area to identify the most prolific journals regarding the volume of articles published, but also the most influential in terms of the volume of citations received. Also, the paper highlights the most cited papers from this specific research area, which helps researchers in developing literature reviews. Another impact of the results is the highlighting of keyword co-occurrence, which, draws a clearer path for future research that may include in an integrated manner the circular economy and supply chain to identify ways to achieve superior economic performance in a sustainable manner.

Nonetheless, this work is not without limitations. Although the data collected from WoS and Scopus were analysed objectively and comprehensively, we must keep in mind that we selected only papers of type "article" and "review", thus ignoring the other types of publications, which could have added value to the results. Another limitation is that we selected papers only from the WoS and Scopus databases, thus omitting other research articles in the two databases, which could potentially add value. Future research should take those issues into consideration.

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