

Circular Economy Strategies in Supply Chain Research: A Bibliometric Analysis of its Contribution to Sustainable Development

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Abstract- In recent years, an inappropriate and uncontrolled utilization of limited natural resources has contributed to the generation of tremendous volumes of waste which is now a source of danger to the ecosystem. Therefore, the circular economy concept has gained prominence as one of the main instruments that can help businesses run their sustainable supply chain activities. The concept of the circular economy is becoming increasingly attractive to corporations seeking to revamp their sustainable supply chain management practices. This evolution in corporate strategy is evident in the growing body of literature on the topic, which remains to be fully catalogued and analyzed. The research aims to study new developments in scientific research related to Circular economy supply chain strategies. It will investigate advanced methods and approaches in the same field. The objective is to understand how circular economy principles can be applied successfully to improve resource use efficiency, reduce waste generation, and ensure sustainability in supply chain management. The research involved an extensive review of global literature on "strategies for circular economy supply chains research" was carried out using databases like Scopus and Web of Science. R language and a bibliometric package were used to conduct a thorough bibliometric analysis, and visualization techniques were employed for a clear summary. The findings provide insights into the development of research in this field and highlight key contributors, countries, and institutions. The study recognizes limitations, including its focus on fully-published English papers and the potential exclusion of relevant non-English publications. The research paper delves into a multitude of categories that were meticulously used to classify the chosen documents. These categories cover various areas including sustainable development, reverse logistics, waste management, supply chain management, recycling and reuse, closed loop, backward logistics, sustainable resource management, zero-waste systems, circular supply chain, product life extension, and manufacturing development.

Keywords- Circular economy strategies, Bibliometric Analysis, Sustainability, circular supply chain.

I. INTRODUCTION

The concept of circular economy is about sustainable development **Grzymala, Z, (2023)**. It emphasizes the purposeful use of resources and provides a zero-waste strategy to provide high-value, useful resources in a series of life cycles for items in use, even if they are inactive **Dimitriu et al, (2023)**. Thus, it focuses on maintaining the highest value and utility of products, components, and materials through continuous cycles, promoting reuse, recycling, and regeneration **Bautista et al, (2023)**. The circular economy model relies on closing the paths of natural resources and energy flows used in the economy. These situations are not only beneficial for the environment but also for economic growth **Bombonatti, (2022)**. This strategy foresees a reorganization of processes aimed at making it sustainable in the long term for resource use and recycling. This reminds us of the complexity and multifaceted aspects of sustainable development and the existence of environmental, economic, and social aspects of sustainable development **Smol & Marcinek, (2023)**. In the context of the above, circular economy is considered an umbrella concept looking forward to decreasing material inputs and minimizing waste generation **Moraga et al, (2019)**. Though coined since 1960, it is clear that there are still differences in its conceptualization **Geissdoerfer et al, (2017)**, characteristics **Morseletto, (2019)**, the definition of its objectives **Morseletto, (2019)**, implementation, and indicators to evaluate its performance **Moraga et al, (2019)**. According to the **Ellen MacArthur Foundation (2015)**, circular economy rests on three principles: (1) protect and better steward natural capital by controlling the limited sources and at the same time balance the circulation of renewable resources; (2) improve system efficiency by circulating products, components, and materials in the technical and biological life cycles; and (3) eliminate the negative environmental externalities by notifying and redesign, thus improves the system effectiveness. Furthermore,

its true contribution to sustainable development is frequently questioned because its goals have mostly been focused on economic prosperity and environmental quality, leaving out the social equality factor, which must address the requirements of both present and future generations **Geissdoerfer et al, (2017)**. This knowledge gap emphasizes the significance of investigating the circular economy's contribution to sustainable development throughout the shift from the old linear economic model to a circular one, as a strategic choice for green reactivation **Kirchherr et al, (2017)**. The concept that **Boulding (1966)** pointed out is connected with the necessity of the shift in the current economic model from the perspective that processes production and consumption with a responsible attitude that recognizes the technological cycles' effects on materials, products, and services. In this case, the circular economy recognizes that these effects are circular as well but the assessment of the progress achieved with the implementation strategies is critical for the overall performance of sustainable development and green economy. The aforementioned validates the feasibility of the research that is focused on the availability of the information that is related to the evolution of this concept and the knowledge that exists regarding its performance. **Dawson (2019)** claims that the circular economy strategy represents a balance correction in the system in favour of nature, a transition from a linear to a resource-efficient circular system based on the "polluter pays" principle, and a new direction in responsibility structure for producer/consumer relationships, corporations, and environment. According to **Dawson (2019)**, the circular economy strategy philosophy is largely based on the maximization of benefits derived from resources and reducing the impacts of waste materials on the environment, which can be achieved through the re-use, "reincarnation" or disposal of these resources, whatever is applicable. Nevertheless, its implementation relies on policies emphasizing on encompassing materials' lifecycle and allocating an additional responsibility to manufacturers with special stress on consumers. the circular economy strategy wants to afford a great number of people access to quality products, and separately form a new structure that determines personal and social duties. Circular economy strategies include a range of innovative ways of direction, with the main focus being sustainable and efficient consumption of resources in multiple domains **Visintin et al, (2023)**. Moreover, **Popa, (2022)**, stated that circular economy strategy considerations target the redesign of linear economic systems by applying "reduce, reuse, and recycle" to the outcome of an environmentally friendly economy framework. The studies demonstrate that certain innovation approaches, such as productive, process, complex, and frugal innovations, are important in that they are useful in the process of transforming the current way of doing things into a circular economy **Chan et al, (2023)**. These strategies incorporate recycling and reuse of materials and items that function for the 3-fold sustainability concept that we know, namely ecosystem, economic, and human welfare. Beyond that, the world addresses the problem of climate change and recycled trash (waste) at the regional level which affects principally, waste management, energy, and industry to contribute to the reduction of carbon emissions and attainment of carbon neutrality by the year 2050 **Gupta, (2023)**. Resource efficiency, and reusing, are the keys to lessening the consumption rate which motivates overconsumption decrease and environmental degradation. Specifically, there is a need to incorporate circular economy principles in different sectors and systems of governing which would help to attain Sustainable Development Goals and transform the current situation into a circular one **Agrawal et al, (2023)**. **Dawson (2019)**, indicated that the development of an efficient circular economy strategy is not just about what mechanisms are used, but also is about the change in how managed resources are disposed of. This change is based on the reversible design of products that allows the materials to be efficiently recycled and reused, moving away from the existing methods. However, it should also be coupled with the implementation mechanisms to be effective. Thus, nowadays, the circular economy is a tactic for green economic recovery in the wake of the outbreak of the COVID-19 world pandemic disease caused by the SARS-CoV-2 virus which substantially impacted the industrial, commercial, and social activities. Nonetheless, social confinement has influenced several cities to get cleaner air and contributed to SDG 13 "Climate Action," while adjustment to and resilience to the circular economy is a must for production and consumption dynamics **Sarkodie & Owusu, (2021)**. According to **Khompatraporn, (2021)**, current supply chain management is moving away from the conventional linear paradigm of "take-make-use-dispose" since it is not ecologically sustainable. The circular economy idea, on the other hand, envisions a circular supply chain capable of mitigating the environmental dangers posed by the linear supply chain by addressing material circularity. Meanwhile, the core principle is to extend material utilisation and limit material exploitation while collecting and developing new values for products and services in the supply chain. This consequently has led to the recent popularity of circular supply chain management (CSCM), revolving around the idea of ditching the linear model for the circular economy, which promotes reuse, recycling, and remanufacturing. Moreover, the circular supply chain management intends to slow down product lifespans, control disposals, and boost economic performance by transitioning towards recycled materials and commodities **Sanusi et al, (2023)**. Considering the literature on circular economy supply chain strategies research, we find that circular economy strategies have been noticed more considerably for their possibilities of enhancing sustainability and resource efficiency **Yang et al, (2023)**. The channelling from a linear to a circular supply chain design involves rethinking traditional practices in a way to

eliminate waste by making more use of the existing products and thus by extension the lifecycle of these goods **Mayanti & Helo, (2024)**. This idea of moving towards circularity is to produce systems that are loop-closed containing materials that are re-used repeatedly hence the desire to have a less environmental impact and a self-sustainable production process **Pellathy et al., (2021)**. Through the application of circular economy in supply chain management, organizations can play not only the role of reducing the generation of waste but also, in the long run, provide competitive and sustainable performance by such means. Besides the circular supply chain, the end users can be encouraged to participate in reverse logistics and resource recovery addressing sustainability on all sides and building the SDGs pillars **Sgalambro et al, (2021)**. As has been highlighted by studies in the CSCM literature, various clusters have been defined such as retro channel improvements and optimization, closed-loop supply chain (CLSC), and consumers; however, there is a gap which needs to be addressed through circular product design and sourcing. Circular economy principles imposition in supply chain will produce important and positive implications for both businesses and the environment and the sustainability of supply chain as a whole, though, the challenges such as resource scarcity and complex supply networks remain. The finished model for a developed CSCM system combines the closed-loop and open-loop supply chains that are inter-connected, thereby encouraging environmentally friendly supply chain management and sustainability beyond the original manufacturer just after realization **Shaharudin et al, (2022)**. Considering the above, a distinction can be drawn between circular supply chain management and sustainable supply chain management, since circular supply chain management gives paramount attention to the concept of keeping resources and their value within the economy to prevent the creation of waste, which endorses actions like product innovation as well as waste recycling and infrastructure **Gupta, (2023)**. On the other side, Sustainable supply chain management aims to develop a circular economy by creating frameworks that deal with the association of sustainable supply chains and circular economies **Baporikar, (2023)**. The incorporation of circular economy philosophy into sustainable supply chain management helps to thereby improve organizations' role in reducing production and consumption. This needs to be achieved through the implementation of the 5R principles, which are Reduce, Reuse, Remanufacture, Recycle, and Recover, by every entity in the supply chain, including the final customer **Ruzive et al, (2023)**. Sustainable Supply Chain Flexibility (SSCF), a key element of the Circular Economy, is used to achieve the strategic objectives of the organization in such a way that the quality is not compromised and the costs are kept under control **Agrawal & Mukti, (2023)**. With regards to transforming through the use of a circular economy, both countries and organizations have opted for this move because it brings sustainability in the face of environmental, social, and economic challenges **Dimitriu et al, (2023)**. The circular economy concept is based on minimizing the consumption of new natural resources, shifting toward the narration of waste materials, and fostering restoration by applying methods like refurbishment and recycling **Johansson et al, (2022)** Changing linear economies to circular ones gives the opportunity to nations to deal proactively with global warming, as well as to manage waste properly and protect against the shortage of resources Such a shift is however, critical in attaining sustainable development, providing energy efficiency and economic resiliency **Ghazanfari, (2023)**. The circular economy approach not only fosters environmental sustainability but also supports socio-economic development by creating new opportunities for businesses and communities to thrive while preserving natural capital **Popa, (2022)**. Based on what was mentioned in the previously mentioned literature, the study aims to: -

1. To determine the major trends of Circular Economy Supply Chain Strategies research.
2. To identify the research and publications that have been most powerful in the Circular Economy Supply Chain Strategies domain.
3. To find the important directions for future research in Circular Economy Supply Chain Strategies.

II. METHOD

This paper discusses circular economy strategies and supply chains using descriptive statistics; bibliometric techniques are applied, which are the quantitative analysis methodologies for the content gathered from written sources on these two areas. The Web of Science (WOS) bibliographic database was used to conduct this research. The identification of relevant articles was predominantly influenced by nine fundamental terms: Circular economy strategies, Reuse, Recycling Materials, Minimize Waste, waste management, zero-waste systems, product life extension, closed loop, as well circular supply chain, among others, coupled with the choice of some selected Research Areas such as business economics, transportation, and management. To do this, the data was put into a BibTeX file to provide an overview of the tables and graphs we use to demonstrate the impact of the results obtained. It should be noted that research has proven that bibliometrics is becoming more widely employed and that Bibliometrics, a statistical approach, has increasingly infiltrated the area of literature in general, where the design of content analysis allows for more in-depth knowledge of research and its linkages **Homrich et al, (2018)**. The type of

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documents examined were mostly articles (205), followed by Early Access (26), Proceeding Paper (6), and Editorial Material (1). The analysis was executed with R-4.2.2 (2024-04-20) software supported by the R Foundation for Statistical Computing, which provides a reliable analysis of the information obtained. Biblioshiny was the chosen application for data sources and 238 different types of documents were gathered, arranged as a result of 77 diverse sources, contributing 14784 references that were contributed by 714 researchers and authors. The study of 238 papers ascertained that 12 were written by a single author. In terms of author collaboration, e, each document has an average of 3.54 Co-Authors, with international co-authorships accounting for 49.16% of the total which has been stated in Table 1.

Table 1: Data Sources

Description	Results
Main Information	
Timespan	2020:2024
Sources (Journals, Books, etc.)	77
Documents	238
Annual Growth Rate %	-3.02
Document Average Age	1.94
Average citations per doc	28.5
References	14784
Document Types	
article	205
article; early access	26
article; proceedings paper	1
editorial material	1
proceedings paper	5
Document Contents	
Keywords Plus (ID)	592
Author's Keywords (DE)	764
Authors	
Number of Authors	714
Authors of single-authored documents	12
Authors Collaboration	
Single-authored documents	12
Co-Authors per document	3.54
International co-authorships %	49.16

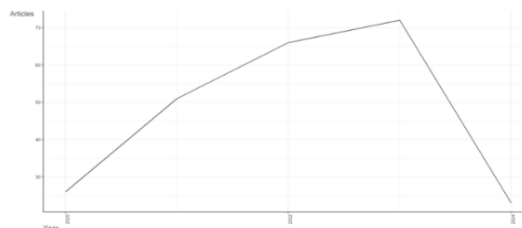
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III. RESEARCH OVERVIEW

1. PUBLICATION ANALYSIS

1.1 NUMBER OF PUBLICATIONS BY YEAR

The trend of development in the specific academic domain area of CESSC was studied and displayed in Figure 1. The data has been extracted from published articles within 4 years. From the data gathered, there is a noticeable increasing growth in the number of publications from 2020 to 2023. Nevertheless, the year 2024 experienced a decrease in the graph that was compared to this year, taking into account that this year has not ended yet, which means that the curve can return to an increasing state again. In addition, it is important to realize that 30.25% out of 238 articles (77 of them) were published in the past year (2023) only. This demonstrates the innovative nature of research at CESSC.

**Figure 1. Annual Scientific Production**
Source: Created by the researcher

1.2 SOURCE OF PUBLICATION

Table 2 shows the most frequent 10 of the bibliometric sources, these 10 sources altogether have produced 132 documents forming about 55% of the total documents recovered. Journal of Cleaner Production was recorded as the most prolific journal with 38 (15.96 %) publications, pursued by Business Strategy and the Environment with 22

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(9.24 %), Journal of Sustainability with 21 (8.82%), Environmental Science and Pollution Research, International Journal of Production Economics, and Production planning and control with 8 documents and (3.36%) for each source.

Table 2: Source of publication

Journal Name	No. of articles	%
Journal of Cleaner Production	38	15.96
Business Strategy and the Environment	22	9.24
Journal of Sustainability	21	8.82
Environmental Science and Pollution Research	8	3.36
International Journal of Production Economics	8	3.36
Production Planning and Control	8	3.36
International Journal of Research and Logistics Applications	7	2.94
Resource Conservation and Recycling	7	2.94
Sustainable Production and Consumption	7	2.94
International Journal of Logistics Management	6	2.52

Source: Created by the researcher

1.3 SOURCES' PRODUCTION OVER TIME

Figure 2 depicts where sources are produced through time. The result of the research displays that the Journal of Cleaner Production with 9 publications for 2020 stands first, in the ranking of Production over time, followed by the Journal of Sustainability with 4 publications as the second. Overall, the Journal of Cleaner Production retains the highest score of publication productivity over the analysis period.

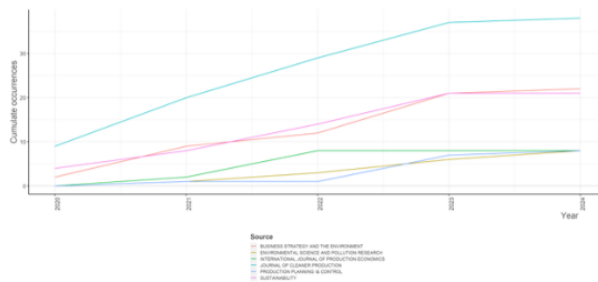


Figure 2: Annual Scientific Production
Source: Created by the researcher

2. CITATION ANALYSIS

2.1 SOURCE CITATIONS

The citation analysis for publishers of CESC journals that catapult their research endeavors among the best in the field is critical. In addition to that, it provides information about the focus areas and the key voices in the community thus the researchers can steer towards the most cited as well as the best sources of circular economy supply chain strategies research. From Figure 3 it is clear that there is a significant decrease in the number of citations from the most cited source: the Journal of Cleaner Production (2004 citations) to the second Business Strategy and the Environment (1000 citations) and then a gradual decrease thereafter, which suggests a few sources hold significant influence in the research or practices. This type of citation resembles the scholarly format and mostly conforms to a power-law distribution, which implies that very not many works acquire numerous citations while the vast majority receive only a few of them.

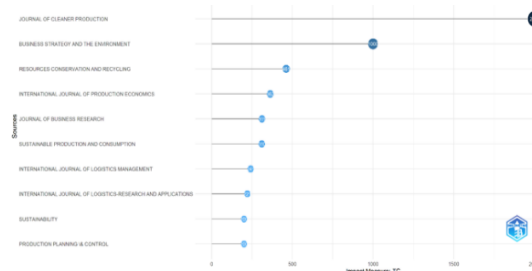


Figure 3: Sources' Citation
Source: Created by the researcher

2.2 AUTHOR INFLUENCE

Figure 4 presents the top 10 authors of whom the most productive in the given area of research in CESC are given. These 4 authors have altogether authored/ co-authored 48 publications, which amounts to around 20% of the total number of 238 papers in our portfolio. It is noteworthy that none of these authors have attained the same level of productivity, with none of them having any published documents to their credit. Such a regularity of publications is

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often found, in the initiation of a field or when the field is highly specialized where people of different mentalities can contribute equally as they advance their knowledge.

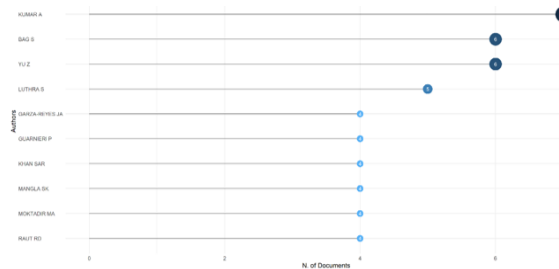


Figure 4: Most Relevant Authors
Source: Created by the researcher

3. COLLABORATION ANALYSIS

3.1 AUTHOR COLLABORATION NETWORK ANALYSIS

This diagram will show the collaborative nature of that network among the authors in the CESC field via network analysis. The circles representing unique authors form the nodes. The strength of each node corresponds to the number of partnerships and publications characterized by a respective author, with the bigger nodes indicating a higher number of collaborations. Edges among the nodes show the network of cooperation among the authors which means they co-authored their work in one or several research.

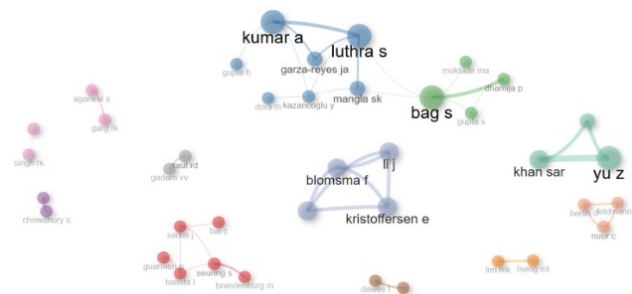


Figure 5: Collaboration Network
Source: Created by the researcher

3.2 COUNTRY COLLABORATION NETWORK ANALYSIS

This network diagram demonstrates visually the collaborative networking between nations in the realm of CESC. Nodes, serve as representations of countries with their respective sizes potentially indicating the magnitude of research output or the number of collaborations that each country engages in within this domain. Countries such as India and China are depicted by larger nodes, implying that they serve as central hubs of research activity with a substantial level of international collaboration. This observation may reflect their significant investment in CESC research and the global influence of their scholarly endeavors. Conversely, smaller nodes, exemplified by Hungary and Turkey, might suggest that these nations possess a more fledgling presence in this field or partake in fewer international collaborations. Nevertheless, their inclusion in the network emphasizes the worldwide nature of circular economy supply chain strategies research, with contributions spanning various regions and economies. Additionally, the diagram indicates the presence of regional clusters, with European countries like Italy, Sweden, the Netherlands, and the United Kingdom forming a dense network of collaboration.

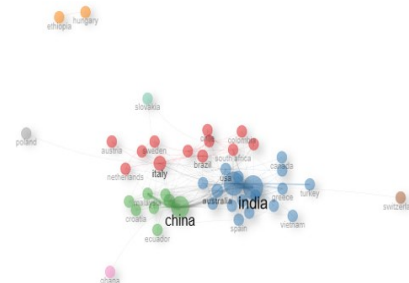


Figure 6: Country collaboration network analysis
Source: Created by the researcher

4. INFLUENCE ANALYSIS

4.1 THREE-FIELD PLOT (AUTHORS – KEYWORDS - SOURCES)

This three-field plot aims to provide a multifaceted view of the research, presenting the connections among authors, their topic-related keywords as additionally, and the sources where they make their work visible by publishing. The links toggle the authors’ display, making the purpose clear and suggesting the major topics they are written on. One can, therefore, think of the following situation: the authors who use terms like 'circular economy', 'circular supply chain', and 'Sustainability', prominently in their works and also get published in the journals devoted to production and operation logistics tend to be more regularly mentioned in respective articles. Therefore, there is a noticeable theme to research contacting which encompasses the main thoughts and rhetoric within the discipline itself. Figure 7 shows the link between the 'early modern period' and 'sustainability explorations in economic history' and showcases ongoing research into the historical context of the subject. This demonstrates that academia is actively engaged in uncovering the origins and development of the circular economy.

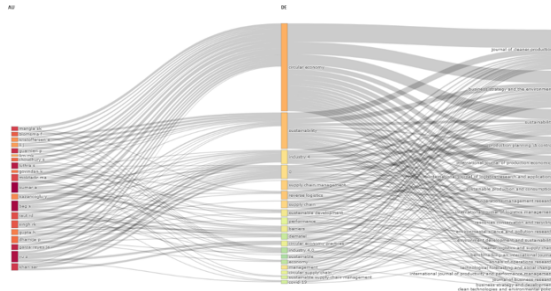


Figure 7: Three-field plot (Authors – Keywords - Sources)
Source: Created by the researcher

4.2 INFLUENTIAL PAPERS

The following table demonstrates a comprehensive compilation of essential scholarly papers that exert a very powerful influence on circular economy discourse that is exclusively more recent in the supply chain domain. It provides a clear view of the most cited journal works in a chosen area by using a set of metrics. The paper with the highest number of citations (YADAV G et al, (2020)) has garnered a remarkable number of global citations totalling 299, thereby signifying its substantial impact and relevance in the field, particularly within the context of the automotive industry. The subsequent document by Kristoffersen et al, (2020) simply focuses on the attention for smart circular economy strategies for manufacturing companies. It has sustained its relevance with a remarkable 263 citations worldwide, thus meaning that certain effective pro-circular strategy practices within the supply chain context remain very relevant. Lastly, the research article by JULIANELLI V et al, (2020) exhibits a lower number of (132) citations on a global scale.

Table 3: Influential papers

#	GC	DOI	Title	Author/s	Year
1	299	10.1016/j.jclepro.2020.120112	A framework to overcome sustainable supply chain challenges through solution measures of industry 4.0 and circular economy: An automotive case	YADAV G et al,	May 2020
2	263	10.1016/j.jbusres.2020.07.044	The smart circular economy: A digital-enabled circular strategies framework for manufacturing companies	KRISTOFFERS EN E et al,	November 2020
3	191	10.1002/bse.2853	Industry 4.0 and circular economy practices: A new era business strategies for environmental sustainability	KHAN SAR, et al,	June 2021
4	179	10.1016/j.jclepro.2020.125233	Key resources for industry 4.0 adoption and its effect on sustainable production and circular economy: An empirical study	BAG S, et al,	January 2021
5	165	10.1016/j.resconrec.2019.104502	Procurement 4.0 and its implications on business process performance in a circular economy	BAG S, et al,	January 2020

Source: Created by the researcher

4.3 INFLUENTIAL AFFILIATION

As a result of CESCO affiliations analysis, 465 institutions were found to publish 238 specialized documents. Figure 8 highlights the top 10 most active institutions, as measured by the number of publications. The collection includes institutions mainly from South Africa as well as from England, China, India, and Germany. This once again supports the idea that CESCO is an active area of research for all researchers of British, South Africa, India, Chinese, and Germany.

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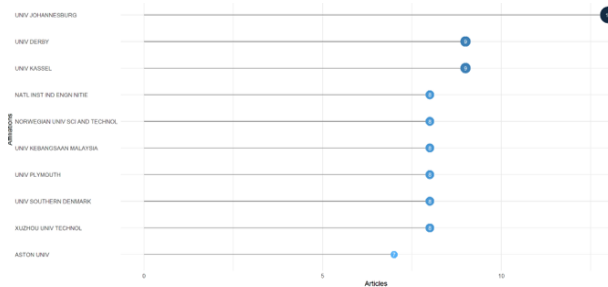


Figure 8: Most Relevant Affiliations
Source: Created by the researcher

4.4 INFLUENTIAL COUNTRIES

Based on the analysis conducted with the help of Biblioshiny, it has been determined that at least 50 different organizations from various countries have contributed to the writing of scientific articles about CESCO. In table 4, the first ten countries with the highest number of scientific publications are highlighted. It's noteworthy that India has secured the top position in terms of the number of publications, both through collaborative and independent efforts. This can be attributed to the country's economic policies, which have played a definitive role in propelling India to the forefront of CESCO research. Additionally, China has also demonstrated its productivity in this area, as reflected in the table. Table 4 further underscores the notable focus on CESCO research in European nations, particularly Italy, Spain, Germany, and the UK.

Table 4. Influential countries

Country	Articles
INDIA	33
CHINA	24
UNITED KINGDOM	23
ITALY	21
BRAZIL	18
AUSTRALIA	10
GERMANY	8
SPAIN	8
TURKEY	8
USA	7

Source: Created by the researcher

IV. CONCLUSION

At present the circular economy has been identified as a green economic recovery strategy to respond to the planet's economic crises last time being part of the development of long-term sustainable supply chain strategies. Based on this standpoint, this article provides an analysis of the evolution of the concept of Circular Economy strategies in the supply chain and it avows sustainable development. A bibliometric analysis effectively illustrated the trends in research, primary research institutions, key authors, research topics, and focal points in the field of CESCO. The number of published papers on CESCO has demonstrated exponential growth. The major findings can be summarized as follows:

- (1) Primary Subjects: The current research on CESCO mainly revolves around the circular supply chain, the circular economy in Industry 4.0, and the Circular Economy implementation guidelines in the supply chain.
- (2) Publication Sources: A total of 77 journals have actively disseminated research on CESCO, with "The Journal of Cleaner Production", "Business Strategy and the Environment", and "Journal of Sustainability" being the most productive ones.
- (3) Influential Institutions: 465 institutions were found to publish 238 specialized documents, the study highlights the prominent role of certain institutions such as the University of C'univ elect sci and Technol of China, and 'Indian inst Technol' in researching CESCO.
- (4) Influential Authors: The study identifies the most influential authors in this field, including YADAV G, Kumar a, BAG S, and KHAN SAR.

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