A model of circular economy in the relationship with sustainable development, recycling, and life cycle: Bibliometric analysis

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ABSTRACT

This paper is carried out by conducting systematic mapping that focuses on the circular economy (CE) theme using bibliometric analysis. The purpose of this study is to provide a comprehensive view of circular economy research that is based on bibliometric data from 2017 to 2021. The data is collected from Scopus using VOSviewer software. Network visualization and density visualization are used in this study. The findings conclude that: (1) the publication trend of the circular economy continues to increase; and (2) the author with the most link is Mangla, S.K. with 15 links, and the author with the most research related to a circular economy is Liu, Y. with 16 papers/research. It is also found that there are 3 big themes that are close to a circular economy, namely sustainable development, recycling, and life cycle. This indicates that the opportunity to examine circular economy while associating it with variables outside of sustainable development, recycling, and the life cycle is still very large. The countries that have conducted the most research on circular economy is (1) United Kingdom (218 papers); (2) Italy (161 papers); and (3) China (161 papers).

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Introduction

Currently, circular economy (CE) becomes a very significant strategic issue along with the development of environmental concerns, both in the academic world and the business world (Kirchherr, et al., 2017; Winans et al., 2017). The business world previously used and wasted resources with a very detailed business calculations, and was less concerned about the environment (Purwanti, 2021; Kirchherr, et al., 2017). The concept of CE was first introduced by Rachel Carson's Silent Spring from the Club of Rome in the 1970s with the first aim of reducing inefficient resources (Winans et al., 2017). Along with the demands of stakeholders, especially consumers, governments, and communities who care about the environment, the business world has begun to change its business model approach by putting forward the CE concept gradually. Kirchherr, et al. (2017) stated that the concept of CE can be carried out at the micro, meso, and macro levels.

The implementation of CE currently has received a high level of concern, not only at the consumer and company level, but it also has grown enormously at the regional level, national level, and beyond. The concept of CE is the antithesis of the production economy that puts forward linear calculations. CE is used to achieve a sustainable economy, environmental quality, economic prosperity, and social justice (Purwanti, 2021). It can also be used to maximize and optimize the potential of each material as well as can restore materials that have reached their final age with environmentally friendly technological innovations (Kristianto & Nadapdap, 2021). In principle, CE is based on the concept of the 3R (Reduce, Reuse, Recycle) with optimal production levels in utilizing natural resources by minimizing natural exploitation, minimizing environmental pollution, and reducing emissions and waste levels by implementing a sustainable concept (Kristianto & Nadapdap, 2021), such as for sustainable development (Murray et al., 2017; Kirchherr, et al., 2017). Therefore, reducing the carbon economy is a benefit of implementing CE (Purwanti, 2021).

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The lack of systematic reviews related to CE obtained from Scopus data becomes a trigger for the author to analyze it further. This also becomes the novelties of this study which are compiled using bibliometric analysis. This study aims to provide a comprehensive picture of academic studies related to CE. The author sorted the database from Scopus and filtered by eliminating publications that are not related to the study theme. More precisely, the author sorted, arranged, visually presented, and explained it in a coherent and systematic story. Based on this explanation, the research questions of this study are:

- i. What is the trend of CE publications over the last 5 years?
- ii. How is the author collaboration for CE topic over the last 5 years?
- iii. How is the trend analysis of CE title terms for the last 5 years?
- iv. What are the country statistics on CE articles for the last 5 years?

Literature Review

Theoretical and Conceptual Background

Circular Economy, Sustainable Development, Recycling, and Life Cycle

Naude (2011) once criticized that the implementation of CE is very difficult and still only a dream. In fact, it turns out that some of the business world experience difficulties in implementing CE. There are several limitations experienced by the business such as: (1) Tangible aspects, which include data, technology, and basic resources; (2) Intangible aspects, which include data driven culture, circular-oriented innovation culture, openness, and co-creation; and (3) Human skills, which include system thinking skills and data science skills (Kristoffersen et al., 2021; Aksoy & Hacıoglu, 2021; Hacıoglu & Aksoy, 2021). Nevertheless, currently, practitioners are still continuing to strive to gradually implement CE (Kirchherr, et al. (2017). Kirchherr, et al. (2017) in their research described that CE is the result of a combination of reduce, reuse, and recycle. Regarding this, Potting et al. (2017) divided the linear economy process to CE from R0 (refuse) to R9 (recover).

Carvalho et al. (2020; Hislop & Hill, 2011) stated that CE is useful for increasing circularity, minimizing energy and natural resources consumption, as well as being a key principle for sustainable resource preservation. Kirchherr, et al. (2017) added that in the long term, CE actually seeks to increase economic prosperity, environmental quality, and social justice. All of these should be used for the long-term benefit of future generations. CE motivates people to have sustainable and healthy behavior, and it should become a significant input for strategies and policies related to the guidelines and regulations that have sustainability principles (Unal et al., 2018). Akkalatham et al. (2021) found a relationship between willingness to recycle, lean manufacturing techniques, and CE success. Practices of environmentally responsible behavior promote and contribute to high levels of productivity. Companies are required to continue to innovate technically or non-technically, especially through the efficient use of equipment such as pre-shredder, shredder, and power plants that accelerate long-term mineral resource savings.

Ghisellini et al. (2016) stated that when CE can be implemented, it will make a significant contribution in improving sustainable business and social performance. This is because CE is expected to be carried out through reducing, reusing, and improving resources when companies produce, distribute, and consume the resulting product (Kirchherr, et al. (2017). Kristoffersen et al. (2021) added that managers should be required to be able to carefully identify and observe the stages of the industrial life cycle in company resources and assets through: (1) reinvent and rethink; (2) restore, reduce, avoid; and (3) recirculate. Li & Yu (2018; Das & Singh (2016; Kola Lawal, 2015; Velasquez et al., 2011; Salimath & Jones III, 2011) suggested that when individuals in an organization have pro-environmental behavior, it can have an impact on business sustainability (business, environmental, and social performance). This means that the company will have the ability to generate profits, conserve the environment, and have a more prosperous social life.

Research and Methodology

Research Design

This study uses bibliometrics, which applies mathematical and statistical analysis to the patterns contained in publications and other documents such as textbooks, journal articles, dissertations, or other sources (Yulianingsih et al., 2020). Bibliometrics is a scientific study that firstly existed in the 1980s, and is included in the field of Library Science (Haryani et al., 2020). Along with the development of the study, bibliometrics can finally be applied and studied in all fields (Rohanda & Winoto, 2019). Basically, bibliometric is a quantitative analysis in a publication that aims to ensure certain types of phenomena, and the data found are then explored through bibliometric analysis (Saifudin, 2019). It is also added by Haryani (2020) that bibliometrics is a science that studies writing and uses mathematical analysis that can function as a new science to find out about the authorship and productivity of authors or researchers.

Research Procedures

There are several steps taken in bibliometric analysis, namely: data search, bibliography filtering, bibliographic attributes searching, and bibliometric analysis (Yulianingsih, et al., 2020; Haryani et al., 2020). The database is taken from Scopus.

Data Search Process

The process of database search from Scopus is carried out with the following settings:

Search within: *article, abstract, keyword*

Search document: *Circular Economy*

Start exploring

Discover the most reliable, relevant, up-to-date research. All in one place.

[Documents](#) [Authors](#) [Affiliations](#)

[Search tips](#)

Search within
Article title, Abstract, Keywords

Search documents *
Circular Economy

Figure 1: Database search from Scopus with search document 'Circular Economy'

Based on the data search, there are 12,560 documents obtained, as shown in Figure 2.

Figure 2: Results of Data Search

The results of data search in Figure 2 are then filtered with the search ranging from 2017-2021 by choosing several subject areas (Business, Management, and Accounting) and choosing the document type (article).

Figure 3: Data Filtering of 2017-2021

Based on the data filtering, there are 1,335 documents obtained, as shown on Figure 4.

Figure 4: Results of Data Filtering

Before the bibliometric analysis is carried out, there are several steps that needs to be taken:

- i. The meta data that has been previously taken from Scopus is exported in the form of .ris and then processed using VOSviewer.
- ii. In VOSviewer, create map is done by selecting based on “bibliographic data” with the type of analysis of “co-occurrence” and “unit of analysis” based on keywords using “full counting” in the counting method.
- iii. The “minimum number of occurrences of keywords” in VOSviewer is set as 5.

Results and Analysis

Publication Trend of Circular Economy

Based on the data taken from Scopus since 2017-2021, it can be known that the publication trend of circular economy increases. The increase per year is presented in Figure 5.

Figure 5: Publication Trend in Articles of Circular Economy of 2017-2021

Author Collaboration

This study also focuses on author collaboration. It is important considering that research is not always carried out individually, but it is also important to collaborate (Yulianingsih et al., 2020). This is based on various reasons including the existence of collaboration between researchers or institutions for synergy between competencies.

This study maps the collaboration of authors who discuss about CE. The results can be seen in Figure 6.

The data from Scopus shows that from 4,035 authors, there are only 48 authors who have a strong association (link strength). Author with the most link is Mangla, S.K. with 15 links, and author with the most related research with CE is Liu, Y. with 16 papers/research.

Figure 6: Visualization of Author Collaboration Network

Each other links to each other and form a group on different links. The link between the two authors that are previously mentioned is presented in Figure 7a and 7b.

Figure 7 (a): Link/Collaboration Network from Author Liu, Y.

Figure 7(b): Link/Collaboration Network from Author Mangla, S.K.

The collaboration between authors, which is illustrated in VOSviewer application, has 6 groups (clusters) with the most collaboration in Cluster 1 (red color) and Cluster 2 (green color) as presented in Figure 8.

Figure 8: Cluster 1

Figure 8(b): Cluster 2

Analysis of Title Term Trend

Furthermore, based on the data from Scopus visualized using bibliometric analysis, it can be seen that there are a number of variables that are close to CE and have a fairly large circle symbol. This indicates that there have been many studies that discuss the influence or relationship of these variables with CE. The results of the title term trend analysis is shown in Figure 9a and 9b.

Figure 9(b): Density Visualization

Based on the results of bibliometric analysis, it is known that there are three main topic that is closely related to CE, namely sustainable development, recycling, and life cycle. The relationship of CE with these three most frequently occurring variables can be seen in Figure 10.

(a) Relationship of CE and Sustainable Development

Relationship of CE and Recycling(b)

Relationship of CE and Life Cycle (c)

Figure 10: Partial Relationship of CE with Sustainable Development (a), Recycling (b), and Life Cycle(c)

Based on the results of bibliometric analysis, it is also found that it is still rare for researchers to examine the relationship between the circular economy and business. It can be seen in Figure 11 that the relationship between the CE variable and business is still far away, and the circle mark is still small. It indicates that researchers rarely discuss this theme. However, it is also found that several studies have discussed the relationship between these two variables, which can be seen in Figure 11a and 11b.

Figure 11 (a): Relationship between CE and Business

Figure 11 (b): Relationship between CE and Business

Analysis of Country Statistics

The last part of this bibliometric analysis is the distribution of countries that have research on CE as shown in Figure 12. Based on the analysis results, the countries that have conducted the most research on CE are: (1) United Kingdom with 218 papers; (2) Italy with 161 papers; and (3) China with 161 papers. From this analysis, it is also known that there are 11 Scopus indexed papers regarding CE written by Indonesian authors/researchers. It is still lagging behind Malaysia, which has produced 20 papers on this issue.

Figure 12: Distribution of Authors from Various Countries on CE Theme

Conclusions

Based on the publication data from 2017-2021 taken from Scopus database, it can be known that the publication trend of CE continues to increase. Regarding the author collaboration, currently there are only 48 authors who have a strong association (link strength). The author with the most links is Mangla, S.K. with 15 links, and the author with the most research related to CE is Liu, Y. with 16 papers/research.

The results of this study also show that there are 3 big themes that are closely related to CE, namely sustainable development, recycling, and life cycle. It indicates that the opportunity to examine CE with variables outside of the 3 big themes is still very large. It also turns out that it is still rare for researchers to examine the relationship between CE and business. Finally, this study also shows the countries that conducted the most research on CE, namely: (1) United Kingdom (218 papers); (2) Italy (161 papers); and (3) China (161 papers).

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