# Recent Research Topics in Circular Economy

M. CAROLINA MARTINS-RODRIGUES[1], LUCIANA APARECIDA BARBIERI DA ROSA[2], MARIA JOSÉ SOUSA[3], TAÍS PENTIADO GODOY[4]
[1,3]CIEO-Universidade do Algarve, Gambelas, FE | Edifício 9 | 8005-139 Faro
[3]ISCTE – Instituto Universitário de Lisboa, Av. das Forças Armadas, 1649-026 Lisboa PORTUGAL
[2,4]Universidade Federal Santa Maria, Av. Roraima, 1000 - Camobi, Santa Maria - RS, 97105-900, BRASIL
rodriguescarolina@live.com.pt, lucianaaparecidabarbieri@yahoo.com.br, mjdcsousa@gmail.com, taispentiado@yahoo.com.br

*Abstract*: - This study presents bibliometric data to compare the growth of research between Sustainability, Sustainable, and Circular Economy. Thus, a bibliometric study was carried out from 2009 to 2017 using Web of Science and Scopus, broadening the understanding about the subject and understanding that there is a particular orientation of these studies for European research on the subject. Another critical fact in this research was the disagreement between the two bases concerning the leading authors and most cited articles, having no agreement between the bases, being this an essential gap for research. This article presents a demonstration of how research in Sustainability, Sustainable and Circular Economy has been treated, with a specific commitment of European productions (Italy, United Kingdom, Spain, Germany, and Belgium, followed by North American productions, resulting in gaps in the literature, and even in the market, and may arouse interest in further research in the area. This article brings a critical contribution to the thought that there is a gap and an opportunity to be explored. From this article, we obtained the search results in the Web of Science and Scopus databases in order to compare their Sustainability, Sustainable, and Circular Economy development.

*Key-Words:* - Bibliometrics; Circular Economy; Sustainability; Sustainable.

## 1 Introduction

Innovation is a competitive advantage for enterprises to boost their leverage against competitors and to achieve desirable revenue streams, to acquire and retain market share and an essential part of economic dynamics. The internal initiatives and capabilities of firms have been found to play a crucial role in order to achieve economic and organizational sustainability with a circular economy business model. This paper begins by understanding the circular economy, what for it can be used, and the organization's role is. For this purpose, it includes a literature review on the concept. The methodology used is bibliometrics analysis, a technique of quantitative and statistical type which allows the measurement of the production and dissemination of scientific knowledge. The next step was the data analysis and the presentation of the results. Finally, the final considerations and the limitations of the research and avenues for future research.

## 2 Review of the Literature

### 2.1 Circular Economy

The definition originated from the thought theory of industrial eco-development, based on "gain-gain" thinking, i.e., a balance between economy and environment [1]. In this context, the circular economy provides the minimization of resources used in the production process, in addition to the insertion of cleaner technologies [2]. In this way, the development of business-oriented to the philosophy of the Circular Economy will provide organizations profitability and increase their competitive advantage, that is, sustainable economic, social, and

environmental development [3]. On the other hand, the definition of Circular Economy currently applied in Asia has theoretical bases of Industrial Ecology, which predicts the type of association between the elements of different ways of business production, that is, through the use of residual materials and by-products in the increase of complex interconnections [4]. Within this context, in addition to the concepts mentioned above, the circular economy is based on three conceptions: conditioning and expanding natural capital, controlling finite inventories and balancing the fluids of renewable resources; improve manufacturing concerning resources, establishing the circulation of productive inputs in the optimization of production, through projects carried out for manufacturing and recycling, allowing the materials to remain circulating and collaborating for the economy; system, highlighting the negative externalities of the production system [5]. However, in Bonciu's words [6], some characteristics differentiate the definition of the circular economy in what concerns the reduction of the consumption of energy and inputs, as well as the reduction of pollution. In this perspective [1], the circular economy can be classified into three levels: micro, meso, and macro levels. At the micro-level, organizations focus on strategies and actions geared toward sustainability, i.e., eco-design and cleaner production. At the meso level, the objective is to create parks and eco-industrial networks in an attempt to benefit the region's economy and environment. Finally, the macro-level results in sustainability-oriented production and consumption processes with a bias towards the circular economy [1]. However, it is necessary to engage and invest in research on the subject so that organizations are aware of the importance of the circular economy.

## 2.2 Sustainability and the Circular Economy

Companies are currently embedded in an uncertain, dynamic, and competitive environment. However, while industrialization has resulted in modernity and progress, bringing business advantages and social welfare, it has also caused significant social and environmental problems [7]. In this way, the adverse effects of environmental degradation have threatened the integrity of natural ecosystems and the stability of the economy continuously, being that they are essences for the survival of humanity [8], [9], [1], [10] and [11]. Business growth is linked to sustainable development, and sustainability is used to provide motivations and integrate sustainability aspects into business processes [12]. Companies that are committed to sustainability and the future are those that encourage the development of sustainable innovations [13], [14], [15]. Therefore, companies consider that they cannot ignore sustainability if they want to remain competitive in the market [16], corroborating with this, the author describes that the business activities developed must preserve ecosystems fully and respect diversity [17]. In this perspective, the discussion of the need to counterbalance the different dimensions of sustainability leads us to reflect on the dominant mode of production, emphasizing that companies must develop new forms of production that are socially and economically fair, resulting in less impact on the environment [18], [19]. Thus, over time, more and more the concept and model of Circular Economics (CE) has called attention as a way to overcome the current model of consumption and production, based on the flow of resources and continuous growth. In this way, the EC concept was first described by British environmental economists, [20], in Economics of Natural Resources and Environment, they describe that an open economy was created with no tendency to introduce recycling that reflected, that the environment was a waste reservoir [20]. The EC policy instrument is increasingly popular for addressing environmental issues. In the year 1996 in Germany, it was the main starting point of the implementation of the EC accompanied by a law: "Closed Cycle of Substances and Waste Management Act," so this law provided closed-cycle waste management, ensuring the disposal compatible with the environment. The Law for the Establishment of a Recycling-Based Society came into force in January 2002 [21], [22]. In this way, this law provides quantitative targets for the dematerialization and recycling of companies and society [23]. One of the characteristics of EC policy is to avoid further environmental degradation and conserve scarce natural resources through effective waste management [24] [25], In this way, the Chinese government adopted the EC as one of the main priorities of the National regulatory policy, introducing various regulations to build and support its implementation of the "Cleaner Production Promotion Law," which was in force in January

2003. This regulation was built with the amended Law on Prevention and Control of Solid Waste Pollution, which came into force on April 1, 2005. Thus, the Law for the Promotion of the Circulating Economy was approved at the 4th meeting of the Standing Committee of the 11th National People's Congress of China and entered into force on January 1, 2009. However, this law promotes EC growth, enhancing efficiency and protecting the employment of natural resources, thereby achieving sustainable development [11], [26]; [27], [28], [29], [30], [8] and [31]. Sustainable development requires a balance between the environmental, technological, economic, and social aspects of a researched economy, industry, or individual industrial process, as well as the relationship between all these aspects ([32], [33]. Therefore, the EC cooperates positively to harmonize all elements, thanks to the underlying logic, rooted in political, commercial, economic, and environmental aspects [34] [35]. The EC requires the environmentally sound and appropriate use of resources, aimed at implementing a greener economy characterized by innovative employment opportunities, and a new business model [35] [36]. Thus, the EC can implement and understand radically new standards, and help society in its well-being, achieve greater sustainability with low cost, energy, environmental, or material. Therefore, because of the complexity of a sustainable development vision most often EC implementation and sustainability need to be supported by innovative intermediaries and designers who provide projects and services for appropriate radical changes in decision-making policies, tools and practices ([37] [38]. Therefore, EC and sustainability together are simple strategies that aim to reduce the impact on the environment of the different forms, closing economic and ecological links of the flows of resources.

# 3 Methodology

This study used bibliometrics, a technique of quantitative and statistical type which allows the measurement of the production and dissemination of scientific knowledge, which emerged at the beginning of the century, due to the need to study and evaluate the activities of scientific production and communication [39] [40] [41]. According to [42] and [43], bibliometrics aims to evaluate the scientific or technical activity of a given area of knowledge through the quantitative study of publications. Moreover, the statistical data produced through bibliometric studies measure the contribution of scientific knowledge originating from publications in certain areas. According to [44] and [45], bibliometry is defined as a discipline that allows the quantitative study of scientific production, through the analysis of its nature and the transfer of science in a given period. The articles published between the years 2009 and 2017, obtained from the Web of Science and Scopus databases, were used as a study material to compare their development regarding Sustainability and Circular Economy, Sustainable and Circular Economy, in all areas of research. The data were collected, in July 2018, directly from the two large multidisciplinary databases, using the Boolean operators to expand the research in order to have a term of comparison of reality. The selected databases were Thomson Reuters's Web of Science (WOS) and Elsevier's Scopus, which include data, abstracts, and quotes from the scientific literature. The research was refined in such a way that it only included scientific articles in both databases, and the term "Sustainability" and "Circular Economy," "Sustainable" and "Circular Economy" were searched in order to broaden the research bases and to the terms. All the publications were searched in 2009 on the respective bases until the year 2017, once the year 2018 is in progress. Thus, in order to compare the production of the articles collected in the Web of Science and Scopus, we identified the primary authors who wrote on the subject, the growth of the researches in the terms during the period, the leading newspapers, central countries and languages, areas of knowledge and the relationship between authors with more publications and those most cited. To analyze the data, comparison tables were created in Excel tables.

There is an index of citations in the Web of Science and in the Scopus where the cited documents by each author and the documents quoted by them are mentioned (Figure 1).

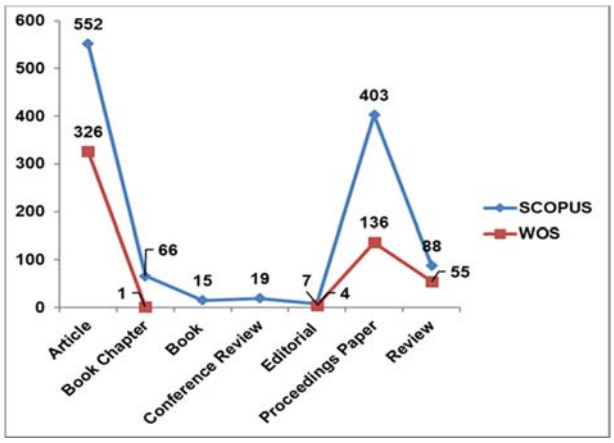


Fig. 1. Distribution of articles by type of publication

### 3.1 Data collection steps

This article was divided into two stages. In the first step, the terms "Sustainability" and "Circular Economy," "Sustainable" and "Circular Economy" were placed in the research field of the WOS database and Scopus, limited to the period between 2009 and 2017. Then, the overall features of the publications were surveyed.

In the second stage, the most cited publications were considered and compared with the authors who published the most in the same period. The steps of the research are shown in Figure 2.


Fig.2 The steps of the research

The bibliometric analysis of this study was performed according to the steps described in Figure 1.

## 4 Results

The results of the research, which was carried out based on the appropriate Boolean operators for refinement, are presented in order to broaden the scope of research to encompass the highest possible number of results in the years 2009 to 2017. Two hundred ninety articles were found scientists in the Web of Science and 370 scientific papers at Scopus when it comes to Sustainability and Circular Economy. When the research is refined to contemplate scientific articles related to Sustainable and Circular Economy, 219 scientific articles were found in the Web of Science and 787 scientific articles in Scopus, as Table 1 points out.

Table 1 – Search Terms

| Terms | Web of Science (WOS) | Scopus |
|---|---|---|
| Sustainability and Circular Economy | 290 | 370 |
| *Sustainable* and Circular Economy | 219 | 787 |

### 4.1 General characteristics of the publications

The following are the general characteristics of the publications related to the themes Sustainability, and Circular Economy, and Sustainable and Circular Economy: 1. Main authors, 2. Source Title, 3. Main Institutions, 4. Annually published articles 5 Main countries, 6. Main languages, 7. Research areas. Then, the number of publications per author and the number of citations will be displayed.

#### 4.1.1 Main authors

Figure 3 presented the principal authors who published articles related to the chosen topics, Sustainability, and Circular Economy, and Sustainable and Circular Economy, in the analyzed period. It appears that for the principal authors, there is a consensus among the bases, since the authors Geng, Y., Kopnina H. and Sarkis, J. repeat themselves. In the Scopus database, the chart shows the authors Geng, Y. and Kopnina, H. with 12 articles, followed by Bocken N.M.P. with nine publications. The difference between publications in the two databases shows a possible gap in the academic field. It was verified that there were only three authors who stand out in the two bases, Geng, Y., Kopnina H. and Sarkis, J., being two of them (Geng, Y. and Sarkis, J.) also among the most cited in the period under analysis. In this way, there is a lack of a researcher that stands out significantly when analyzing the themes of Sustainability and Circular Economy, Sustainable and Circular Economy.

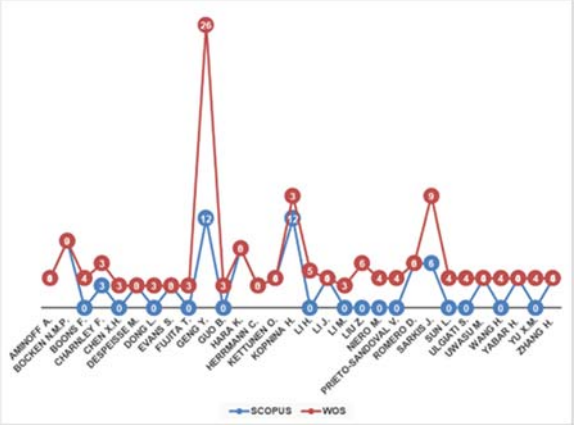


Fig. 3 Distribution of articles by authors

### 4.1.2 Title of sources

Table 2 shows the primary sources of publications and the number of published articles related to the theme Sustainability, Sustainable, and Circular Economy.

Table 2 - Distribution of articles by source

| Source Title | SCOPUS | WOS |
|---|---|---|
| Advanced Materials Research | 45 | 9 |
| Applied Mechanics and Materials | 21 | |
| Bioresource Technology | 17 | 4 |
| Energy Procedia | 22 | 11 |
| Environmental Engineering and Management Journal | | 4 |
| Journal of Cleaner Production | 91 | 112 |
| Journal of Industrial Ecology | 15 | 14 |
| Procedia CIRP | 43 | 21 |
| Procedia Environmental Sciences | 9 | 6 |
| Proceedings of the International Conference Engineering Design Iced | 8 | |
| Resources Conservation and Recycling | 21 | 23 |
| Shengtai Xuebao Acta Ecologica Sinica | 16 | |
| Sustainability | 46 | 43 |
| Waste Management | | 7 |

The papers with the most significant impact that more scientific articles published involving the theme in the two Web of Science and Scopus databases stand out: Journal of Cleaner Production, Sustainability, Proceedings CIRP, "Materials Conservation and Recycling," Journal of Industrial Ecology, Energy Proceedings, Advanced Materials Research. Articles published in the journals only from Scopus: Applied Mechanics and Materials, Shengtai Xuebao Acta Ecologica Sinica, Proceedings of The International Conference on Engineering Design Iced. Moreover, articles only published in the journals in the Web of Science: Waste Management and Environmental Engineering and Management Journal.

It seems that there are some publications in the area's newspapers that are not yet a reference for articles in these subjects, and there are also publications of articles in multidisciplinary journals.

### 4.1.3 Main institutions

The institutions that most stood out and published works related to the theme Sustainability, Sustainable, and Circular Economy are presented in Table 3.

Table 3 - Distribution of articles by main institutions

| Institutions | SCOPUS | WOS |
|---|---|---|
| Aarhus University | | 4 |
| Alma Mater Studiorum Universita di Bologna | 6 | |
| Central South University | | 4 |
| Centre National De La Recherche Scientifique Cnrs | | 6 |
| Chinese Academy of Sciences | 29 | 25 |
| Cranfield University | 12 | 5 |
| Dalian University Of Technology | | 5 |
| Delft University of Technology | 39 | 20 |
| East China Institute of Technology | 9 | 4 |
| Helmholtz Association | | 6 |
| Ministry of Education China | 8 | |
| National Institute for Environmental Studies Japan | | 17 |
| Politecnico di Milano | 9 | |
| Shanghai Jiao Tong University | | 17 |
| Shenyang Institute of Applied Ecology Cas | 8 | |
| Technical University Of Denmark | | 5 |
| Tecnologico de Monterrey | 4 | |
| Tianjin University of Technology | 9 | |
| Tsinghua University | 9 | 7 |
| Universidade de Sao Paulo - USP | 4 | |
| Universita di Salerno | 4 | |
| University of Cambridge | 22 | 9 |
| University of Manchester | 4 | |
| Wageningen University and Research Centre | 4 | |
| Shenyang Institute Applied Ecology Cas | | 15 |

The Table 3 shows the institutions that published the most scientific articles involving the subject in the two bases, Web of Science and Scopus: Chinese Academy of Sciences, Tsinghua University and East China Institute of Technology in the People's Republic of China, Delft University of Technology in the Netherlands, University of Cambridge and Cranfield University in the United Kingdom.

### 4.1.4 Annually published articles

According to Figure 4, it is possible to follow the growth of the publications in the two databases. Both in the Web of Science and Scopus, the years 2016 and 2017 were the ones with the highest productivity. Scopus has 245 and 494 publications, respectively, against 124 and 235 publications in the Web of Science.

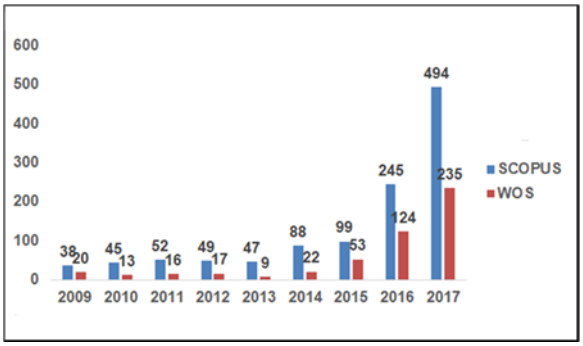


Fig. 4 Total publications per year

### 4.1.5 Main countries

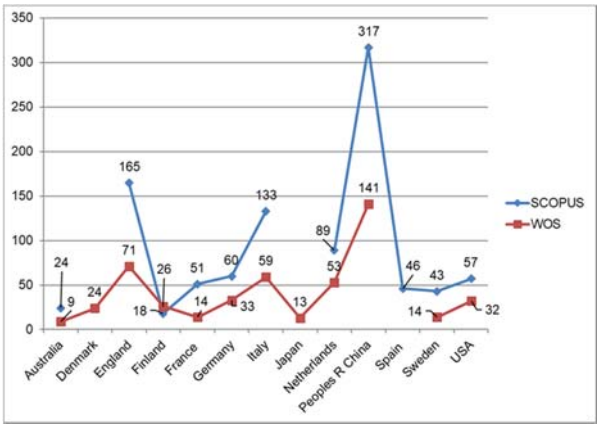


Fig. 5 Distribution of articles by country

The number of articles distributed by significant countries is shown in Figure 5.

It was noted that the countries that published the most articles were: the People's Republic of China, European countries, the USA, Australia, and Japan. It should be noted that there is an absolute centralization of articles published in these areas and will, therefore, be an area of interest for research.

### 4.1.6 Main languages

The languages of the papers published in the study area are published in English, 500 in the Web of Science, and 1097 in Scopus, as shown in Figure 6, corresponding to 95.63% of the works.

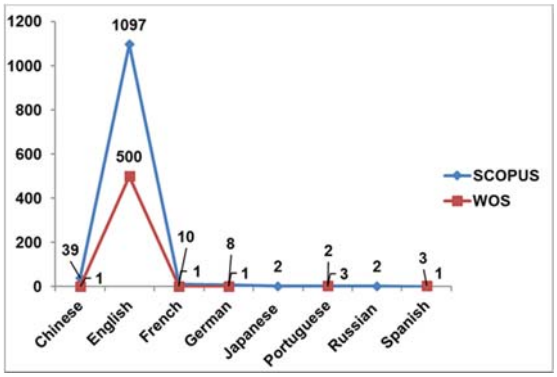


Fig. 6 Distribution of articles by language

### 4.1.7 Research areas

Regarding the main Research Areas in Sustainability, Sustainable and Circular Economy publications, there seems to be a convergence in the main research areas of most published articles in Web of Science and Scopus: Environmental Sciences and Engineering, as shown in table 4.

Table 4. Distribution of articles by research areas

| Research Areas | SCOPUS | WOS |
|---|---|---|
| Agriculture | 63 | |
| Business | 211 | 12 |
| Chemical Engineering | 25 | |
| Chemistry | 21 | |
| Computer Science | 85 | |
| Decision Sciences | 48 | |
| Ecology | | 5 |
| Economics | 96 | 14 |
| Energy | 259 | 34 |
| Engineering | 467 | 246 |
| Environmental Sciences | 507 | 403 |
| Geology | | 6 |
| Geosciences Multidisciplinary | | 11 |
| Green Sustainable Science Technology | | 211 |
| Management | | 17 |
| Materials Science | 48 | 3 |
| Mining Mineral Processing | | 5 |
| Social Sciences | 180 | |

### 4.2 Most cited articles from 2009 to 2017.

Among the data from the Web of Science and Scopus survey on Sustainability and Circular Economy, Sustainable and Circular Economy, from 2009 to 2017, it is crucial to highlight Table 5 which presents the foremost publications in number of citations, shows signs of an approximation between the two bases, which corroborates with the leading authors and main newspapers for publications.

Table 5. List of the twenty-eight most cited publications

| Number of Quotations | | Title | Author | Journal | Year |
|---|---|---|---|---|---|
| Scopus | WoS | | | | |
| | 183 | Product services for a resource-efficient and circular economy - a review. | Tukker, A. | Journal of Cleaner Production | 2015 |
| 226 | 172 | A review of the circular economy: The expected transition to a balanced interplay of environmental and economic systems. | Ghisellini, P.; Cialani, C.; Ulgiati, S. | Journal of Cleaner Production | 2016 |
| 185 | 162 | Current options for the valorization of food manufacturing waste: a review. | Mirabella, N.; Castellani, V.; Sala, S. | Journal of Cleaner Production | 2014 |
| 119 | 139 | Sustainability and in situ monitoring in battery development. | Grey, C.P.; Tarascon, J.M. | Nature Materials | 2017 |
| 149 | | A review of the circular economy in China: Moving from rhetoric to implementation. | Su, B.; Heshmati, A.; Geng, Y.; Yu, X. | Journal of Cleaner Production | 2013 |
| 145 | 124 | Towards a national circular economy indicator system in China: an evaluation and critical analysis. | Geng, Y.; Fu, J.; Sarkis, J.; Xue, B. | Journal of Cleaner Production | 2012 |
| 123 | | Measuring China's circular economy. | Geng, Y.; Sarkis, J.; Ulgiati, S.; Zhang, P. | Science | 2013 |
| 98 | 67 | The Circular Economy – A new sustainability paradigm. | Geissdoerfer, M.; Savaget, P.; Bocken, N.M.P.; Hultink, E.J. | Journal of Cleaner Production | 2017 |
| | 94 | Progress Toward a Circular Economy in China The Drivers (and Inhibitors) of Eco-industrial Initiative. | Mathews, J.A.; Tan, H. | *Journal of Industrial Ecology* | 2011 |
| 93 | | How circular is the global economy? An assessment of material flows, waste production, and recycling in the European Union and the world in 2005. | Haas, W.; Krausmann, F.; Wiedenhofer, D.; Heinz, M. | *Journal of Industrial Ecology* | 2015 |
| 86 | | Waste biorefinery models towards sustainable circular bio-economy: Critical review and future perspectives. | Venkata, S.M., Nikhil, G., Chiranjeevi, P., Nagendranatha, C.R., Rohit, M.V., Kumar, A.N., Sarkar, O. | Bioresource Technology | 2016 |
| 85 | | 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 | 2010 |

| Number of Quotations | | Title | Author | Journal | Year |
|---|---|---|---|---|---|
| 83 | | Products that go round: Exploring product life extension through design. | Bakker, C., Wang, F., Huisman, J., Den Hollander, M. | Journal of Cleaner Production | 2014 |
| 83 | 75 | The E factor 25 years on the rise of green chemistry and sustainability. | Sheldon, Roger A. | *Green Chemistry* | 2017 |
| | 69 | Emergy analysis of an industrial park: The case of Dalian, China. | Geng, Y.; Zhang, P.; Ulgiati, S.; Sarkis, J. | Science of the Total Environment | 2010 |
| | 56 | The possible use of sewage sludge ash (SSA) in the construction industry as a way towards a circular economy. | Smol, M.; Kulczycka, J.; Henclik, A.; Gorazda, K.; Wzorek, Z. | Journal of Cleaner Production | 2015 |
| 77 | 48 | Product design and business model strategies for a circular economy. | Bocken, N.M.P.; de Pauw, I.; Bakker, C.; Van Der Grinten, B. | Journal of Industrial and Production Engineering | 2016 |
| 77 | | Moving toward the circular economy: The role of stocks in the Chinese steel cycle. | Pauliuk, S., Wang, T., Müller, D.B. | Environmental Science and Technology | 2012 |
| | 48 | Bio-derived materials as a green route for precious & critical metal recovery and re-use. | Dodson, J.R.; Parker, H.L.; Garcia, A.M.; Hicken, A.; Asemave, K.; Farmer, T.J.; He, He; Clark, J.H.; Hunt, A.J. | *Green Chemistry* | 2015 |
| 54 | 45 | Recovery and recycling of lithium: A review. | Swain, B. | Separation and Purification Technology | 2017 |
| 76 | | Ecological utilization of leather tannery waste with circular economy model. | Hu, J., Xiao, Z., Zhou, R., Deng, W., Wang, M., Ma, S. | Journal of Cleaner Production | 2011 |
| 71 | 43 | The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context. | Murray, A.; Skene, K.; Haynes, K. | Journal of Business Ethics | 2017 |
| 61 | | Interrogating the circular economy: the moral economy of resource recovery in the EU. | Gregson, N., Crang, M., Fuller, S., Holmes, H. | Economy and Society | 2015 |
| 58 | | Closed-loop production systems - A sustainable supply chain approach. | Winkler, H. | CIRP Journal of Manufacturing Science and Technology | 2011 |
| 57 | | Effectiveness of the policy of circular economy in China: A DEA-based analysis for the period of 11th five-year-plan. | Wu, H.-Q., Shi, Y., Xia, Q., Zhu, W.-D. | Resources, Conservation and Recycling | 2014 |
| 56 | 42 | 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. Lenny | Omega-International Journal of Management Science | 2017 |
| 49 | 40 | Towards a more Circular Economy: Proposing a framework linking sustainable public | Witjes, S.; Lozano, R. | Resources Conservation and Recycling | 2016 |

| Number of Quotations | | Title | Author | Journal | Year |
|---|---|---|---|---|---|
| | | procurement and sustainable business models. | | | |
| 56 | 32 | Environmental sciences, sustainable development, and circular economy: Alternative concepts for trans-disciplinary research. | Sauve, S.; Bernard, S.; Sloan, P. | Environmental Development | 2016 |
| 54 | | Designing the business models for circular economy-towards the conceptual framework. | Lewandowski, M. | Sustainability | 2016 |
| 43 | | Conceptualizing the circular economy: An analysis of 114 definitions. | Kirchherr, J., Reike, D., Hekkert, M. | Resources Conservation and Recycling | 2017 |
| | 32 | Overview and description of technologies for recovering phosphorus from municipal wastewater. | Egle, L.; Rechberger, H.; Zessner, M. | Resources Conservation and Recycling | 2015 |
| | 28 | Green chemistry, catalysis, and valorization of waste biomass. | Sheldon, R.A. | Journal of Molecular Catalysis A-Chemical | 2016 |
| | 27 | New Frontiers in the Catalytic Synthesis of Levulinic Acid: From Sugars to Raw and Waste Biomass as Starting Feedstock. | Antonetti, C.; Licursi, D.; Fulignati, S.; Valentini, G.; Galletti, A.M.R. | Catalysts | 2016 |
| | 27 | A review on China's pollutant emissions reduction assessment. | Xue, B.; Mitchell, B.; Geng, Y.; Ren, W.; Mueller, K.; Ma, Zhixiao; Oliveira, J.A.; Puppim; F.T.; Tobias, M. | Ecological Indicators | 2014 |
| | 27 | An analysis of E-waste flows in China. | Veenstra, A.; Wang, C.; Fan, W.; Ru, Y. | International Journal of Advanced Manufacturing Technology | 2010 |
| | 25 | Closing the loop or squaring the circle? Locating generative spaces for the circular economy. | Hobson, K. | Progress in Human Geography | 2016 |
| | 24 | Product service system: A conceptual framework from a systematic review. | Annarelli, A.; Battistella, C.; Nonino, F. | Journal of Cleaner Production | 2016 |
| | 24 | A case study of a phosphorus chemical firm's application of resource efficiency and eco-efficiency in industrial metabolism under circular economy. | Ma, S.; Hu, S.; Chen, D.; Zhu, B. | Journal of Cleaner Production | 2015 |

It is important to note that of the 25 most cited articles in each database 12 appear in the two databases, and 13 articles in each database are different, thus justifying the 38 articles in the Table.

It is also observed that, of the ten most published authors on the subject in the two databases, four of Scopus (Geng, Y., Sarkis, J., Bocken, N.M.P, Zhang, H.) and five of the Web of Science (Geng,

Y; Sarkis, J.; Fujita, T, Ulgiati, S.; Yu, X.), are listed in the most cited authors.

Comparing Graph 2 with the table 5, it was possible to verify that Tukker, Arnold the most cited author, in the Web of Science, and the authors Ghisellini, P.; Cialani and Catia most cited in Scopus are not among the top ten authors on the subject during the study period.

# 5 Final Considerations

The present study aimed to verify the characteristics of the national and international scientific production that relate the themes Sustainability and Circular Economy, Sustainable, and Circular Economy. In order to reach the objective, a bibliometric research was carried out in the Web of Science and Scopus databases, obtaining 290 scientific articles in the Web of Science and 370 scientific articles in Scopus when it came to Sustainability and Circular Economy and was refined the research to contemplate scientific articles related to the Sustainable and Circular Economy, having been found 219 scientific articles in the Web of Science and 787 scientific articles in Scopus. The analysis of the distribution by categories of the Sustainability and Circular Economy, Sustainable and Circular Economy publications in the Scopus and Web of Science databases shows that six appear in the two bases: Business, Economics, Energy, Engineering, and Environmental Sciences. It has been noted that of the 25 most cited articles in each base 12 appear in both the Web of Science and Scopus, and 13 articles are different in each base, so the 38 articles in the Table are justified. It was also noticed that, of the ten authors that published more on the subject in the two bases, four of Scopus and five of Web of Science appear in the list of the most cited authors, but, Ghisellini, P.; Cialani, C., the most cited authors in Scopus and Tukker, and Arnold, the most cited author, in the Web of Science, are not among the ten most published authors on the subject during the study period. E, Geng Y; Sarkis J. are among the ten authors who have published the most on the subject and are included in both bases. In this way, it is possible to verify that there is a relation between the publications with the most significant publications in the Sustainability and Circular Economy, Sustainable and Circular Economy, in the two databases. It was found that the publications found are necessarily articles and Proceedings, and in the period between 2014 and 2017, the scientific production related to the theme increased in both bases, evidencing the highest growth in Scopus. Concerning the standard journals, in the two databases, could be identified: Advanced Materials Research, Bioresource Technology, Energy Proceedings, Journal of Cleaner Production, Journal of Industrial Ecology, Proceedings CIRP, Proceedings Environmental Sciences, Resources Conservation, and Recycling, Sustainability. It was also verified that, in both databases, the People's Republic of China leads the ranking of the countries that published the most on the subject, and the English language is the predominant in the publications. It is noteworthy that, although no publications were found in Brazil and Portugal in the Web of Science and Scopus on the subject researched, which indicates that this theme is still little worked so that it may serve for future Brazilian and Portuguese researchers who seek originality in their work. The contribution of this study to the studies in Management is due to the resulting indicators regarding the research institutions and the newspapers that stand out most in the production of the knowledge on the subject at the international level.As the main limitation of this study, it is highlighted that in its realization, two databases of Web of Science and Scopus were used. The second limitation of this study refers to the fact that only the terms used were "Sustainability and Circular Economy, Sustainable and Circular Economy," and third, the bibliometric analysis is limited to authors, articles, sources, institutions, countries, language and period. Thus, it is suggested that for future research it is necessary to use other research terms; perform other bibliometric analyses, such as the creation of networks of authors and institutions; to carry out a systemic analysis to analyze other contents different from those analyzed in the present study, such as: what theories have been worked together and in which countries, what themes emerged in "Sustainability and Circular Economy, Sustainable and Circular Economy."

*References:*

[1] Geng, Y., Fu, J., Sarkis, J., Xue, B., Towards a national circular economy indicator system in China: an evaluation and critical analysis. Journal of Cleaner Production, Vol.23, 2012, pp.216-224.

[2] Andersen, M.S., Governance by green taxes: implementing clean water policies in Europe 1970–1990. Environ Econ Policy Stud Vol.2, No.1, 1999, pp.39–63

[3] Li, S., The research on quantitative evaluation of circular economy based on waste input-output analysis. International Conference on Environmental Science and Engineering. Procedia Environmental Sciences, 2012.

[4] Jacobsen, N.B., Industrial Symbiosis in Kalundborg, Denmark: A quantitative assessment of economic and environmental aspects. Journal of Industrial Ecology, Vol.10, No.1-2, 2006, pp.239-255.

[5] Ellen MacArthur Foundation. Growth within A circular economy vision for a competitive 2015, Europe.https://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArt hurFoundation_Growth-Within_July15.pdf. Acesso em 17/08/18.

[6] Bonciu, F., The European economy: From a linear to a circular economy. Romanian Journal of European Affairs. Vol.14, 2014, pp.78-91.

[7] Duarte, A.L.M.; da Rui, M.C.; Zambra, E.M.; Costa, S.R.; Souza, P.A.R. e Pereira, R.S., Práticas De Gestão Ambiental Em Uma Organização De Produtores De Suínos Em Vera Mt. Nucleus, Vol.14, No.2, 2017, pp.187-198.

[8] Lett, L. A., Las amenazas globales, el reciclaje de residuos y el concepto de economia circular. Rivista Argentina de Microbiologia, Vol.46, No.1, 2014, pp.1-2.

[9] Park, J.J., Chertow, M. Establishing and testing the “reuse potential” indicator for managing waste as resources. Journal of Environmental Management, Vol.137, 2014, pp.45-53.

[10] United Nations Environmental Programme (UNEP), Overview of the Republic of Korea’s National Strategy for Green Growth. UNEP DTIE Economics and Trade Branch, Geneva, Switzerland, 2013.

[11] Whaugray, D. e Davos, Circular economy offers opportunities for Latin America. The Guardian, 2013. Available: http://www.theguardian.com/sustainable-business/davos-2013-circular-economy-opportunities-latin-america accessed 24/07/2013.

[12] Maletic, M.; Maletic, D.; Dahlgaard, J. J.; Dahlgaard-Park, S.; Gomiscek, B., The relationship between sustainability-oriented innovation practices and organizational performance: empirical evidence from Slovenian organizations. The University of Wollongong in Dubai - Papers Organizacija, Vol.47, No.1, 2014, pp.3-13.

[13] Huang, Y.C.; Yang, M.L., “Reverse logistics innovation, institutional pressures, and performance," Management Research Review, Vol.37, No.7, 2014, pp.615-641.

[14] Wu, T.; Wu, Y.J.; Chen, Y.J. e Goh, M., Aligning supply chain strategy with corporate environmental strategy: a contingency approach. Int. J. Prod. Econ. Vol.147, 2014, pp,220–229.

[15] Lo, S. M.; Shiah, Y., "Associating the motivation with the practices of firms going green: the moderator role of environmental uncertain," Supply Chain Management: An International Journal, Vol. 21, No4, 2016, pp.485.

[16] Montalvo, C., Diaz-Lopez, F., Brandes, F., Eco-innovation Opportunities in Nine Sectors of the European Economy. European Sector Innovation Watch. European Commission, Directorate-General Enterprise and Industry, Brussels, 2011.

[17] Dias, R., Sustentabilidade: Origem e Fundamentos; Educação e Governança Global; Modelo de Desenvolvimento. São Paulo, Editora Atlas, 2015.

[18] Medeiros, M.; Almeida, J., Insustentável sustentabilidade do desenvolvimento. Revista Uniara, Vol.13, No.1, 2010, pp.107-114.

[19] Neutzling, D.M.; Land, A.; Seuring, S. e Nascimento, L. F., Linking sustainability-oriented innovation to supply chain relationship integration. Journal of Cleaner Production. 2017.

[20] Pearce, D.W., Turner, R.K., Economics of Natural Resources, and the Environment. Harvester Wheatsheaf, London, 1990.

[21] METI, Handbook on Resource Recycling Legislation, and 3R Initiatives. Ministry of Economy, Tra, e and Industry, Tokyo, Japan, 2004.

[22] Morioka, T., Tsunemi, K., Yamamoto, Y., Yabar, H., Yoshida, N., Eco-efficiency of advanced loop closing systems for vehicles and household appliances in Hyogo Eco-town. Journal of Industrial Ecology, Vol.9, No.4, 2005, pp.205-221.

[23] Van Berkel, R., Fujita, T., Hashimoto, S. e Geng, Y., Industrial and urban symbiosis in Japan: analysis of the eco-town. Journal of Environmental Management, Vol.90, 2009, pp.1544-1556.

[24] Fang, Y., Coté, R. P., Qin, R., Industrial sustainability in China: Practice and prospects for eco-industrial development. Journal of Environmental Management, Vol.83, 2007, pp.315-328.

[25] Yap, N. U., Towards a circular economy: progress and challenges. Green Management International, Vol.50, 2005. pp.11-24.

[26] Feng, Z.J., Yan, N.L., Putting a circular economy into practice in China. Sustainability Science. Vol.2, 2007, pp.95-101.

[27] Geng, Y., Doberstein, B., Developing the circular economy in China: challenges and opportunities for achieving "leapfrog development." International Journal of Sustainable Development and World Ecology Vol.15, No.3, 2008a, pp.231-239.

[28] Ness, D., Sustainable urban infrastructure in China: Towards a Factor 10 improvement in resource productivity through integrated infrastructure system. International Journal of Sustainable Development & World Ecology, Vol.15, 2008, pp.288-301.

[29] Mathews, J. A., Tan, H., Progress towards a circular economy: the drivers and inhibitors o Eco-industrial al initiative. Journal of Industrial Ecology, Vol.15, 2011, pp.435- 457.

[30] Europesworld, The circular economy, is the basis of the new industrial policy, 2014. available: http://europesworld.org/2014/06/15/the-circular-economy-is-the-basis-of-a-new-eu-industrialpolicy/#. VQCon5VARdg Accessed 11/08/2018.

[31] Naustdalslid, J., Circular economy in China – the environmental dimension of the harmonious society. International Journal of Sustainable Development & World Ecology, 2014.

[32] FAO, Food, and Agriculture Organization. Guidelines for the integration of sustainable agriculture and rural development. The concept of SARD, available: http://www.fao.org/docrep/w7541e/w7541e04.htm Accessed 08/08/2018.

[33] Ren, J., Manzardo, A., Toniolo, S., Scipioni, A., Sustainability of hydrogen supply chain. Part I: Identification of critical criteria and cause-effect analysis for enhancing sustainability using DEMATEL. International Journal of Hydrogen Energy, Vol.38, 2013, pp.14159-14171.

[34] Birat, J.P., Life cycle assessment, resource efficiency, and recycling. Metallurgical Research &Technology, Vol.112, No.206, 2015, pp.1-24.

[35] Ellen Macarthur Foundation, Towards the circular economy. 2012. Available: http://www.ellenmacarthurfoundation.org/business/reports accessed 10/08/2018.

[36] Stahel, W.R., Reuse is the key to the circular economy, 2014. available: http://ec.europa.eu/environment/ecoap/abouteco- innovation/experts-interviews/reuse-is-the-key-to-the circular-economy_en.htm accessed 16/08/2018.

[37] Golinska, P., Kosacka, M., Mierzwiak, R., Werner-Lewandowska, K., Grey Decision Making as a tool for the classification of the sustainability level of remanufacturing

companies. Journal of Cleaner Production, Vol.105, 2015, pp.28-40.

[38] Küçüksayra., E., Keskin, D., Brezet, H., Intermediaries, and innovation support in the design for sustainability field: cases from the Netherlands, Turkey, and the United Kingdom. Journal of Cleaner Production, Vol.101, 2015, pp.38-48.

[39] Fonseca, E.N. (org.), Bibliometria: teoria e prática. Cultrix/EDUSP, São Paulo. pp.9-15, 1986.

[40] Okubo, Y., Bibliometric Indicators, and Analysis of Research Systems: Methods and Examples, OECD Science, Technology and Industry Working Papers, 1997/01, OECD Publishing, Paris, 1997.

[41] Araújo, C.A., Bibliometria: evolução histórica e questões atuais. Em Questão, Porto Alegre, Vol.12, No.1, 2006, pp.11-32.

[42] Silva, M. R., Análise bibliométrica da produção científica docente do programa de pós-graduação em educação especial/UFSCar. Dissertação (Mestrado em Educação Especial) - Universidade Federal de São Carlos, São Carlos, Brasil, 2004.

[43] Leite Filho, G. A., Padrões de produtividade de autores em periódicos e congressos na área de contabilidade no Brasil: um estudo bibliométrico. Revista de Administração Contemporânea, Curitiba, Vol.12, No.2, 2008, pp.533–554.

[44] Rousseau R., Indicadores bibliométricos y econométricos en la evaluación de instituciones científicas. ACIMED. Vol.9, 2001, pp.23-9.

[45] Camps, D; Samar, M.E.; Ávila, R.E. e Recuero Y., Estudio bibliométrico de un volumen de la revista Archivos de Medicina. Arch Med.; Vol.2, No.3, 2006.