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Review

Insights from Circular Economy Literature: A Review of Extant Definitions and Unravelling Paths to Future Research

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Abstract: The circular economy (CE) has become one of the prominent topics in both natural science and management literature over the last few decades. CE is a dual-loop regenerative system that focuses on the effective and efficient utilization of resources in the ecosystem, which is beneficial to environmental and economic performance optimization. Dual CE initiatives allow firms to increased resource eco-efficiency, as well as resource effectiveness. CE has profound consequences for economic and operational advantage. This reinforces the need for reflection on the definition that may provide guidelines to assess and advance the depth and diversity of the field. We aim to provide a definitional analysis of the CE and suggest future research streams to advance the existing literature. For this purpose, we employed a systematic literature review to collect related publications in the CE. As a result of this, a total of 91 papers were selected, studied, and analyzed. We proposed a sound definition of a circular economy that includes the main identified elements, organizational planning processes, customers and society, utilization of the ecosystem, and economic resource flows. Moreover, future direction agenda, in CE research, is suggested considering three research streams: (1) circular design as value creation and capture, (2) antecedents of key activities, and (3) consequences of key processes. There is limited empirical research conducted on CE, and much of the existing research focuses on theoretical, conceptual, and normative. A few empirical research studies are mainly cross-sectional in their focus and are confined to developing and emerging economies. We hope this study's findings will extend the field of CE, in which some of the most influential information regarding CE literature is provided. This study suggests that the development of CE initiatives plays an important role in the growing digital transformation in the value chain. There have been limited research studies in the interface of circular economy and Industry 4.0. Future research studies may investigate the extent to which digital transformation can increase the implementation of CE, and their influence on digital performance management.

Keywords: circular economy; ecosystem; circular design; value creation; digital performance

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1. Introduction

In recent years, the circular economy (CE) has been the focus of attention from practitioners and academics. CE set out "pathways to provide opportunities for the dematerialization of resources throughout the product physical life cycle" [1]. The interface of the CE and the promotion of a resilient infrastructure have interested scholars for years [1]. According to Awan et al. [2], "CE is an industrial system that could be seen as a system that integrates economy with ecological design considerations and proposes a completely different way of resource utilization" (p. 12). A variety of conceptualizations have emerged to explain and understand CE, but none of them is unchallenged [3]. A CE is understood as the "realization of closed-loop material flow in the whole economic system" [4].

There is increasing recognition of CE for the management of natural resources, which has resulted in a structural change in sustainability initiatives. Sustainability research informed us of how firms can identify and exploit the natural environment [2]. However, there has been little progress; the scholars have not produced a fully green innovation research paradigm [5]. The domain of CE has experienced rapid growth over the last decades. Much research in this area is focused on developing material efficiency and the design of new business models. Only recently has the CE field started to broaden from many different disciplinary backgrounds. CE is a value-oriented resource transformation concept [1]. Consistent with the current literature [6], green technologies play an important role in our conceptualization of how green innovation supports sustainable development objectives. CE is defined as "optimizing the consumption of resources and patterns and redesigns industrial system at the system level" [7]. Perhaps the best-known CE definition in academic literature is by Stahel [8], who first referred to a "closed-loop economy". There have been some systematic literature reviews on the CE definition [9–16]. Recently, scholars have called for the conceptualization of CE definition, owing to change in organizations' business models [16].

The circularity concept became prevalent with the advent of industrial ecology, and it has attracted the most research attention. There is a need to establish a better understanding of the CE definition [10]. In spite of the comprehensive surge in the existing literature on CE, researchers do not agree on how to define CE [17]. The literature on CE is developing largely on a conceptualization of CE from the meso, micro, and macro-level [16]. Awan et al. [1] have highlighted the need to adopt an ecology theory perspective to explore the CE definition. Despite the growth of scientific knowledge, literature has generally tended to focus on material or resource efficiency. Given the complex nature of the CE concept, there are challenges in defining and operationalizing CE. The CE concept has also been the subject of an increasing number of practitioner-oriented studies [2]; however, researchers have yet to develop a widely accepted common definition of CE [11]. Future research is needed in order to understand how CE is defined [16]. The above gap in literature brings about the need to develop a working definition of CE with specific characteristics and measures so that a common language is developed to move action towards sustainable development and growth. The purpose of this study is to analyze the published definitions of CE (which are incoherent) and to develop a working definition of CE, along with future research opportunities.

Our contribution is threefold. First, we expand our understanding of CE concepts by discussing the recent research trends in the literature using bibliometric analysis. Second, we propose a CE definition emphasizing the significance of the systems approach, which has the potential to promote material resilience, close loops, and offer sustainability benefits. We defined CE is the set of organizational planning processes for creating, delivering products, components, and materials at their highest utility for customers and society through effective and efficient utilization of ecosystem, economic and product cycles by closing loops for all the related resource flows. Finally, we underline that future research studies should encompass stakeholders' expectations that create value for the natural environment. The literature review is structure as follows: we start by briefly reviewing the emergence of CE literature; next, we proceed with the methodology section. Then, we discuss the way this systematic literature review has been carried out. We then present the challenges of CE and highlight the key findings from previous literature. Finally, we suggest the future research direction by examining it from various perspectives.

2. Review Methodology

The method used in this study consists of four steps, as shown in Figure 1. First, data are collected, and the search strategy is discussed in Section 4. Second, the data retrieved are broken down into the number of documents to be included in the sample for the systematic literature review (SLR), where bibliometric analysis is conducted. Third, the definitions of CE are analyzed and, finally, future research areas are identified.

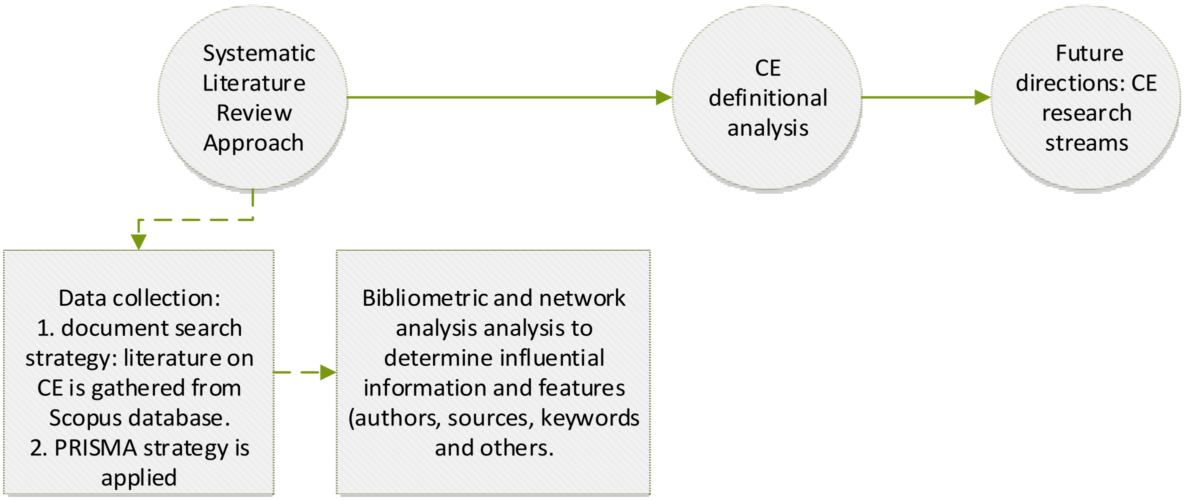

Figure 1. The methodology followed. CE, circular economy.

2.1. Systematic Literature Review Approach

The systematic literature review (SLR) approach has gained popularity since the appearance of data mining tools. SLR considers the inclusion of data collection through a search strategy and then applying the bibliometric analysis (BA).

2.1.1. Information Sources Search Stage

Circular economy and cradle-to-cradle are keywords that have been become popular in mainstream academic research, particularly about the manufacturing sector. Further, the literature indicated that some terms, e.g., cradle-to-cradle, closed-loop, and industrial technology, are used interchangeably with the circular economy. However, to avoid any misunderstanding and confusion as to whether these terms are interchangeable or not, only the search term "circular economy" was used. To develop and understand the body of knowledge on the circular economy, an SLR following the PRISMA method was carried out [18]. The PRISMA method is a step-wise process, which helps to summarize existing literature according to the rigorous, explicit, and transparent way [18]. By adopting this method, keywords were identified and screened for the articles for inclusion in the analysis or not. Tranfield et al. [19] explain that the literature review helps researchers to identify fields that need to be mapped and evaluated. The PRISMA flow map is shown in Figure 2.

In this paper, according to the Scopus database, there are two available access types: open access (OA) and others. Open access is associated with articles being published in "Gold" OA. This includes open access journals, hybrids, open archives, and promotional access. However, another type is related to any other type of access such as subscription or "Green" OA, which is not yet supported in Scopus (https://www.scopus.com). The authors considered all available access types in this paper.

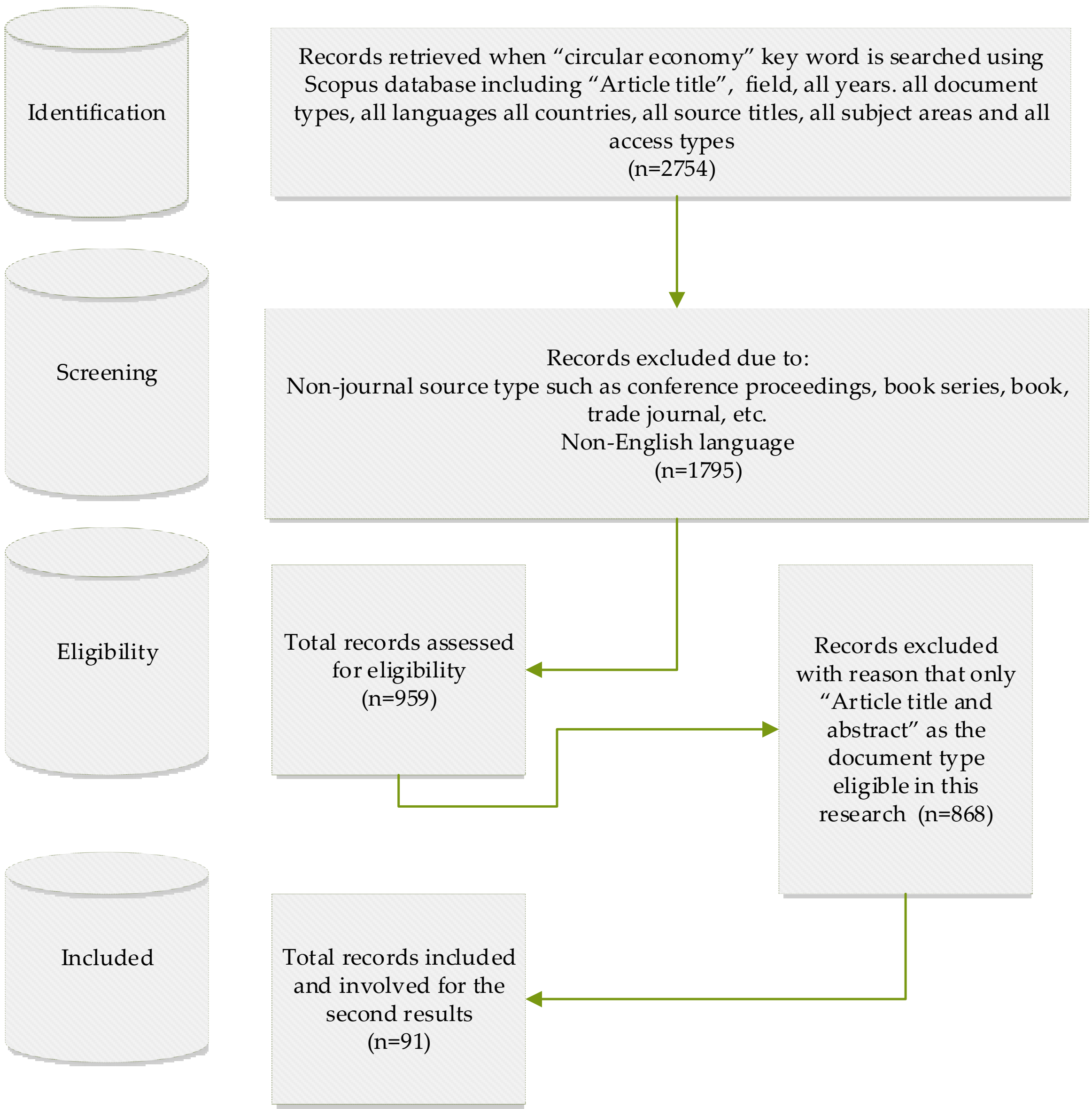

Figure 2. PRISMA flow map.

2.1.2. Bibliometric Analysis

In this study, bibliometric tools proposed by Aria et al. [20] were used, which are more comprehensive than other tools for science mapping analysis such CitNet Explorer [21], VOSviewer [22], SciMAT [23], and CiteSpace [24]. The most recent version of R software for statistical computing and graphics is used in this paper to conduct bibliometric analysis. The "bibliometrics" package includes the tools for quantitative research for citation and bibliometric analysis. As the "Bibliometrics" package and dependencies are installed in R, "Biblioshiny" or the shiny app, included in "Bibliometrics", is utilized for exploring some analysis. The included data are obtained through the method of exporting the "BibTex" file from the Scopus database. Afterward, it is examined for duplication using "JabRef" software. Then, data are exported to the "Biblioshiny" app. and converted into R format in R-studio software. The bibliometric analysis schematic layout is provided in Figure 3. In a bibliometric analysis, data are analyzed and then visualized.

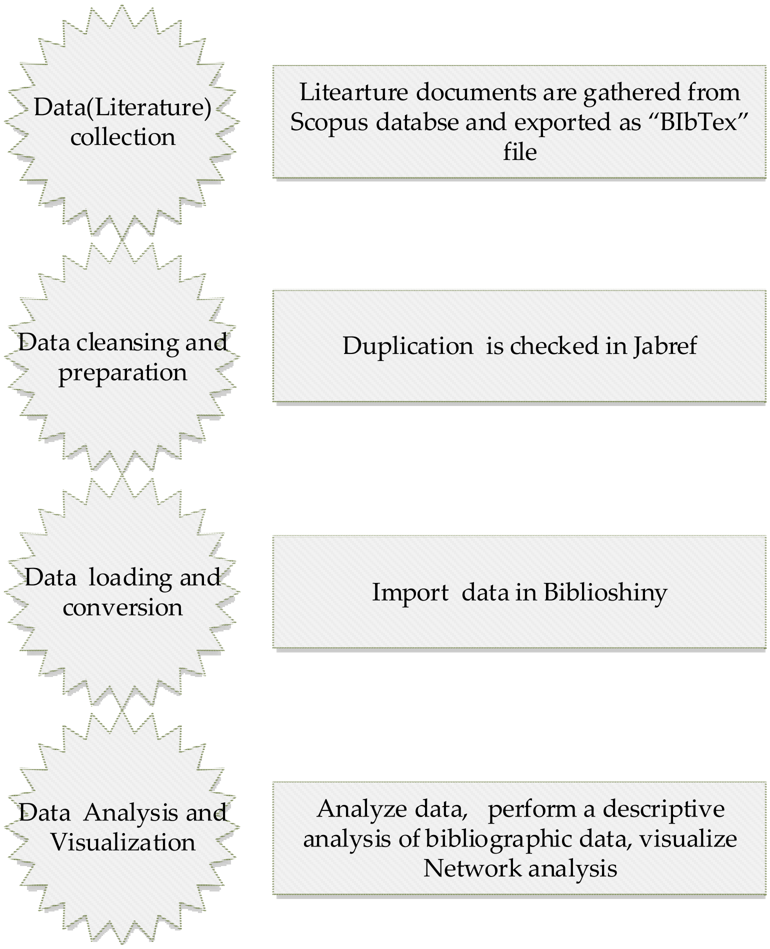

Figure 3. Bibliometric analysis schematic layout.

2.1.3. Exploration Analysis

The main information about the dataset collection generated by "Biblioshiny" is shown in Table 1. Although the search in the Scopus database is up to 29 November 2020, the timespan starts from the year 2004. The total number of articles is 1408, with 73,927 references and an average of 16 citations per article or document. Further, there are 4046 authors, in which 3914 authors are considered in the multi-authored articles and 166 in the single-authored articles. The growing collaboration among authors is measured by the collaboration index (CI) given by Equation (1) [25].

$$\text{Collaboration Index (CI)} = \frac{\text{Total Authors of Multi} - \text{Authored Articles}}{\text{Total Multi} - \text{Authored Articles}} \quad (1)$$

Table 1. Results of the main information about data in R software.

	Timespan	**2004 to 2020**
Information about Timespan, average citation, and number of references	Sources (Journal)	439
	Document type	article
	Documents	1408
	Average years from publication	1.51
	Average citations per document	16
	Average citations per year per doc	5.14
	References	73,927

Table 1. *Cont.*

Authors	Authors	4064
	Authors of single-authored documents	150
	Authors of multi-authored documents	3914
	Single-authored documents	166
	Documents per author	0.346
	Authors per document	2.89
	Co-Authors per document	3.61
Document Contents	Keywords Plus (ID)	5837
	Author's Keywords (DE)	3719

The index of collaboration is calculated as follows:

$$\text{Collaboration Index (CI)} = \frac{3914}{(1408 - 166)} = 3.15$$

As for the document contents, the frequency distribution of keywords plus associated with the articles by Scopus is 5837. The frequency distribution of authors' keywords is 3719.

The annual scientific production is measured by the number of articles published in the years of publications. Figure 4 shows the number of publications from 2004 through to 2020. It is noticed that there are no publications in the years before 2004.

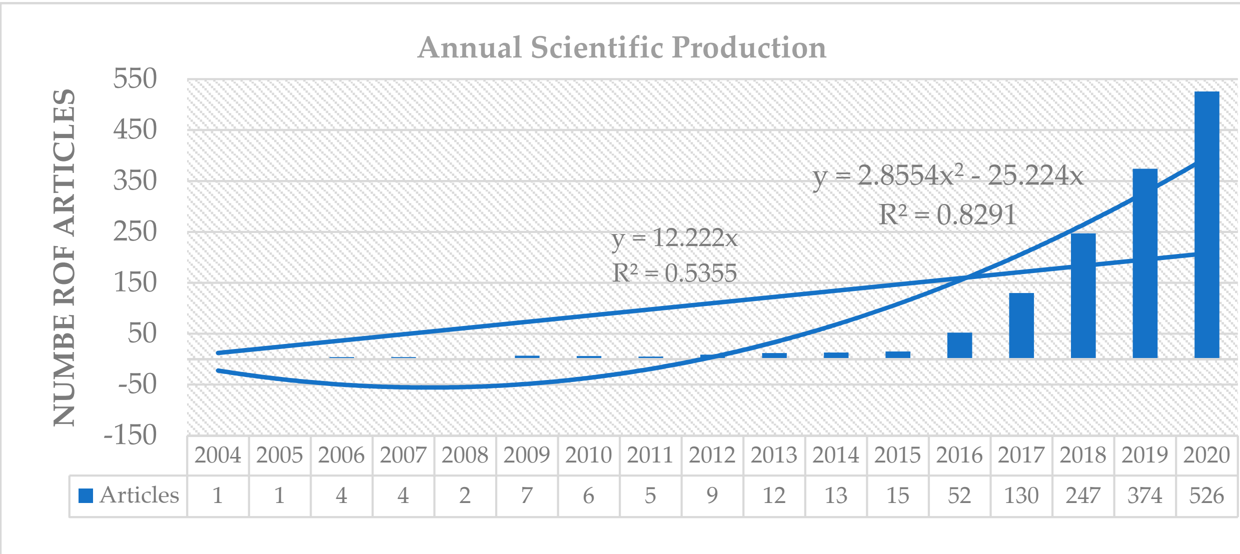

Figure 4. Publication growth estimation over the specified period.

Excel software was used to create a graph of the yearly publication growth. The authors fitted linear and second-order polynomial (nonlinear) trend models to estimate yearly growth. In the case of a linear trend, the annual growth is 12.222 publications. However, it is observed that the nonlinear model is a better fit, with an R^2 value of 0.8291, than the value of 0.5355 associated with the linear model.

2.2. Influential Component

This section is meant to further analyze the publication dataset to show the influence of the set of components considering the information of sources, authors, regions, publications, and keywords.

2.3. *Sources*

The "shiny app" is employed to show the top 20 most influential sources for the publications, shown in Figure 5. The most influential source is "Journal of Cleaner Production" with 186 articles, followed by "Sustainability" and "Resource Conservation and Recycling" with 145 and 104 articles, respectively.

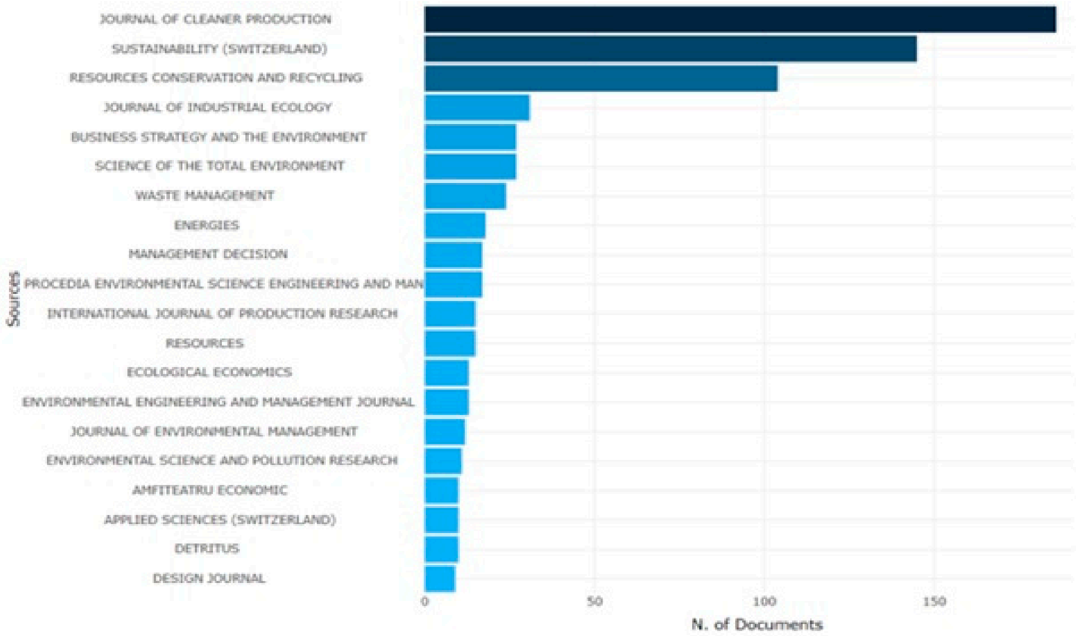

Figure 5. Top 20 influential sources.

2.3.1. Authors

To analyze the influence of the authors, Figure 6 depicts the top 20 most cited authors. GENG Y is the most cited author, with 997 citations. SARKIS J is ranked next, with 564 citations, followed by ULGIATI S with 553 citations.

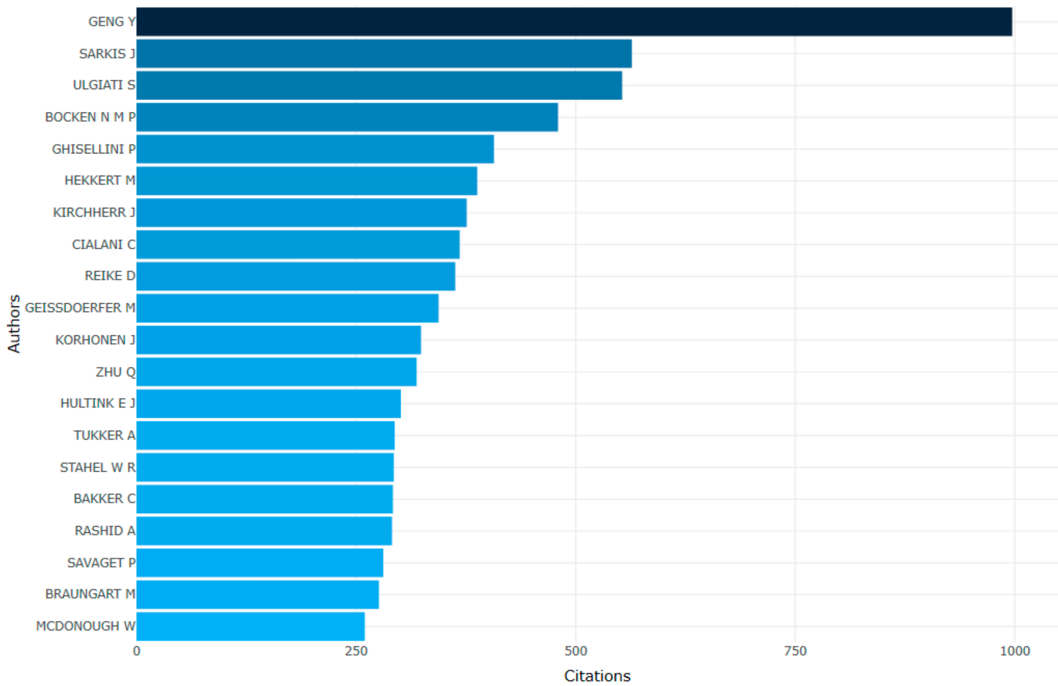

Figure 6. Top 20 most cited authors.

2.3.2. Regions

To show the most influential regions, Figure 7 displays the country's scientific production. The top 20 most productive countries in terms of the number of documents published are listed. The United Kingdom has the highest number (362), followed by China with 335 documents.

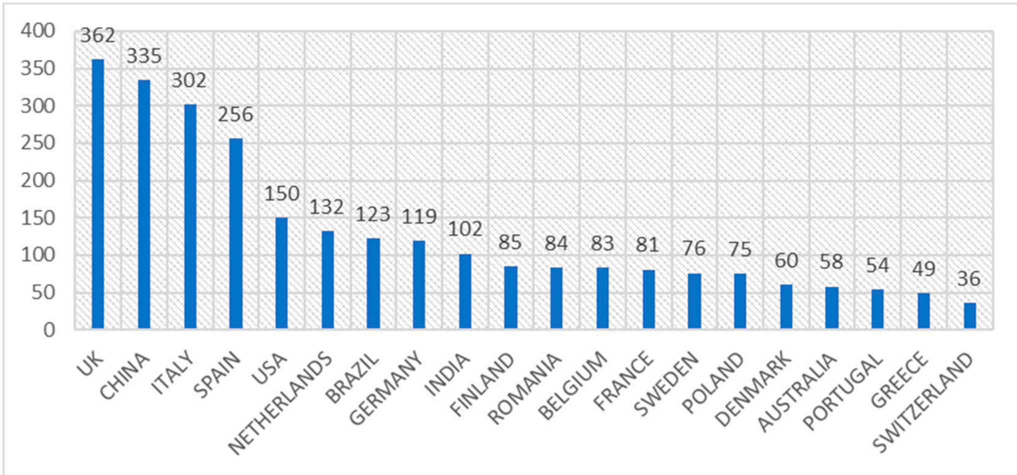

Figure 7. Top 20 counties with most publications.

2.3.3. Publications/Documents

The 30 most cited documents (articles) are listed in Figure 8. It is noticed that GHISELLINI P (2016), published in the Journal of Cleaner Production, has a significant lead as it is considered as the most influential outlet based on the highest total citations of 1117. BOCKEN NMP (2016), published by the Journal of Industrial and Production Engineering, comes next with 483 citations.

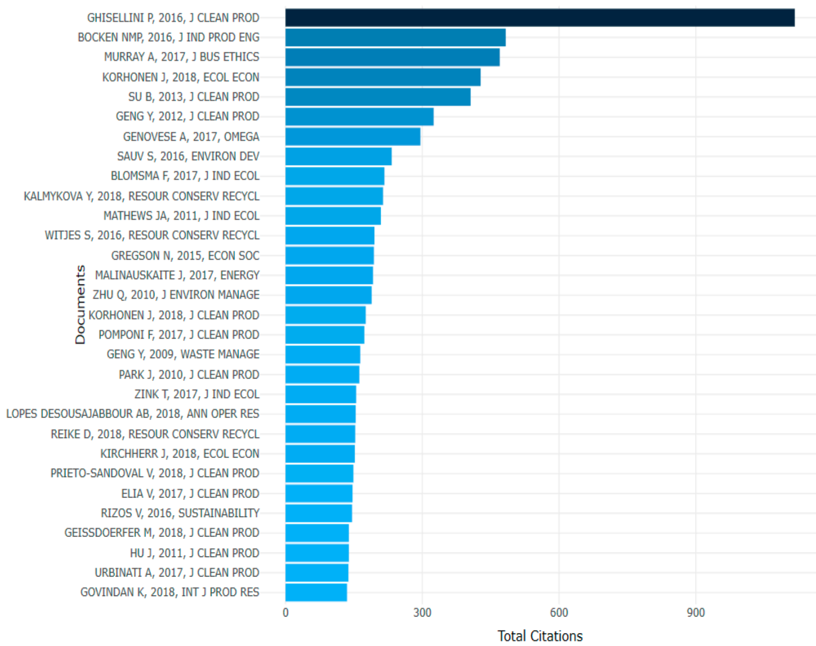

Figure 8. The 30 most cited documents.

2.3.4. Keywords

The "Biblioshiny" application allows searching in different fields such as "authors' keywords" and keywords plus", which consider the influential keywords. The "authors' keywords" are the words used to show the most relevant words mentioned by the authors, as shown in Figure 9. Most relevant keywords according to keywords plus, as shown in Figure 10. The most relevant keywords are "circular economy", with more than 1000 occurrences, followed by "sustainability" and "recycling" keywords with 158 and 100 occurrences, respectively. The words "circular economy", "recycling", and "sustainable development" are the most frequent and relevant with 514, 413, and 300 occurrences, respectively.

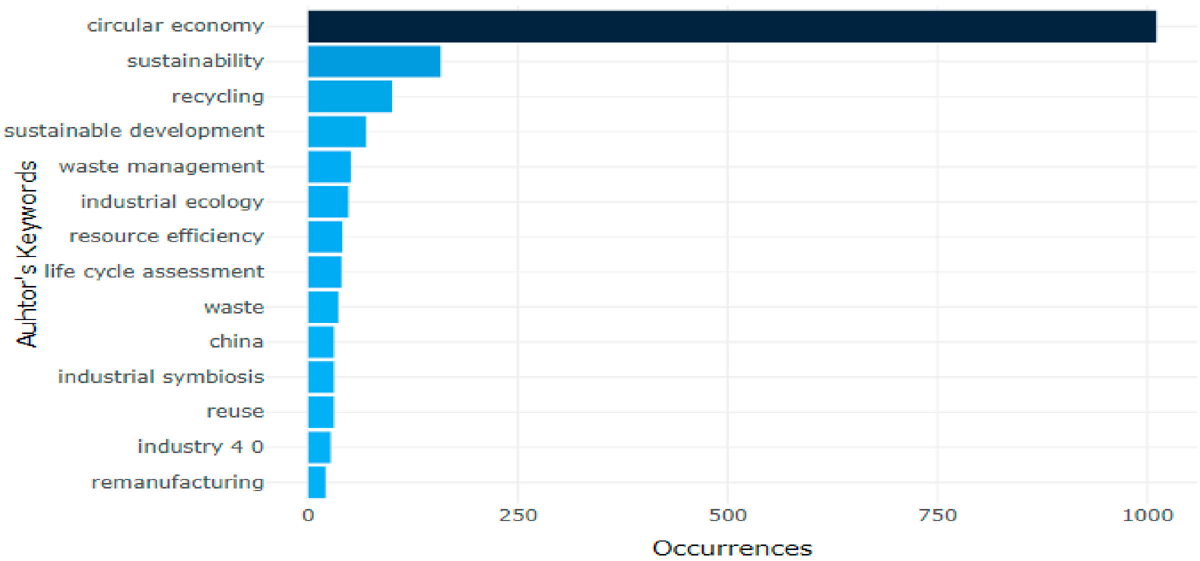

Figure 9. Most relevant keywords according to authors' keywords.

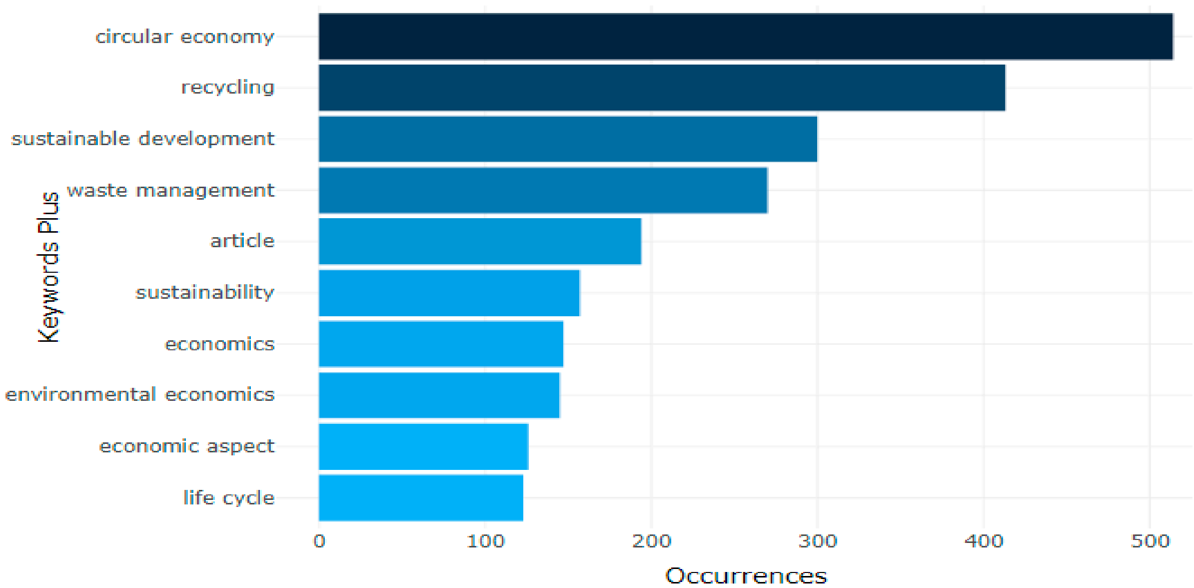

Figure 10. Most relevant keywords according to keywords plus.

Considering the "keywords plus" field, the "circular economy" word has grown exponentially; Figure 11 shows the word dynamics and the annual occurrences. Note that, since 2015, the CE concept has been increasing dramatically.

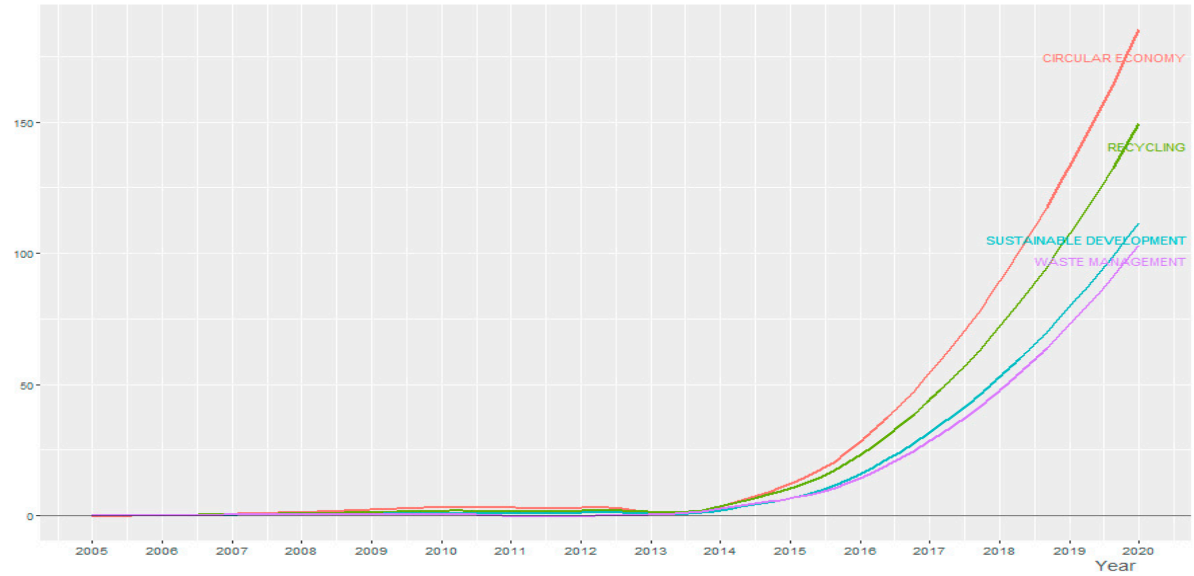

Figure 11. Word dynamic.

The paper's methodology was very helpful in showing the structural relationships between the essential aspects of bibliometric analysis. Therefore, a conceptual structure can be shown through the keywords' network using keywords' co-occurrences. Figure 12 shows the conceptual structure including the closely related topics or aspects in the dataset in which the most important issues are revealed by the keyword network.

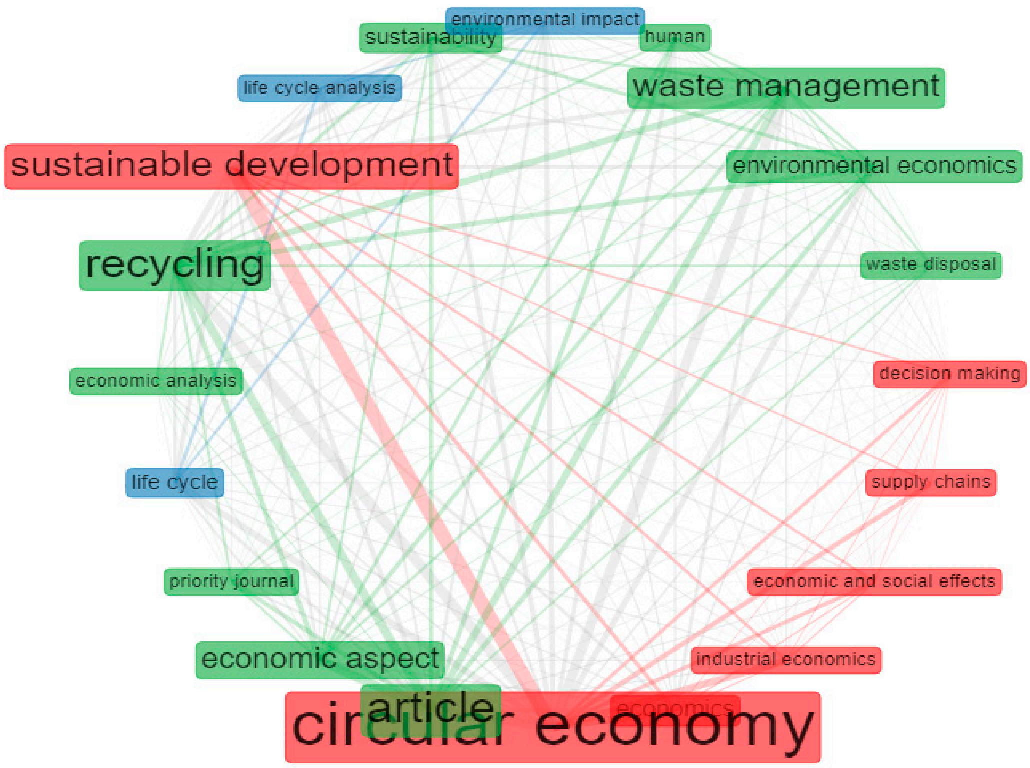

Figure 12. Keyword network.

This map clusters the keywords that share a common ideology. Table 2 presents the clusters of the most important issues resulting from the keyword network analysis shown in Figure 12. Accordingly, some themes are addressed based on the identified clusters.

Table 2. Keywords of network cluster analysis.

Clusters	Featured Keywords	Themes
Cluster 1	Circular economy, sustainable development, industrial economics, supply chains, decision making	Circular economy helps in decision making of minimizing input of resources to supply chains and creating a valuable and sustainable resource
Cluster 2	Life cycle analysis, environmental impact	Product lifecycle assessment to measure the environmental impact of a product
Cluster 3	Recycling, sustainability, waste management, environmental economics, waste disposal	Minimizing the creation of waste enhances sustainability and contributes to environmental benefits

3. Analyzing the Circular Economy Definitions: An Organizational Perspective

Our literature review points to the lack of consensus on the definition of CE. In the context of CE definition, we realized that the CE definition suggested by Kirchherr et al. [16] has been used as the basis for the advancement of CE. Table 3 summarizes the well-recommended or key definitions for CE and key terms according to the related literature reviewed. Moreover, there are few insights into the system ecology. Further, Yuan, Bi, and Moriguichi [17] and Zink and Geyer [26] addressed CE as a continuous use of the material and closing the loop. Several scholars have attempted to define CE, and the focus was on the reduction of raw material consumption and reduction in the use of energy [27]. Basically, before 2010, Yap [28] described CE as where resources become products and emphasize recycling. In 2006, Yuan et al. [17] defined CE as the process of planning and the use of raw material to create products that satisfy human needs. MacArthur (2013) defines CE as "A circular economy approach encourages the organization of economic activities with feedback processes which mimic natural ecosystems through a process of natural resources transformation into manufactured products byproducts of manufacturing used as resources for other industries" [29] (p. 232). This definition focuses on organizational economic activities, but recognizes the reuse of the material as a source of other industries. This is the only definition since 2008 that prompts the concept of reuse of material as a resource for other industrial products. In 2009, Liu et al. [30] describe the concept of CE as a different way to solve the problems by emphasizing on keeping a balance between soci-economic and ecosystem. This definition includes the conceptualization of stakeholders included in the "ecosystem and the socioeconomic system" (p. 265). This definition did not use a holistic view of stakeholders. However, this definition has been central to CE, and CE should be understood for solving the problem from a positive and normative perspective.

On the other hand, Hu et al. [31] identified eco-efficiency and resource productivity as expanding the conceptualization of CE, and stated that the application of new technology and management renovation is important to firm actors to create value rather than focus on eco-efficiency. In 2012, Bilitewski [32] emphasized the need for a connection between use and waste residual. On the other hand, MacArthur [29] incorporated the concept of the end of life. The regenerative economy perspective in the 2013 definition was seen as an important step forward as MacArthur [29] defined CE as "A circular economy is an industrial system that is restorative or regenerative by intention and design" (p. 07). This CE definition is most accepted and warranted of the elimination of waste through the better design of process, material, and products within existing organizational business models. In 2013, Thomas and Birat [33] made advances in the concept of CE and introduced the idea of a "closed-loop economy" (p. 5). This definition states that CE is the activity of a set of three core principles: reduce, reuse, and recovery. Stahel's [34] definition maintained a waste management orientation by explicitly focusing on industrial sectors at large from an economic perspective. In 2013, Geng et al. [35] suggested a new definition of CE. This definition emphasizes large and important entities to support long-term sustainability. This definition considers the need for the exchange of resources for sustainability. A more appropriate definition of CE by Webster [36] must include "restorative by design" in determining value creation "(p. 16). This definition again emphasizes the utilization of material value for creating high-quality products. This definition partially emphasizes the concept of material resilience. This concept is rarely discussed in the CE literature.

Gregson et al. [37] provided a CE definition that implies extending the item's life by managing the reuse after consumption. Rizos et al. [38] indicated that CE is a concept that questions the linear economic systems. Witjes & Lozano [39] stated that CE is the transfer of waste into resources. Haupt et al. [40] followed the CE definition including "production and consumption system with minimal losses of materials and energy through extensive reuse, recycling, and recovery" presented by Geng and Doberstein [41]. However, Jurgilevich et al. [42] defined CE as it is referred to as the ability to change waste into a beneficial resource through CE principles such as re-using, re-paring, and recycling. Moreover, Bocken et al. [43] supported the definition of CE as the method to help avoid sustainability pressures according to the Ellen MacArthur Foundation & European Commission in 2014. Meanwhile, the 2016 CE definition by Sauvé [12] included internalizing environmental externalities linked to the generation of waste. This definition describes the importance of resilience, but fails to address the outside organizational environment to articulate more sophisticated management strategies that have an environmental and social impact.

Stahel [44] offered a revised CE definition "loop (or circular) economy is to bring goods and molecules back into new use in a grave-to-cradle approach" (p. 6). This definition reaffirms the importance of the grave to cradle approach and brings back material to the loop. Given the importance of CE, Murray et al. [13] also pointed out the importance of procurement and production functions to "maximize ecosystem functioning and human well-being"(377). This definition devotes significant attention to understanding human well-being and reprocessing the material for an integrative ecosystem functioning. (Blomsma & Brennan, 2017) referred to the definition presented by Murray et al. [13]. This definition provides an exchange of material and resource efficiency concept as the central concept in CE, although it does not focus on human well-being. Murray et al. [13] claimed that CE is a process that supports the natural environment and involves minimizing waste throughout the production process. Emergent thought signals a paradigm shift toward the business model [45]. Kirchherr et al. [45] describe CE as an "economic system that is based on business models which replace the end-of-life concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes" (pp. 224–225).

As opposed to a linear economy, Malinauskaite et al. [46] mentioned, based on (European commission, 2015), that "circular economy is defined as one in which the value of products, materials, and resources is maintained for as long as possible, minimizing waste and resource use". This definition implies the necessity of managing waste and turning it into better reuses and sustainable development. This definition means the industrial domain items are sustained by closed-material flow, as Korhonen [47] pointed out that CE has placed considerable influence, which is defined as "societal production-consumption systems that maximize the service produced from the linear nature-society-nature material and energy throughput flow" (p. 39).

From the literature discussion, there are varying views on defining the CE. It appears from the above discussion that CE is a dual-loop regenerative system that focuses on the effective and efficient utilization of resources in the ecosystem, which is beneficial to performance optimization. CE is a dual loop system because it is a combination of a closed-loop and take back syste. Dual CE initiatives allow firms to increased resource eco-efficiency, as well as resource effectiveness. A linear economy is a single loop, where material produces and consume, and a circular economy, where the material takes back for re-consumption. In summary, the CE literature encompasses considerable differences in the definitions and conceptualization of the key constructs. Considering the little insight into the ecosystem and more on economic and industrial/material perspectives, along with building on the previous discussion, we propose, from an organizational perspective, a comprehensive working definition of CE as follows.

CE is the set of organizational planning processes for creating, delivering products, components, and materials at their highest utility for customers and society through effective and efficient utilization of ecosystem, economic, and product cycles by closing loops for all the related resource flows.

Based on the literature review, a commonly understood and accepted CE definition can pave pathways for advancing research and theory. Organizational CE activities are actions that occur in the development of infrastructure and relationships with different actors to achieve material efficiency through closing ecological loops. In essence, the CE is a set of practices aimed to keep products in use as long as possible even after the end of their lives.

Table 3. Circular economy (CE) key definitions and terms in the literature review.

Author (Year)	Key Definition	Key Terms
[28]	"Circular economy is described as a scientific development model where resources become products, and the products are designed in such a way that they can be fully recycled" (p. 13)	Emphasize on recycling
[30]	"Circular economy defines its mission as solving the problems from the perspective of reducing the material flux and making the material flow balanced between the ecosystem and the socioeconomic system" (p. 265)	Reduction of material use
[31]	"Circular economy (CE) focuses on resource-productivity and eco-efficiency improvement in a comprehensive way, especially on the industrial structure optimization of new technology development and application, equipment renewal and management renovation" (p. 221)	Eco-efficiency and resource productivity
[29]	"A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models" (p. 07)	Regenerative and restorative of resources
[35]	"A circular economy is an industrial system focused on closing the loop for material and energy flows and contributing to long-term sustainability" (p. 1256)	Closing the loop for material
[36]	"A circular economy is one that is restorative by design, and which aims to keep products, components and materials at their highest utility and value, at all times" (p. 16)	Restorative by design
[37]	"The circular economy is what seeks to stretch the economic life of goods and materials by retrieving them from post-production consumer phases. This approach too valorizes closing loops but does so by imagining object ends in their design and by seeing ends as beginnings for new objects." (p. 9)	CE prolongs product's life
[42]	"Circular economy means to reuse, repair, refurbishing, and recycling of the existing materials and products; what was earlier considered to be waste becomes a resource" (p. 2)	Transform waste into a resource
[43]	"The circular economy (CE) is viewed as a promising approach to help reduce our global sustainability pressures according to Ellen MacArthur Foundation and European Commission" (p. 300)	CE promotes sustainability
[46]	"circular economy is defined as one in which the value of products, materials, and resources is maintained for as long as possible, minimizing waste and resource use". (p. 2014)	Sustainability development
[26]	"The concept of closing material loops to preserve products, parts, and materials in the industrial system and extract their maximum utility" (p. 1)	Products are sustained by the closed-material flow
[13]	"CE is an economic model wherein planning, resourcing, procurement, production, and reprocessing are designed and managed, as both process and output, to maximize ecosystem functioning and human well-being" (377)	Maximize ecosystem functioning
[14]	"Circular economy as a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling" (p. 759)	Regenerative system

Table 3. *Cont.*

Author (Year)	Key Definition	Key Terms
[48]	"A circular economy is one that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times" (p. 483)	Restorative and regenerative by design
[13]	"An economy is envisaged as having no net effect on the environment; rather it restores any damage done in resource acquisition, while ensuring little waste is generated throughout the production process and in the life history of the product" (p. 371)	Restoration by design
[16]	"A circular economy describes an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro-level (products, companies, consumers), meso level (eco-industrial parks) and macro-level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations."(pp. 224–225)	Creating environmental quality
[49]	"Circular economy is an economy constructed from societal production-consumption systems that maximize the service produced from the linear nature-society-nature material and energy throughput flow. Circular economy limits the throughput flow to a level that nature tolerates and utilizes ecosystem cycles in economic cycles by respecting their natural reproduction rates" (p. 39)	Maximizes the service produced
[1]	"Circular Economy (CE) is an activity, set of process for reducing the material used in production and consumption, promoting material resilience, closing loops and exchange sustainability offering in such a way that maximize the ecological system"(p. 30)	Reducing the environmental burden with an ecological system theory approach

4. Overarching Themes for Future Research

Given that a comprehensive definition of the CE concept is suggested in the previous section, the paper enhances the understanding of CE by exploring the future research streams concerned. Figure 13 shows three research streams: circular design as value creation and capture, antecedents of key activities and resources, and consequences of key activities.

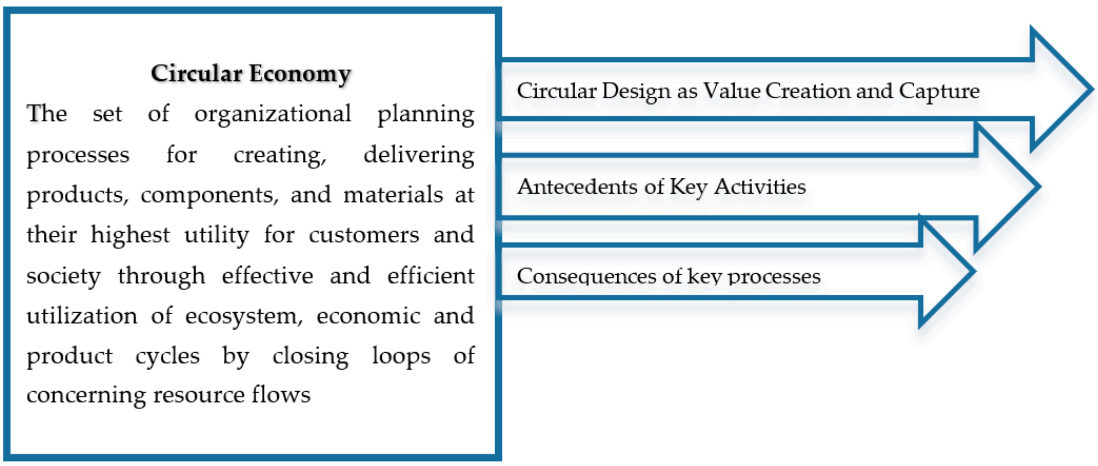

Figure 13. Circular economy (CE) future research streams.

4.1. Research Stream 1: Circular Design as Value Creation and Capture

Based on our literature review, recent advances in circular product design and management of the natural environment have allowed the development of new ways for the renewal of organizational business models and to deliver value, which has offered the scope of creation of innovative products [50]. Value creation and capture is an important element of the business model. According to Reed et al. [51], a business model is a " set of capabilities that is configured to enable value creation consistent with either economic or social strategic objectives" (p. 53). Recent studies also indicate that a future investigation requires understanding the implementation of CE business models by small and large firms [38]. CE infrastructure planning for industrialized countries is a complex process, which includes various processes such as reuse, remanufacturing, product-take-back, collection, repairing, and disassembly. Despite a number of research studies on circular business models, the question here is one of what organizational capabilities affect the implementation of CE infrastructure planning in the organization [52].

Several circular business model areas have already been examined using a systematic literature review, such as supply chain CE [53,54]. Product service system for CE [55], designing circular business model(CBM) [50], current practices impact on implementation CBM [56] CE for operations management [57]. Some literature reviews focused on the application of Industry 4.0 technologies in remanufacturing [58], a review of assessing CE and I4.0 [59], a key research direction on I4.0 [60]. A few scholars have made efforts to explore the link between I4.0 and CE [61,62], exploring barriers of I4.0 and CE [63], proposing a road for sustainable operations [62], and recently reviewing the literature on BM innovation and digitalization [64] and I4.0 implications for CE [65]. It is evident that these studies either focused on linking two streams and reviewing the literature or suggesting future research on both streams of research; however, few literature studies have examined the interface between CE for I4.0, except a recent review on the application of digitization and intelligent robots for CE in the value chain [66]. This review provides a future opportunity for further systematic literature investigation on developing CE for I4.0 in the value chain perspective.

A study by Goodman et al. [67] finds, for instance, that analyzing and evaluating micro-level 4Rs strategy contributes more towards CE. This literature review also identifies future research directions. In the context of remanufacturing and refurbishment, a fundamental question still unresolved is the relative importance of the organizational internal modular design strategies for cost-saving and radical reduction of environmental impacts [68]. While the literature emphasizes the operational flexibility and organizational ambidexterity, future research studies should address operational flexibility through an assessment of the tradeoff among the internal capabilities and their impact on operational resilience. The infrastructure decision-making process is accompanied by some environmental uncertainties, such as the price for the remanufacturing product and the customer demand for recycled products.

Future research is required to explore success factors on the contributions of circular business models [39]. The organization's cooperation with key partners has the potential to enable economic, social, and environmental growth for firms who wish to transition towards participating in the CE. Through collaboration and reciprocal information exchange processes, suppliers engaged with buyers to expand new solutions and ideas that emerge from their interaction process, which in turn permits them to solve problems in a more creative and novel manner. Here, we argue that suppliers are contributing to creative solutions for upcycling and downcycling. Moreover, to meet the increasing demands of customers, employee well-being, and a sustainable society, the integration of creative problem-solving activities helps translate customer demands into opportunities for sustainable processes and products. Competitive priorities drive firms toward the implementation of sustainability-related measures in their supply chain and internal operations [69]. Managers must invest in environmental management capabilities to maintain and enhance CE performance. While many of the factors may bring value creation opportunities to the organization, many factors may moderate the strength of this effect. For example, firm-level culture, organization design, and orientational capabilities may help in structuring and implementing activities to create and capture value. This approach calls for collaboration and directed efforts towards the integration of processes innovation into existing products, instead of riskier efforts to develop radically new products [70]. Despite the substantial body of literature addressing supplier development, the research has paid little focus to how supplier firms integrate the resources and knowledge creation into practice and connect it with an enhancement of firm sustainability objectives by collaborating with their customers. However, recent research points out that most buyers and suppliers take an operational performance improvement approach [71]. Recently, Awan et al. [6] highlighted that knowledge management practices lead to green innovation. Our review uncovers various issues and several insights can be gained from better knowledge combination and development practices; little is known about knowledge management practices with the resource theory of attention [72]. A future research scholar may pay attention to how Industry 4.0 technologies affect the firm's existing knowledge management resources for design and implementation CE performance. We define CE performance as a measure of effective promotion of material resilience and management of natural resources to achieve resource effectiveness and efficiency [1].

4.2. Research Stream 2: Antecedents of Key Activities

Our literature review has yielded several key future research areas. Our review revealed that CE antecedents might have many differences in nature, such as activities and resources, and they can be internal or external to the organization, such as pressure and demands from related stakeholders. CE has provided firms with the potential to design circular products with novel forms of resources, which are key collaborators and networks [73]. Some researchers have relatively focused on stakeholder analysis is to illustrate their representation, legitimacy, power, and participation in the decision-making process with the business enterprises [74]. Despite this, there are still significant gaps that exist in the literature, which provides future research opportunities to sense, shape, and build activities and resources. The stakeholder literature is often linked with resource provision and monitoring of organizational activities [75]. Future research should clearly enquire as to why stakeholders are a principal driver of the surge of interest in CE. However, there has been little information on how, when, and why global stakeholders are effective. As a result, there are some studies on the business model to describe how firms implement this new paradigm [76]. However, it is yet not clear which group of stakeholders might possess the knowledge and resources [77]. In parallel, institutes use coercive pressure, mimetic pressure, and normative pressure to promote and sustain the competitiveness of the manufacturing industry. Some local governments are held responsible to the manufacturer for not undertaking a collection system of used products and often place tax penalties or recovery fees [78]. Stakeholder pressure describes "the degree of accountability in which an organization perceives held responsible for its action and decisions regarding the design of the product, production, sourcing or distribution to stakeholders" [79]. The external pressure on the firm should be taken into account in the product and process design activities for building a green image and to maintain a long-term relationship with the customers [80]. The question remains here as to how a firm may make sustainable investment decisions to improve green product and process innovation. Environmental investment might serve as a solution to enhance organizational sustainability [81]; organizational sustainability is a pillar of the circularity of materials. As such, firms should emphasize more on prioritizing different sustainable investment initiatives at achieving CE performance. The prevalent questions are as follows: are stakeholders playing an important role in the planning and decision-making of implementing digital transfomation strategy for achieving the organizational outcomes. What interests and expectations of stakeholders are important for implementing CE initatives, and how do they affect digital transformation strategy in the manufacturing enterprises? To this end, future research scholars should focus on, "What are the key stakeholders that are dominant in infrastructure planning at the firm level?" More specifically, future research studies should explore what the multi-stakeholders are involved in, with a focus on critical success factors and activities at the organizational level. It is reported that several different stakeholders leading inducive factors encourage companies to pursue CE practices [9,10,82,83]. Recently, Wagner and Heinzel [84] highlight that future studies should examined which socio-demographic characteristics are important for CE awareness Even though advancements have been made, much remains to be achieved in understanding the relationship between stakeholders' role and the adoption of CE practices.

The rapid development of CE challenges has set the stage for global stakeholders to be one of the most important concerns over the forthcoming decades. Previous research in the CE contextualization of stakeholders has primarily focused on examining the challenges, drivers, and barriers, such as lack of recycling policies [85]; lack of implementation [86]; lack of cost analysis [10,87]; technological limitations by tracking recycled material [9]; and lack of skills by employees in implementation CE practices [88]. The interdisciplinary literature on CE has discussed the role of stakeholders' interest and involvement in building business enterprises; it has not explicitly considered implementation decisions related to CE practices. Despite these advances, the success of implementation at large by many business enterprises is hampered, leaving the gap to examine the stakeholder analysis in the development of business enterprises' infrastructure. In addition, little research exists on how a company mobilizes as a reaction to competitors or regulators to put into practice CE practices. There is a need to develop a better understanding of the environmental and economic benefits of a CE [49]. There is limited research on how CE strategies affect product differentiations [89]. The extent of CE practices contributing to sustainable performance improvements is also not clear.

4.3. Research Stream 3: Consequences of Key Processes

On the other hand, to foster CE practices, the Industry 4.0 concept brings about new business models and proposes solutions to some sustainability problems through communication networks based on Internet of Things (IoT), Internet of Services, cloud manufacturing, and cyber-physical system [90]. IoT is part of a digital infrastructure allowing the storage of, processing of, and access to the data generated by various means or other systems [91]. Still, though, CE practices may be rather difficult to achieve in the global manufacturing industry. This is because the pattern of consumption and production, with their risk factors especially pertinent to hazardous raw materials, may be difficult to track and implement in countries that have different business and trade regulations. Instilling the benefits and the culture of CE into business models necessitates developing operational analytical models that integrate sustainable supply chains at the intra-industry levels (c.f., Ülkü and Engau [92]) The implementation of Industry 4.0 helps in accelerating productivity because it reinforces greater product tracking and access to real-time information in the operating environment and the possibility of new avenues of reducing environmental impact while improving resource efficiency. These include public policies, legal frameworks, and societal expectations, and interest in the IoT. Further, the study aims to synthesize the literature analysis in a way to identify Industry 4.0 stakeholder interest and expectations on how IoT could be employed for CE management. The link between key resources and activities is key in the development process to offer its customers better value. Acquisition of new knowledge may create new competencies that help in altering existing resources to create new capabilities by recombining knowledge assets. Thus, our review suggests that firms with a circular business model revolved around the customer focus are an actual reflection of cooperation and partnership.

As a result of the literature analysis, the findings clearly show that to make progress towards the implementation of CE, all industry 4.0 stakeholders should be aware of each other's interests and expectations on digitization while integrating into a circular economy. There are also opportunities to extend current Industry 4.0 research to focus more on digital intelligence or artificial intelligence. Future research might examine the relationship between Industry 4.0 technologies adopted in pursuit of internationalization opportunities and firm growth outcomes. Our review shows that Industry 4.0 applications are in the developing phase to improve the recycling, remanufacturing, and reuse of products after the end of the life cycle. The Industry 4.0 tool has the potential to improve overall circularity issues by providing real-time data access. There is little empirical and theoretical explanation of how and why Industry 4.0 is engaged in CE practices. On the other hand, many other companies fail to implement solid CE practices. Instead, some companies tend to adopt some circularity practices that address the interest of only specific stakeholders. Another fruitful area of research would be examining how CE activities transfer across borders and comparing such international practices.

Implementation of the CE with IoT is ultimately a sound competitive advantage for manufacturers 4.0. The integration of IoT into CE practices is a new topic. One of the most recent studies in the realm of Industry 4.0 and the CE is by Cezarino et al. [65]. They highlighted that Industry 4.0 tools could be useful for CE if there is clear articulation among different actors as to how to promote digitization business models. The current review demonstrates and analyses the existing research either independently at the interface of Industry 4.0 and CE [93]. Much of the research on the IoT presents its conceptual basis as being a resilient, smart, and sustainable CE [94]. Meanwhile, much of the remaining study's rapid development of a smart product-service system and future research on Industry 4.0 and CE might, therefore, benefit from particularly applying dynamic capability theory or from developing a theoretical perspective alongside the technology adoption models. I4.0 has become the route of many firms to achieve sustainable development goals. Despite its contemporary importance, however, existing research in I4.0 and CE has largely neglected the role of stakeholders' interests and expectations in the pursuit of digital CE [95].

5. Conclusions

In the present study, we conducted a systematic literature review to identify the published definitions of a circular economy. Our analysis shows that the circular economy definition varied in their coverage and no comprehensive definition was identified capturing the system approach. The suggested definition captures the key aspects of ecology system theory. Additionally, this paper contributes to the body of knowledge of CE literature by providing a better understanding of the CE concepts by examining the different definitions. CE has profound consequences for economic, social, and environmental advantage. We define CE from an organizational perspective as, CE is the set of organizational planning processes for creating and delivering products, components, and materials at their highest utility for customers and society through effective and efficient utilization of ecosystem, economic, and product cycles by closing loops of concerning resource flows. Further, the issues prevailing in CE research are discussed and a future research agenda is developed in this field. CE is a dual loop regenerative system that focuses on the effective and efficient utilization of resources in an ecosystem that is beneficial to performance optimization. Dual CE initiatives allow firms to increased resource eco-efficiency, as well as resource effectiveness.

To achieve both environmental and economic performance benefits, CE is a dual loop system aimed at closing the loop and focuses on a take-back system. CE, therefore, has become one of the prominent topics in management discussion over the last few decades. Our analysis reveals that research in the interface of Industry 4.0 and the circular economy is gaining much attention in disciplines and is still relatively little explored. There has been little research examining how the structure of value chain activities may affect CE outcomes. However, in the future, research on the integration of digitalization into the circular economy is continuing to expand, as well as how digital transformation can reshape CE practices in the local and global value chain. In sum, the results revealed that CE literature is conceptually ambiguous, and more research is needed not only on the understanding of challenges and barriers but also on understanding conflicting demands and interests from the different stakeholders in the implementation of digital strategy in the I4.0 environment. Our literature review highlights that much of the previous research has considered only a certain type of digital technology, thereby ignoring the fact that digital transformation is an important area for future research to address the challenges and complexities of CE. This study suggests that the development of CE initiatives plays an important role in the growing digital transformation in the value chain. Future research studies may investigate the extent to which digital transformation can increase the implementation of CE, as well as their influence on digital performance management.

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