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Exploring the Evolution of Sustainability Paradigms: From Linear to Circular Economy Models

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Abstract. *As a response to the urgent environmental degradation and depletion of resources, this article analyzes the historical evolution from linear to circular economy models as a response for achieving sustainability. Tracing back to sustainable forest use proposed in 17th-century and evolving towards modern circular economy principles, there is a paradigm shift of decoupling economic growth from resource consumption. Moving through the landscape of sustainability, the paper criticizes the linear economy model that originated during industrialization period and was incapable of addressing sustainability. Key milestones, such as sustainable development, closed-loop-systems, and biomimicry, demonstrate the journey to current business models. An extensive literature review proves the inter-disciplinary importance of circular economy research, exploring domains such as Sustainability Science, Management, and Bioengineering. The present research combines bibliometric analysis and systematic review on articles published between 2000 and 2023. These methods were chosen to assess the main directions of research for development of circular economy models, and recent trends. Research is centered around dynamics and trajectory of scholarly outputs on the topic, mainly those published in the past five years. A sharp rise in the number of publications regarding circular economy models is found, characterized by three notable inflections in 2017, 2018 and 2021. Two pivotal articles emerge as influential contributions. The interdisciplinary landscape of circular economy research is observed, covering diverse research areas such as Supply Chain and Logistics, Bioengineering, or Social Psychology. The co-occurrence analysis reveals 6 thematic clusters for which we propose a conceptual framework. The clusters are: environmental impact, sustainable development, interdisciplinary connections (niche sciences), circular supply chain, climate change, and IT-centric approaches that have emerged in research in the past five years. Insights from recent trends provide valuable guidance to researchers, professionals, and policymakers by using an interdisciplinary lens in the transition to a circular economy.*

Keywords: circular economy models, sustainable development, sustainability paradigms, interdisciplinary research, bibliometric analysis

Introduction

In the current global situation, sustainability has become more dominant, as industries and societies are seeking to meet emerging universal needs to stop resource use and minimize pollution of the environment. One of the most promising approaches to address to these challenges is transitioning from linear to circular economy models, which represents a paradigmatic shift in sustainability commitment (Ellen MacArthur Foundation, 2013; González-Márquez & Toledo, 2020; Voulvoulis et al., 2022).

According to Topliceanu et al. (2022) the first systematization of the principles of sustainable forest use was proposed by Carl von Carlowitz in 1713. Thus, sustainability as a concept is older than

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the linear economy model, which was introduced when industrialization began toward the middle of the eighteenth century. This linear model (which in effect follows a straight line throughout both extraction of resources and consumption) fails to provide a systematic approach to recycling or waste reduction (Geissdoerfer et al., 2017).

The industrialization era brought about a vast series of social and environmental problems, as well an absolutely unprecedented speed in both economic and technological development. Concerns about resource depletion deterioration of the environment existed in the late 19th and early 20th centuries (Topliceanu et al., 2022). As economic concepts evolved by mid-20th century, a state of heightened environmental consciousness started to emerge and brought with it a more general critique of the linear model. Figure 1 illustrates key milestone in the conceptual evolution from a linear to a circular economy, in chronological progression.

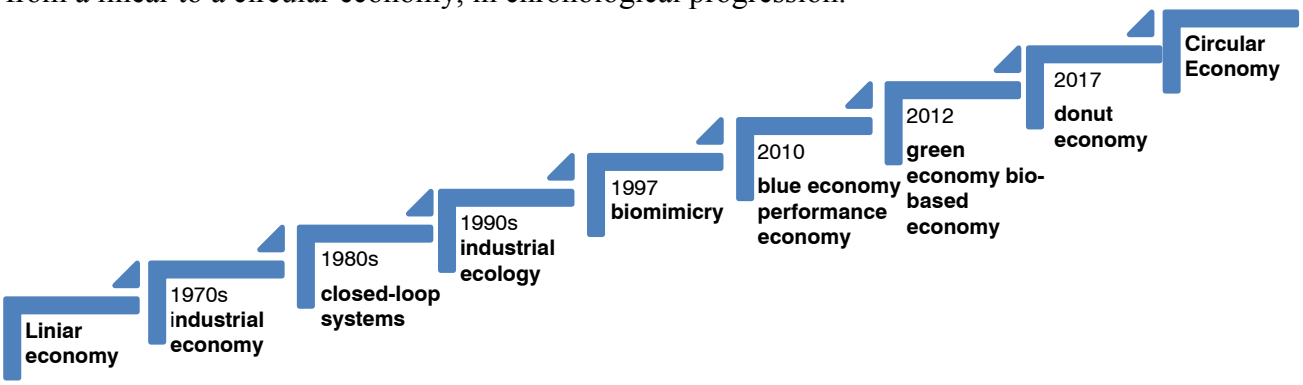


Figure 1. Timeline of the conceptual evolution from linear to circular economy

Source: Authors' own research.

In response to the neglect and depletion of the environment, discussions on the sustainable development of society emerged in the 1970s. Stahel and Reday introduced industrial economics in 1976, while Stahel in 1982 emphasized on the shift from property to use thinking (in Stahel, W.R., 2013). Stahel also went later on to create the "cradle to cradle" concept in the 1980s, by proposing a closed-loop system where products could be both recycled or biodegraded. Subsequently, William McDonough and Michael Braungart further developed this approach in 2002, emphasizing that raw materials could be reused endlessly (in Braungart et al., 2007).

Recent years have seen the incorporation of new features into sustainability paradigms, including industrial ecology developed in 1989 by Frosch and Gallopoulos (in Awan, U., 2022; in Van Ewijk et al., 2023), loop economy and performance economy, regenerative design, biomimicry, and the blue economy. Industrial ecology, which began in the 1990s, was concerned with making industrial systems more efficient by imitating natural cycles of (Stahel, W.R., 2010; Stahel, W.R., 2020). Having sustainable innovation as its theme, biomimicry emerged to look for solutions in natural processes. Additionally, Walter Stahel's vision of a closed-circle economy, stressing life extension, product repair and waste prevention, gave rise to the Performance Economy (Stahel, W.R., 2010; Stahel, W.R., 2020). In the same year, Gunter Pauli proposed the Blue Economy concept, which integrates novel business models with nature's systems (in Lee et al, 2020; in Martínez-Vázquez et al., 2021).

The Green Economy concept was formed for the first time at United Nations Conference on Sustainable Development, and it prioritizes growth with the highest possible returns on certain resources such as carbon, clean energy, high efficiency, and reducing pollution to the lowest limit

possible. (Kettunen et al., 2012; Merino-Saum et al., 2020; D'amato & Korhonen, 2021). Interestingly, green economy not so much applies directly to a single-sector resource or ecological factor; instead, it has an array of ecological implications (D'amato & Korhonen, 2021). The subset of a green economy is the bio-based economy. It merely takes the principles of sustainability and focuses them the use of biological resources This includes the employment of renewable biomass and other plants, microorganisms, and algae to produce traditional fuels, chemicals, and materials otherwise extracted from fossil resources (Ferraz & Pyka, 2023). Leading the promotion of the bioeconomy, the European Union (EU) unveiled its inaugural Bioeconomy Strategy in 2012 (Lühmann, M., 2020; Stegmann et al., 2020). The policies are suggested to be efficient, innovative, eco-economic and eco-friendly, and its basis rests on the use of renewable sources (Kardung et al., 2021). Another important concept in the area of ecological economics comes from the Oxford economist Kate Raworth who introduced the concept of the donut economy in her 2017 book (Raworth, 2017). This model serves as a framework for assessing expectations of society, aligning with United Nations' Sustainable Development Goals and planetary boundaries (Wahlund & Hansen, 2022).

The Circular Economy (CE) is a recent pivotal paradigm that aims to decouple economic growth from resource consumption through closed-loop systems (MahmoumGonbadi et al., 2021). A basic understanding of what the circular principle involves is building products that are more durable and easily repairable, adopting reuse and recycling in the production cycle, and subsequently, changing the human attitude to consumerist culture to a more resource efficient one (Di Maio et al., 2017). The rapid progress in technology represents an important aspect of this shift.

The European Union plays a key role in supporting the transition from a linear model to a circular economy (Lucaci & Năstase, 2019; Camilleri, M.A., 2020). In this regard, efforts are being made to create, adopt and implement a legislative base where all stakeholders can a focus on keeping products and materials in the production cycle for as long as possible ensuring that the transition to a sustainable model of consumption is met, thus reducing waste and promoting sustainability (Parajuly et al., 2020; Chioatto & Sospiro, 2023; Halkos & Aslanidis, 2023).

The purpose of this research is to present a bibliometric analysis followed by a systematic literature which will span across 2000 to 2023 to discuss the transition in the economy from a linear model to a circular model, and consider the main topics, key studies, and recent trends in this area of knowledge.

Literature review

The evolution of the Circular Economy (CE) is rooted in various perspectives, with Korhonen et al. (2018) tracing its origins to the ecological economy. Andersen (2007) and Su et al. (2013), however, attribute its inception to Pearce and Turner in 1989 when they explored the lifecycle of natural resources in traditional economic systems.

Presently, the Ellen MacArthur Foundation provides a widely acknowledged definition, characterizing the Circular Economy as an industrial system intentionally designed for restoration and regeneration (Ellen MacArthur Foundation EMF, 2013). This definition emphasizes the necessity for companies to develop production models based on the 10R philosophy, encompassing principles such as reduce, reuse, reject, rethink, redistribute, repair, restore, reuse, recycle, and recover (Bag et al., 2021; Reike et al., 2022). The application of the 10R philosophy prompts companies to intensively use products and services, fostering awareness and minimizing natural resource usage, while encouraging products should be reused in developing repair systems (Goyal et al., 2018; Jabbour et al., 2020). Simultaneously, companies need to consider remanufacturing

and repair, extending the useful life of products and promoting different functionalities (Gurita et al., 2018). The incorporation of circular principles into recycling processes allows for the recovery of energy and materials, either reincorporating them into the cycle or promoting their natural absorption (Fischer & Pascucci, 2017; Bag et al., 2021).

Circular and linear systems approach value creation differently. In a linear economy, value is generated by producing and selling numerous products, while a circular economy focuses on value preservation. The 3R approach (reduce, reuse, and recycle) centers on minimizing resource use and maximizing the reuse of raw materials to a high standard (Reike et al., 2022). Apart from that, the 4R and 10R philosophies expand the cycle with the 10R one shifting the use of the circular economy principles from the individual to corporate level (Bag et al., 2021; Reike et al., 2022).

The sustainability viewpoint in a circular economy differs markedly from a linear economy. In a linear model, eco-efficiency, or minimizing environmental impact for the same result, is paramount, leading to an extended time until the system overloads (Di Maio et al., 2017; Iagăru et al., 2023).). In contrast, sustainability in a circular economy aims to enhance environmental efficiency, reducing ecological impact and positively influencing ecological, economic, and social systems (Kjaer et al., 2019; Awan & Sroufe, 2022).

The conservation of raw materials, a central focus in a circular economy, contrasts with the inefficient handling of raw materials in a linear model (Iagăru et al., 2023). This transition gives rise to various business models, with service playing a key role over the sales of merchandise. The Product-as-a-Service System, integrating products and services, emerges as a model facilitating the transition to the circular economy (Michelini et al., 2017; Koide et al., 2022).

As depicted in Table 1, the dichotomy between the linear economy, centered on the notion of "disposability" and product-centric focus, and the circular economy, emphasizing services, marks a critical distinction. In the linear model, materials and energy are utilized in the production of commodities that are then thrown away, expressing the concept of eco-efficiency without achieving circularity. On the other hand, circular economy revolves around maximizing eco-efficiency of products by eliminating any harm to the environment and fostering positive impacts by transforming materials while reducing waste. A linear model focuses on products while the circular model prioritizes recurring services that include numerous consumers, thus reducing the necessity for replicating the same product.

Table 1. Overview of Circular versus Linear economy model concepts

	Circular	**Linear**
Step plan	"Reduce-reuse-recycle"	"Take-make-dispose"
System boundaries	Long-term	Short-term
Focus	Eco-Effectivity	Eco-Efficiency
Business model	Emphasis on services	Emphasis on products
Reuse	Upcycling	Downcycling
Goal	Sustainability	Profitability
Value creation	Preserving products	Manufacturing products

Source: Authors reinterpretation based on literature review.

In a circular economy, material cycles mimic an ecosystem, emphasizing closed loops where every residual stream contributes to creating new products (MahmoumGonbadi et al., 2021).

This eliminates the concept of waste, requiring appropriate recycling of materials and the maintenance of high quality in finished goods, parts, and raw materials throughout various cycles, as highlighted by Korhonen et al. (2018) and D'amato & Korhonen (2021).

Recent literature integrates business models for sustainability with circular economy visions, positioning the latter as a promising new model for achieving more sustainable development (Preghenella & Battistella, 20 21). Notable scholars such as Bocken et al. (2016), Ghisellini et al. (2015), and Murray et al. (2017) have contributed to this discourse, conceptualizing the circular economy as a transformative business model that contrasts with the linear take-make-dispose industrial system. It is expected that this newfound understanding will lead to more sustainable patterns of development where the sustainability discourse in business practices will be incorporated.

In the Linear Economy Model, sustainability is framed as the ability to sustain economic growth and resource utilization without compromising the well-being of future generations (Iagăru et al., 2023). But is it still applicable if the model is based on a "take, make, dispose" approach and the consequent expectations of resource depletion, environmental damage, and a doubtful viability are affecting the model? On the other hand, the Circular Economy Model proposes sustainability as the creation of a regenerative system (Morseletto, P., 2020). This involves electing and that promoting cost-effective use of resources and utilizing waste reduction methods with circulation of materials in a closed-loop system. The circular paradigm emphasizes the restoration and regeneration of resources, striving to promote environmental health and ensure economic resilience over the long term (Friant et al.,2020).

Kirchherr et al. (2023) conducted an updated systematic analysis of Circular Economy (CE) definitions, providing a current scholarly snapshot. Their earlier findings in 2017 revealed that only 11 percent of CE definitions prioritized sustainable development and another 11% of articles mention a use of business models. This research gap that was also identified by Lieder et al. (2017) and inspired the present research that was carried out. In the subsequent 2023 study by Kirchherr et al. when they revisited the circular economy concept by analyzing 221 definitions, this percentage saw a substantial increase, with 27–31 percent of definitions now emphasizing sustainable development.

Methodology

Bibliometric analysis and Systematic Literature Review techniques were used to identify the research areas for circular economy models and concept evolution over time. We selected a Bibliometric approach in order to provide quantitative information about prominent authors, keywords, trends and research areas, and because this methodology helps to quickly analyze a very large number of scientific studies (Ferraz & Pyka, 2023). According to Lim and Kumar (2024), the bibliometric methodology should be further supported by a systematic literature review in order to determine relevant concepts, research areas and potential research / knowledge gaps.

Thus, we followed the below steps:

Step 1: Keyword selection for query pull

Step 2: Bibliometric analysis of articles found in Web of Science (WoS) database

Step 3: Screen and select articles for an in-depth analysis based on title, abstract, number of citations and published year

Step 4: Synthesize most relevant concepts resulting from in-depth analysis

The first step was selecting a few broad keywords for our query pull, in order to obtain a broad and unbiased pool of research papers. Although there are studies such as Kraus et al. (2022)

or Ferraz and Pyka (2023) that recommend choosing keyword by first reading a few articles, our main purpose was to identify a larger pool or articles for linear and circular economy models, including sustainable business models. These generic key words were essential in our first analysis using VOSviewer (Visualization of Similarities) software to create an occurrence network and identify broad conceptual themes of the research performed between 2000 and 2023.

Using the keywords from Step 1, we searched articles on the Web of Science (WoS) database in November 2023 based on articles keywords, without any language restrictions (as seen in the query presented in Table 2). We decided the use Web of Science since it is the most comprehensive global collection of articles and publishers pertaining to circular economy (Ferraz & Pyka, 2023). Using WoS database enabled us to reach a diverse collection of appropriate articles that were published between 2000 and 2023. A total of 7,073 research articles were identified and used in the bibliometric analysis through VOSViewer and through WoS database own reporting functionality.

Table 2. Query used in this research

***Q*uery**: *circular economy model (Topic AND Article (Document Type) And Circular Business Models (Should – Search within topic) and Linear Economy (Should – Search within topic) and Sustainable Business Model (Should – Search within topic) and Circular Business Model (Should – Search within topic); **Timespan**: 2000-01-01 to 2023-11-28* ***Date Run**: Sun Nov 29 2023 17:25:38 GMT+0200 (Eastern European Standard Time); **Results**: 7073*

Source: Authors' own research.

The Web of Science query result was introduced into VOSviewer version 1.6.20. VOSviewer (Visualization of Similarities) is a software tool commonly used for bibliometric analysis. VOSviewer allows us to create maps that visually represent the scientific landscape based on various metrics such as co-authorship, co-citation, or co-occurrence of terms. The instrument applies methods such as clustering and density visualization to categorize linked objects. Bibliometric analysis through VOSviewer offers a valuable understanding of the structure and trends in academic research, as well as determining the progression of the circular business model concept in science and where the research focus has been. An overview of authors, relevant journals, areas of research, and research directions will be addressed in the Results section below.

Step 3 involved a screening process based on publication year to narrow down the research to the past five years. Important articles were kept in the analysis based on their quantity of citations within the field. As a result, our pool of articles was reduced to 5,502; these were then further screened using criteria such as title, research area, abstract, and number of citations to determine which ones would be the focus of a thorough analysis. After abstracts screening for research areas linked to the sustainable economy, the final list of articles was drastically reduced to 46 articles. The most relevant concepts resulting from full-text screening and in-depth analysis were synthesized at Step 4. In the process of this synthesis, our research not only adds value to the existing knowledge base; it also attempts to provide an overview of the models of the circular economy that are researched the most. The achieved result can create a certain base for further development of research in this area.

Results and discussions

The findings of this research are consistent with those of Kirchherr et al. (2023) who point out that the absence of attention to business models in the CE literature, discussed originally by Lieder et

al. (2017), appears to have gradually been overcome. Indeed, research on circular business models has emerged as one of the most animated sub-fields of current CE research (Kirchherr et al., 2023) and solidifies the exponential growth that the circular economy model concept has gained in the research world over the past 5 years since their 2017 paper.

Bibliometric analysis

The results of the bibliometric analysis performed in this research paper reveal a highly sloped curve of publication activity regarding circular economy models and methodologies from 2017 to 2023. The trajectory of scholarly outputs is a crucial aspect of comprehending a field from an evolutionary and impactful perspective. As shown in Figure 2 below, the published works' curve is consistently intensive and increasing in size throughout the indicated period.

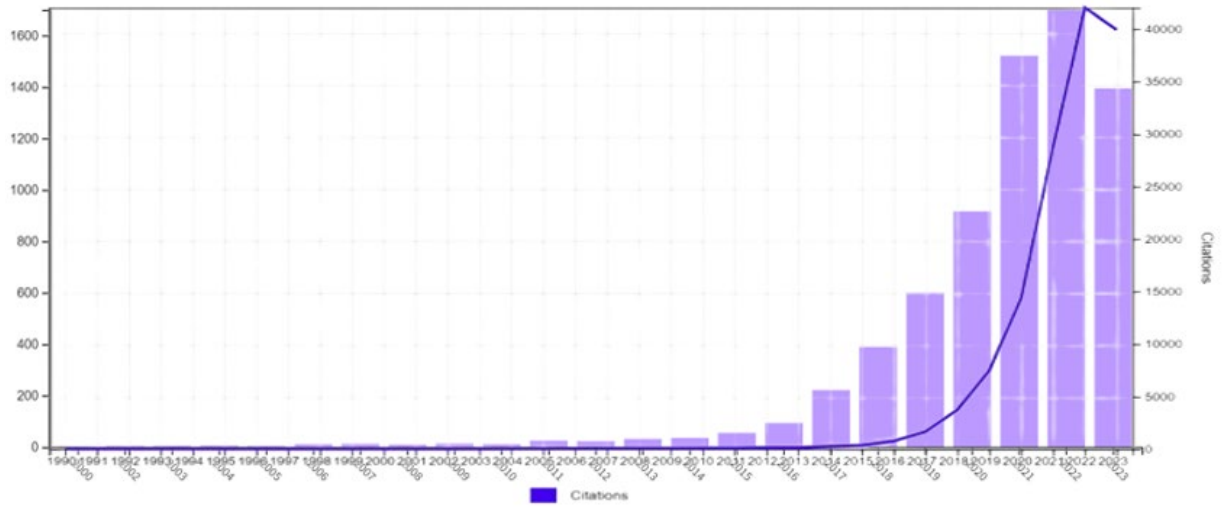


Figure 2. Number of publications and citations in the Web of Science database between 2000-01-01 and 2023-11-29 under the topic of circular economy model

Source: www-webofscience-com.z.e-nformation.ro/wos/woscc/analyze-results and www-webofscience-com.z.e-nformation.ro/wos/woscc/citation-report

Starting 2017, the number of publications entered an exponential growth period, indicating robust and accelerating interest in circular economic model. From 2017 to 2023 the average annual growth rate of 54% confirms a rapid-generation of research contributions on this topic. Key inflection points in this growth trajectory are notable, with remarkable slope increases observed in 2017 (138% growth per annum), 2018 (76% growth per annum), and 2021 (66% growth per annum). The zenith of this growth is particularly evident in 2022, marked by a substantial peak of 1699 articles published under the topic of circular economic models.

Alongside the rise in publications, the analysis shows an impressive rise in citations, proving the impact and influence that the research in circular economy models is experiencing. Since 2019, there has been a remarkable 500% increase in the number of citations, catapulting from an average of 8,000 citations to an impressive 40,000 citations in 2022 and 34,000 citations in 2023. This exponential growth citations it is a vivid indicator of the increased recognition and use of research outputs in the broader academic community. Among the most frequently cited articles, two standout contributions are Geissdoerfer et al. (2017) and Kirchherr et al. (2017). Geissdoerfer et al. (2017) delve into the exploration of the rise of the circular economy as a new sustainability paradigm. This article is probably one of the foundational pieces available in terms of contributing

to the growing scholarly interest to circular economic models. In their conceptual research on the circular economy, Kirchherr et al. (2017) use 114 definitions to comprehend this field in a broader sense. As evidenced by their high citation counts, these two articles somehow open the path toward understanding the models of the circular economy.

To conclude, the bibliometric analysis does not only reflect the incredible growth in publications related to the models of the circular economy but also the increased usage of this research among other researchers, as measured in the growing number of citations. This emphasizes a very dynamic and rapidly evolving field from the scholarly perspective, where the circular economy models can play a crucial role in mitigating some of the sustainability challenges.

Figure 3 below highlights the number of publications per academic journal in the top 25 most relevant journals. The Journal of Sustainability from MDPI and the Journal of Cleaner Production from Elsevier are the two main leading publications well known for their internationality, peer-reviewed process and high impact factor.

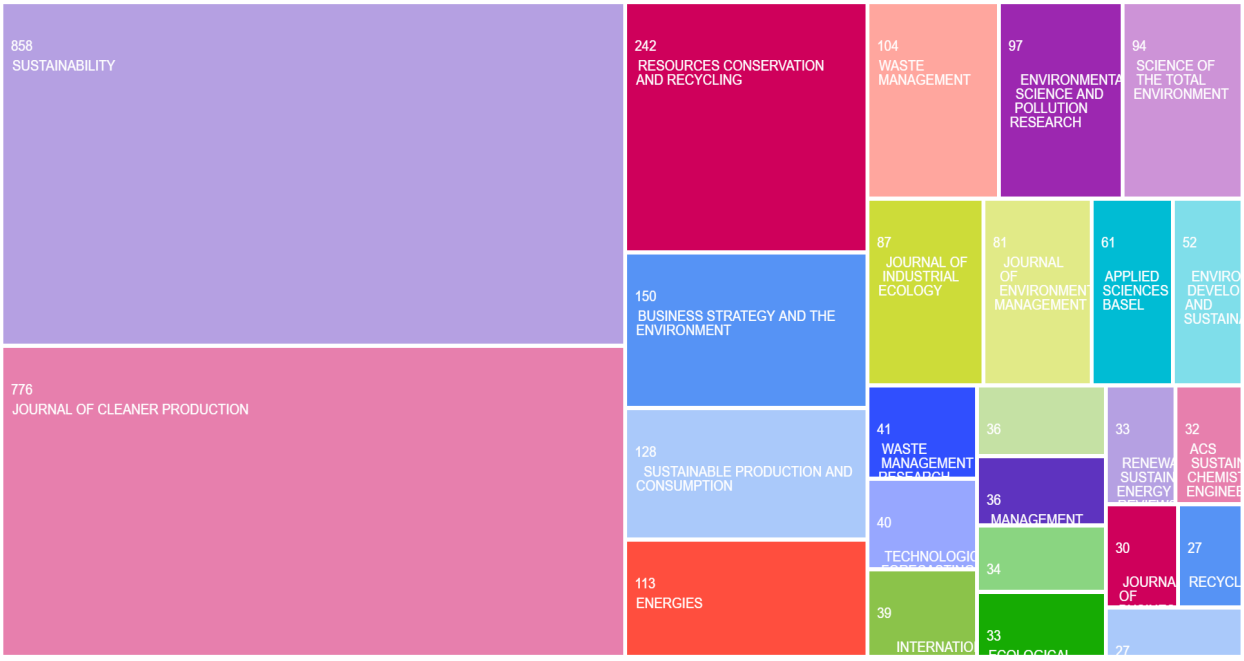


Figure 3. Top 25 Publications in the Web of Science database between 2000-01-01 and 2023-11-29 under the topic of circular economy model

Source: www-webofscience-com.z.e-nformation.ro/wos/woscc/analyze-results.

The analysis of top research areas where circular economy models have been applied reveals a multifaceted and interdisciplinary landscape. Nearly 60 % of the research conducted in Sustainability Science points at the vital role of the circular economy in mitigating environmental, economic, and social sustainability effects. Management, Supply Chain & Logistics, and Bioengineering are the three dominant fields that highlight the multidimensional facet of circular economy research that intersects with the business, logistics, and engineering disciplines. Not surprisingly, interdisciplinary studies are also seen as integral parts of circular economy research. Forestry, Electrochemistry, Polymer Science and Agricultural Policy are the prime representatives of how circular economy ideas can permeate across different fields. This diversity indicates that the circular economy concept is neither restricted to a certain sector but rather infiltrating through

other areas. Therefore, the circular economy concept proves to be a flexible and applicable concept over different industries.

The fragmented number of studies on circular economy, shown in Figure 4, conveys a disconnected but interrelated framework. This follows the pattern of circular economy principles and their intention of coordinating with different contexts. With the rise of the circular economy concept, scientists start to examine its potential across various disciplines. The interdisciplinary and cooperative approach becomes a norm in proceedings towards sustainable development. These results emphasize the need for comprehensive, multi-disciplinary approaches that are able to bridge across traditional disciplinary boundaries to ensure a smooth implementation and full realization of the circular economy advantages across sectors.

Figure 4. Top 25 research areas in the Web of Science database between 2000-01-01 and 2023-12-01 under the topic of circular economy model

Source: www-webofscience-com.z.e-nformation.ro/wos/woscc/analyze-results.

Utilizing the VOSviewer Key Words Analysis, the keyword co-occurrence was thoroughly broken down, giving useful context about the use and targeted areas of circular business models in scientific discovery. Figure 5 demonstrates the six separate clusters that were highlighted by the breakdown, each characterized by context for a specific area or term within circular economy.

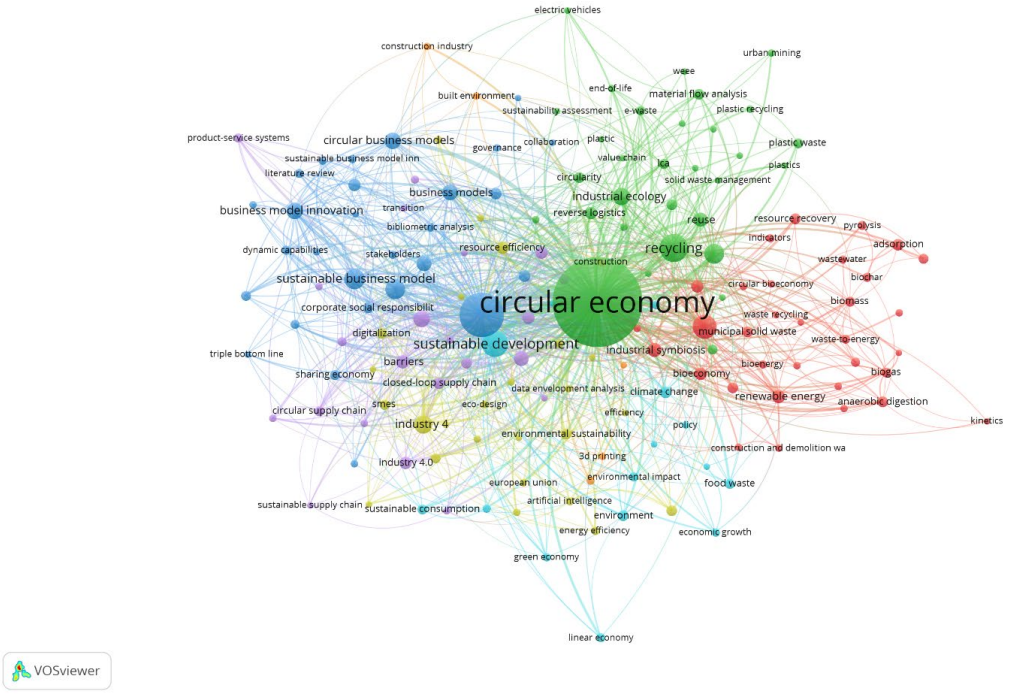


Figure 5. Key words co-occurrence clustering in Circular Economy Models research

Source: Authors' own research.

The circular economy clusters focus on its environmental impact, sustainability science, sustainable development, innovation, niche sciences, circular supply chains, closed-loop systems, climate change, environmental impact, policies, and the intersection of circular business models with the Information Technology sector. The green cluster emphasizes sustainability science, recycling, industrial ecology, and waste management, while the dark blue cluster emphasizes sustainable development, innovation, and corporate social responsibility. The red cluster links the circular economy to niche sciences, industrial symbiosis, bioeconomy, and renewable energy. The purple cluster emphasizes circular supply chains and closed-loop systems, while the light blue cluster explores climate change, environmental impact, and policies. The yellow cluster links circular business models with IT advancements, focusing on resource efficiencies, industry 4.0, and digitalization.

Figure 6 below presents a conceptual framework for the clusters identified in the VOSviewer key Words Analysis of circular economy models' research. It is possible to formulate six separate clusters with the specific theme concentration of circular economy models.

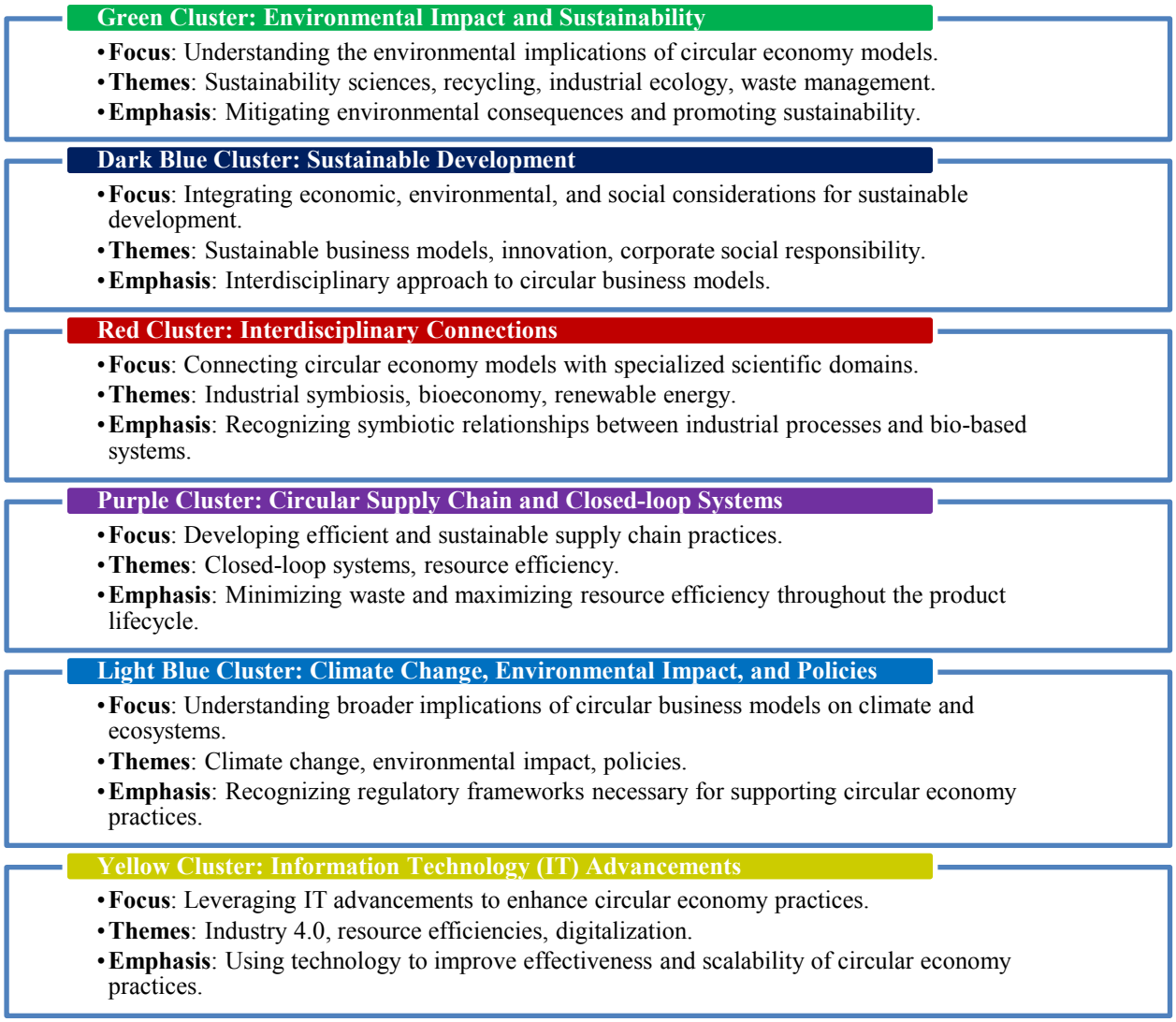


Figure 6. Conceptual framework for the research area clusters identified using VOSviewer

Source: Authors' own research.

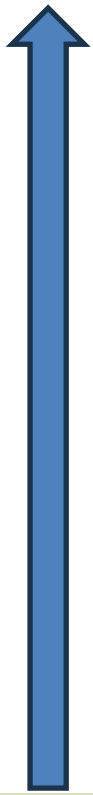
Summing up, the VOSviewer analysis has illustrated the multi-dimensional character of circular business model research through the variety of themes and cross-disciplinary collaboration. These clusters collectively contribute to offer significant potential for the growth of the topic, considering the detailed and systemic nature of sustainable development.

To summarize, the conceptual framework displayed in Figure 6 above reveals the wide diversity and fragmented nature of research into circular economy models across a number of other interdisciplinary niche sub-fields, while proving that sustainable development research has grown in the past 5 years as a result of a coordinated, interdisciplinary work. Based on these recent patterns, therefore, we systematically reviewed all included 46 papers under the research area associated with the sustainable economy in an effort to overview the recent development of circular economy models.

Systematic Literature Review

Table 3 summarizes the current trend in business models and the findings of our investigation. The table leverages the conceptualization made by Potting, et al. (2017), Achterberg et al. (2016), and Kurilova-Palisaitiene et al. (2023), who used R-strategies in developing a conceptual framework about circular economy transitions.

Table 3. Recent trends in circular business models

Circular economy model	Strategies	Strategy Description	**Business Models recent trends**
	R0. Refuse	Discontinue product use or provide same use with another product	Bio-Based Compostable Packaging Biodegradable and Edible Packaging
			Zero-Waste Grocery Stores
	R1. Rethink	Intensify product use (sharing products, multifunctional products)	Sharing Economy Platforms
			Product Leasing in the Agriculture Sector
	R2. Reduce	Increase efficiency by using fewer natural resources	Closed-Loop Water Systems in Manufacturing
			Eco-Industrial Parks
	R3. Re-use	Re-use by another consumer, original function	Product-as-a-Service (PaaS)
			Circular Retail Platforms for Second-hand Goods
	R4. Repair	Repair and maintenance for original function	Modular Design Upgradable Products
	R5. Refurbish	Updating an old product	Circular IT Asset Management
	R6. Remanufacture	Use old parts for a new product with same function	Circular Textile-to-Fiber Technologies
	R7. Repurpose	Use old parts for a new product with different function	Food Waste Repurpose Platforms
	R8. Recycle	Processing used products to obtain similar or lower quality products	Reverse Logistics Take-Back Programs
			Waste Sorting Technologies
Linear economy model	R9. Recover	Incinerate materials and obtain energy	Waste-to-Value Biorefineries
			Waste Heat Recovery in Industry

Source: Authors' own research.

Recent research reveals the emergence of circular business models in different sectors and industries and demonstrates the growing popularity and adoption of product-as-a-service and remanufacturing by companies, in particular. The above business models are best characterized by longevity and repairability, as well as retrieval of the product's materials after the end of life. Moreover, research and development efforts result in many innovative practices to push their development forward, such as bio-based materials, renewable energy implementation, and the use of digital solutions. At the same time, achieving the full adoption and implementation of circular principles shows several challenges. This process includes overcoming economical and institutional barriers, untangling the complexity of several global and local supply chains, and creating consumer demand for sustainable and circular alternatives.

Conclusion

Through this paper, it was reviewed how the classical linear economy business models, which are inflexible, obsolete, and energy-consuming, have shifted towards circular economy models, which are adaptable, upgraded, and energy-saving. Economic, environmental, and social sustainability have become the key features of transition business models to circular economy approaches and demonstrate a profound paradigm shift toward the common targets of sustainable development and resilience. Key concepts such as closed-loop systems, performance economics, biomimicry, and green economics were explored as part of the historical evolution.

This study makes use of combined methods of bibliometric analysis and systematic literature review to define the major research themes in the period 2000 to 2023. The findings present an average annual growth rate of 54% between 2017 and 2023 for the number of published papers focusing on inter- and cross- disciplinary research areas, while the number of the citations rose by about 500% from 2019. This exponential growth of citations points directly to the vital position of circular markets in maintaining the world's health economic, environmental, and social factors.

The conclusion of our research proved to be in line with that of Kirchherr et al (2023) that the shortage of business models studies previously highlighted by Lieder et al. (2017) has been gradually addressed in recent literature.

Own author conceptual framework is put forward after a total of six dominant thematic categories are revealed through word co-occurrence analysis by VOSviewer. By leveraging the conceptualization made by Potting, et al. (2017), Achterberg et al. (2016), and Kurilova-Palisaitiene et al. (2023), this paper provides insight into most researched business models of the past five years, and builds up existing knowledge base by synthesizing the identified business models under their corresponding R-strategies.

The bibliometric research and abstract screening stages implemented in this study have inherent limitations. A greater focus on qualitative research is necessary to highlight the potential immanent opportunities and factors that shape the future circular models.

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