CIRCULAR ECONOMY IN ENTREPRENEURIAL BUSINESS MODELS: A SYSTEMATIC LITERATURE REVIEW

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Objetivo do estudo
A Economia Circular (CE) assenta num sistema de produção regenerativo que minimiza a entrada de matérias-primas e o desperdício de recursos naturais, e visa a sustentabilidade empresarial.

Relevância/originalidade
O objetivo deste estudo foi identificar quais são os temas emergentes sobre EC em modelos de negócios empreendedores para avançar nas pesquisas acadêmicas sobre o tema.

Metodologia/abordagem
Uma revisão sistemática da literatura selecionou 84 artigos do Web of Science e Scopus usando o Start, categorizando-os em sete categorias: Simbiose Industrial, Cadeia de Suprimentos, Ciclo de Vida do Produto, Modelos Circulares de Negócios, Plataforma de Compartilhamento, Produtor-Consumidor e Sistemas Produto-Serviço.

Principais resultados
A classificação desses modelos de negócios pode resultar em oportunidades de mudança de energia, criação de valor, extensão do ciclo de vida do produto, reaproveitamento de matérias-primas, estudo de indicadores e métricas, design de produtos, gerenciamento de resíduos gerando oportunidades para empreendedores.

Contribuições teóricas/metodológicas
Os estudos analisados indicam que a adoção de práticas de EC está sendo aplicada em diversos modelos de negócios, gerando oportunidades para a sociedade, instituições, organizações e empreendedores em geral.

Contribuições sociais/para a gestão
Os resultados sugerem que, para que as empresas empreendedoras tenham sucesso, seus gerentes precisam aprender a lidar com os desafios de gerenciar as barreiras e facilitadores de suas atividades.

Palavras-chave: Economia circular, Empreendedorismo, Empreendedorismo Sustentável, Modelos de negócios circulares, Sustentabilidade

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Study purpose
The Circular Economy (CE) is based on a regenerative production system that minimizes the input of raw materials and the waste of natural resources, and it aims at business sustainability.

Relevance / originality
The objective of this study was to identify what are the emerging themes about CE in entrepreneurial business models to advance academic research on the topic.

Methodology / approach
A systematic literature review selected 84 articles from Web of Science and Scopus using Start, categorizing them into seven categories: Industrial Symbiosis, Supply Chain, Product Lifecycle, Circular Business Models, Sharing Platform, Producer-Consumer, and Product-Service Systems.

Main results
The classification of these business models can result in opportunities in energy change, value creation, product life cycle extension, reuse of raw materials, study of indicators and metrics, product design, waste management generating opportunities for entrepreneurs.

Theoretical / methodological contributions
The analyzed studies indicate that the adoption of CE practices is being applied in several business models, generating opportunities for society, institutions, organizations and entrepreneurs in general.

Social / management contributions
The findings suggest that in order for entrepreneurial businesses to succeed, their managers need to learn how to deal with the challenges of managing the barriers and enablers to their activities.

Keywords: Circular economy, Entrepreneurship, Sustainable Entrepreneurship, Circular Business Models, Sustainability

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1 Introduction

The Circular Economy (CE) is a new sustainable development strategy focused on protecting the environment and mitigating pollution (Molina-Moreno et al., 2017), and proposes to dissociate economic growth from the exploitation and depletion of natural resources. This decoupling can be achieved when, in the production and consumption cycles, there is no or minimal waste generated. For this objective to be achieved in the production and consumption cycles, products and energy must be reused and/or recycled (Kuzma et al., 2020).

CE is the opposite of the conventional production model, also called a linear system, this *take-make-use-dispose* system uses fossil fuel dependent energy and has as its objectives the creation of products and materials aimed at profit (Bocken et al., 2016). According to the authors, the CE production system model allows the reuse of products and materials continuously. More efficient products and materials are important for today's consumer societies, as they generate less greenhouse gas (GHG) emissions into the environment, less waste in landfills and prematurely discarded products (Bocken et al., 2016).

The linear production system is becoming unviable, as it causes the depletion of natural resources and the deterioration of ecosystems (Fischer & Pascucci, 2017). Contrary to the current linear system of production, CE precisely proposes the use of resources extracted from nature. These resources must be kept circulating in production processes in a cyclical flow (Sehnem et al., 2021).

Companies need to modify their business models towards CE principles as a competitive strategy to improve their organizational processes (Almeida-Guzmán & Díaz-Guevara, 2020) towards sustainability. In this sense, sustainable entrepreneurship is identified as one of the ways to promote changes in organizations towards the adoption of sustainable values and practices (Spence et al., 2011; Schaefer et al., 2015), because by adding economic, social and environmental value in the final objective of the projects (De Medici et al., 2018), these have great potential to incorporate and integrate sustainability goals (Rok & Kulik, 2020).

According to Brendzel-Skowera (2021), CE advocates the reuse of raw materials and products and the non-generation of waste to the environment. The adoption of these CE business models should be studied to verify whether these practices are being adopted and how companies are dealing with their implementation. Despite the constant evolution of knowledge in studies and research on CE in entrepreneurial business models, understanding how this transition process occurs allows finding research gaps to be explored (Brendzel-Skowera, 2021).

Studies in all areas of scientific research advance quickly and require understanding and knowledge of practices and organizational efficiency on the subject. More studies and research are needed to analyze CE practices and definitions in entrepreneurial business models (Brendzel-Skowera, 2021), therefore, they need planning for their execution and scientific rigor to enable the replication of research (Kraus et al. , 2020).

The methodological and procedural follow-up of the research must be frequent so that the studies advance with the same characteristics with which the understanding of the subject evolves. Thus, the research question proposed in this study is: “Considering recent research carried out on CE in entrepreneurial business models, what are the emerging themes observed for the advancement of academic research?”. Therefore, the objective of this study is to map how academic research on the Circular Economy (CE) has been related to entrepreneurial

business models. In this way, this study explores the research question through a Systematic Literature Review (SLR), identifying the production of knowledge in CE in entrepreneurial business models addressed in recent academic literature. This study is structured as follows: the introduction described above, the second section addresses the theoretical framework on the subject; the third section presents the methodological procedures employed; the fourth section presents and discusses the results, and the fifth section presents the final considerations of the research.

2 Theoretical Reference

2.1 The Circular Economy

CE is a business model for a more sustainable development, as it promotes the use of resources in a more appropriate way in the systems of production, distribution and recovery of products (Ghisellini et al., 2016). The CE was presented by the environmental economists Pearce and Turner (1989), when they compared in their theoretical structure the change from the linear economic system to the circular system and proposed that this system obeys the laws of thermodynamics of transformation of matter and energy (Ghisellini et al. ., 2016). The use of these ideas of sustainable development according to Ghisellini et al. (2016), is being put into practice in China as a national government policy and adopted to transform industry and society at all levels.

CE is identified by the principle of the 3Rs, that is, Reduce, Reuse and Recycle (Ghisellini et al., 2016). The principle of Recycling means "the recovery of waste, materials or substances from their original use for other purposes". Waste recycling allows the use of resources and the reduction of the amount of waste that needs to be treated and/or discarded, reducing the environmental impact (Ghisellini et al., 2016; Kirchherr et al., 2017). The principle of Reduction aims to "minimize the input of primary energy, raw materials and waste through productive efficiency and consumption processes" and Reuse refers to "the use of products or components that are not waste, to be reused for the same purpose for which they were conceived" (Ghisellini et al., 2016, p. 15).

CE evolved to incorporate the principles of reduction and reuse in addition to the principles of recycling, being defined by the *Ellen MacArthur Foundation* (EMF), as "an economy that provides for the restoration and eradication of waste in the productive system" (Geissdoerfer et al ., 2017; MacArthur, 2021c). The EMF is important in the works for the dissemination and popularization of CE with companies (Bocken et al., 2016). It has published several reports on the subject and works in collaboration with academia, public policy makers and companies (MacArthur, 2021a, 2021b, 2021c).

CE is an economical system that allows the minimization of resources and energy in the production circuits. These conditions are achieved through good design, repair, reuse, remanufacturing, reconditioning, maintenance and long-term recycling in production systems (Geissdoerfer et al., 2017; Kirchherr et al., 2017) and can help reduce pressures from global sustainability (Bocken et al., 2016).

CE is based on the General Systems Theory (GST) by Bertalanffy (1977), as it explains the relationship between organizations and their environments; in Industrial Ecology (Preston, 2012), as it proposes to keep separate the source "industrial system" and the receiver of impacts, "the environment". Other more recent theories, such as Regenerative Design, Performance Economics, Cradle-to-Cradle, Biomimetics and Blue Economy, are cited by EMF as important for the development of CE (MacArthur, 2021a, 2021b, 2021c).

For Bocken et al. (2016), industrial metabolisms or the concept of physical processes of transformation of raw materials and energy into finished products and waste are important, as they refer to the concept of "cycles". Most of the traditional productive systems are linear and are based on the concept of "Cradle-to-Grave". CE's production system proposes to be

structured to be "Cradle-to-Cradle". Transforming production systems allows achieving sustainable and economic development for the benefit of current and future generations (Kirchherr et al., 2017).

CE can be applied at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation) (Kirchherr et al., 2017). The way businesses are structured defines their level of performance in the market, as well as the choice of business models of companies that adopt CE, defines their structure. So, they can choose to slow resource loops and encourage long life and reuse of a product through business model innovation. Or companies may choose to structure their business around closing loops, when materials are reused in manufacturing processes within a production facility (Bocken et al., 2016).

2.2 Entrepreneurship

The academic study on entrepreneurship from the beginning of the 20th century by the economist Schumpeter (1942) highlighted that the entrepreneur is important for economic development, as he is able to introduce new contributions to the market. Schumpeter (1942) argued that the entrepreneur is the engine of economic growth, as he is capable of innovating and creating new products and services. In doing so, the entrepreneur can create new employment and work opportunities, while increasing the productivity and competitiveness of the economy (Ferreira et al., 2019).

Since then, the meaning of entrepreneurship has evolved from analyzing small companies to studying entrepreneurial behavior, intrapreneurship, entrepreneurial business models, as it contributes to the generation of new jobs, income generation and the implementation of new technologies. In addition, entrepreneurship contributes to the diversification of the economy, as it helps to develop new market niches, increasing competitiveness and allowing small companies to find new markets. It also contributes to innovation, as it encourages companies to be creative and seek innovative ways to relate to the market (Ferreira et al., 2019).

New routines in production processes, entrepreneurial behavior, intrapreneurship and new technologies that can be used to change or improve production processes are some of the constructs studied in entrepreneurship. That is, entrepreneurship is an emerging field of study with many possibilities for study, with important new concepts for the improvement of society and the economy (Kraus et al., 2019). Entrepreneurship can also be understood as the process of creating and managing a new business (Kraus et al., 2018a).

Shane and Venkataraman (2000, p. 218) defined entrepreneurship as "the process in which opportunities to create future goods and services are discovered, evaluated and explored". According to the authors, this definition does not limit the entrepreneur to be described specifically as a founder of new companies, he can be an entrepreneur who seeks and identifies opportunities for the creation and development of new services, processes or products. Entrepreneurship, according to Shane et al. (2003) , can be considered a creative process, in which the entrepreneur reorganizes resources and engages in creative activities.

The understanding of entrepreneurship research has grown significantly in recent years. Some of these studies include social entrepreneurship (Kraus et al., 2019); family entrepreneurship (Kraus et al., 2018a); innovative entrepreneurship (Kraus et al., 2018b); digital entrepreneurship (Kraus et al., 2018c); responsible or sustainable entrepreneurship (Gasbarro et al., 2017; Vallaster et al., 2018); entrepreneurial behavior (Kraus et al., 2016) and entrepreneurship and ethics (Vallaster et al., 2019).

Entrepreneurs create, deliver and capture value by promoting the profitability and productivity of organizations, but sustainable entrepreneurs bring more competitive advantage to organizations (Šebestová & Sroka, 2020), because by adding economic, social and

environmental value, the Triple Bottom Line, in the final objective of sustainable developments (De Medici et al., 2018), these have great potential to incorporate and integrate sustainability goals (Rok & Kulik, 2020).

In this way, sustainable entrepreneurs contribute to reducing business activity through solutions that minimize economic pressures on society and sustainability on the environment (Franco & Rodrigues, 2020), as they adopt routines in their ventures, production processes related to stepping up, narrowing and slowing down resources (Geissdoerfer et al., 2017).

In recent years, entrepreneurship has been studied by researchers under different aspects and a Systematic Literature Review (SLR) allows checking the progress in studies, from its origins to the present day. The growth in the number of research related to entrepreneurship is an indication that this topic has become increasingly relevant for the academic community.

3 Methodological procedures

The Systematic Literature Review (SLR) is a systematized method of steps and processes that allows the mapping and evaluation of existing knowledge, enables the researcher to identify a research question, topic area or phenomenon of interest and contributes to the advancement of the area. under study (Tranfield et al., 2003). SLR has been widely used in studies on CE and Entrepreneurship (Merli et al., 2018). RSL synthesizes existing studies, is carried out according to a predefined search strategy and adopts quality criteria for each primary study (Kitchenham & Charters, 2007). The pre-defined protocol adopted in this SLR is based on the guidelines of Kitchenham and Charters (2007); Kraus et al. (2020) and Tranfield et al. (2003) to reduce the possibility of researcher bias.

3.1 Search strategy

The terms and keywords used were tested in the *Web of Science (WoS)* and *Scopus* databases. Returned documents were selected and analyzed to determine the final set of keywords and combinations. Only suitable keywords and combinations were used in the final search.

The following search string was used, with the terms “Circular Economy” and synonyms “Circular Economy Practices, Circularity, Life Cycle Extension, Non-linear Production, Circular Provision, Extended Product Lifecycle, Resource Recovery” and the term “Entrepreneurship” and synonyms “Entrepreneurs, Entrepreneurships, Entrepreneurial, Entrepreneurially and Entrepreneurialism” as follows: ("Circular Economy" or "Circular Economy Practices" or "Circularity" or "Life Cycle Extension" or "Non-linear Production" or "Circular Provision" or " Extended Product Lifecycle" or "Resource Recovery") and (Entrepreneur*). The search string used was adapted for each database, as shown in Figure 1.

Database	Strings
Web of Science (WoS)	(TS=(("Circular Economy" OR "Circular Economy Practices" OR "Circularity" OR "Life Cycle Extension" OR "Non-linear Production" OR "Circular Provision" OR "Extended Product Lifecycle" OR "Resource Recovery")) AND TS=((Entrepreneur*))) AND ((DT==("ARTICLE" OR "REVIEW")) NOT (PY==("2023")))
Scopus	TITLE-ABS-KEY(("Circular Economy" OR "Circular Economy Practices" OR "Circularity" OR "Life Cycle Extension" OR "Non-linear Production" OR "Circular Provision" OR "Extended Product Lifecycle" OR "Resource Recovery") AND (Entrepreneur*)) AND (EXCLUDE (PUBYEAR,2023)) AND (LIMIT-TO (DOCTYPE,"ar") OR LIMIT-TO (DOCTYPE,"re"))

Figure 1 Search expression used in databases
Source: Prepared by the authors (2023)

The next step was the selection of data sources for the research. The SLR was conducted using the search through online databases. Only peer-reviewed journal articles

were retrieved, verified through the scholarly process to create a more transparent process that can be replicated. The search used more than one database to cover most articles and focused on the *Scopus* and *Web of Science (WoS)* databases. These databases are considered important for having publications from Journals with a relevant impact factor and important for the areas of Applied Social Sciences (Kraus et al., 2020). The database search was carried out on April 1, 2023, and returned 767 articles. After applying some filters, this sample was reduced to 335 articles, as summarized in Figure 2.

String	Combinations	Web of Science	Scopus
("Circular Economy")	("Circular Economy" OR "Circular Economy Practices" OR "Circularity" OR "Life Cycle Extension" OR "Non-linear Production" OR "Circular Provision" OR "Extended Product Lifecycle" OR "Resource Recovery") AND (Entrepreneur*)	372	395
(Entrepreneur*)			
Total		767	

Figure 2 Total scientific articles mapped
Source: Prepared by the authors (2023)

A chronological restriction was applied in the selection of studies for the period up to 2022. The types of documents selected were Article and Review and there were no area restrictions. The research protocol was described in Figure 3.

Research Protocol	Description
Database	*Web of Science (WoS) e Scopus*
Type of publication	Article and Peer review
Language	English
Period	Publications up to 2022
Area	No area restriction
Topic	Title, abstract and Keywords.
Search terms	*("Circular Economy" OR "Circular Economy Practices" OR "Circularity" OR "Life Cycle Extension" OR "Non-linear Production" OR "Circular Provision" OR "Extended Product Lifecycle" OR "Resource Recovery") AND (Entrepreneur*)*

Figure 3 Research protocol
Source: Prepared by the authors (2023)

3.2 Selection of Studies

For better accuracy and handling of information, the study selection process was supported by the *State of the Art through Systematic Review (StArt)* tool, considered the SLR facilitator tool (Laboratory of Research on Software Engineering (LaPES), 2022). The steps performed in this process are described below:

a) The search in the *Web of Science (WoS)* and *Scopus* databases resulted in a total of 767 articles according to the protocol described above, these articles were loaded into the *StArt* software for reading and selection.

b) The *StArt* software identified 432 duplicate articles that were not considered for content analysis.

c) The inclusion criteria of the articles were: (I) Good relationship with the search string, (I) Circular Economy Practices, (I) Entrepreneurial business models, (I) Circular Economy Principles, (I) Fully published on scientific bases.

d) The exclusion criteria of the articles were: (E) Low relationship with the search string, (E) Does not use Circular Economy practices, (E) Not related to entrepreneurial business models, (E) Article without Abstract, (E) Different from the English Language.

e) In a preliminary analysis of the title, Abstract and keywords, 84 articles met the inclusion criteria, therefore, they were incorporated into the sample. All articles had the article accessible for in-depth analysis with the help of the *Atlas.ti* software.

f) The articles were analyzed in full and classified by two researchers in relation to each of the pre-established criteria in the protocol.

Following the recommendations of Tranfield et al. (2003), for each of these 84 selected articles, a summary and an entry in an *Excel* table were developed, with the objective of identifying the evolution of publications, the methodologies used in research, a thematic analysis of the articles and suggestions for research. future, in addition to checking whether the classification made by the *StArt* software was efficient. Figure 4 demonstrates the methodological procedures adopted in the SLR.

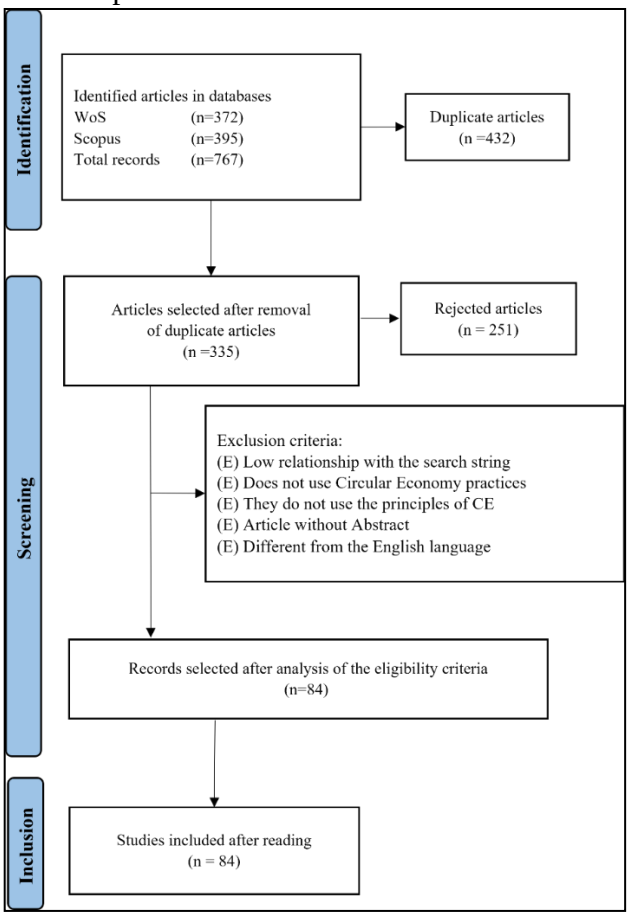

Figure 4 Study identification flowchart
Source: Prepared by the authors (2023)

The selected articles formed the object of this SLR and seek to identify, evaluate and interpret available research related to a research topic. After selecting the studies, the *Atlas.ti* software was used to integrate the searches and identify the pre-established categories according to the literature review in each of the articles analyzed (Woods et al., 2016). The codes described in Figure 5 were defined through observation of the articles.

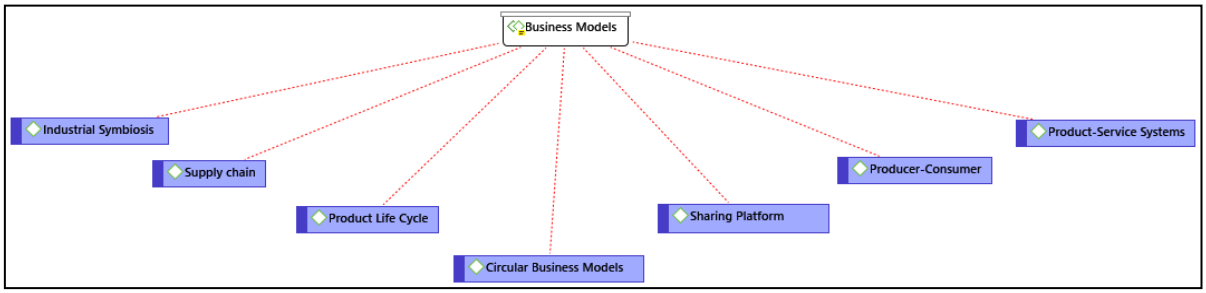

Figure 5 Codes used in *Atlas.ti*
Source: Prepared by the authors (2023)

Thus, with the help of *Atlas.ti*, it was possible to establish, in the articles analyzed, relationships with the categories established according to the codes defined in Figure 5 and, based on that, to perform the inductive analysis of the content of the studies (Woods et al., 2016). With this, it is expected to be able to contribute to the understanding of CE phenomena and entrepreneurial business models.

4 Results

The analysis of the articles covered the period from 2002 to 2022. Figure 6 illustrates the distribution of the 84 publications on CE and Entrepreneurship. Our search string shows that the subject was first discussed in 2002, when there were some publications. A total of 6 works were published during this period, representing 7% of the sample. From 2017 to 2020, there was a linear increase in the number of publications, which in numerical terms represented 57% of the sample (48 publications). However, from 2020, there is a stabilization and a decrease in the number of publications, in this period 30 works were published, representing 36% of the sample. This shows that this research topic has gained relevance, consolidated and has the potential to expand in the coming years to include more specific topics. This trend is reflected in the growing demand for research on the subject, which extended from its origin to reach broader areas.

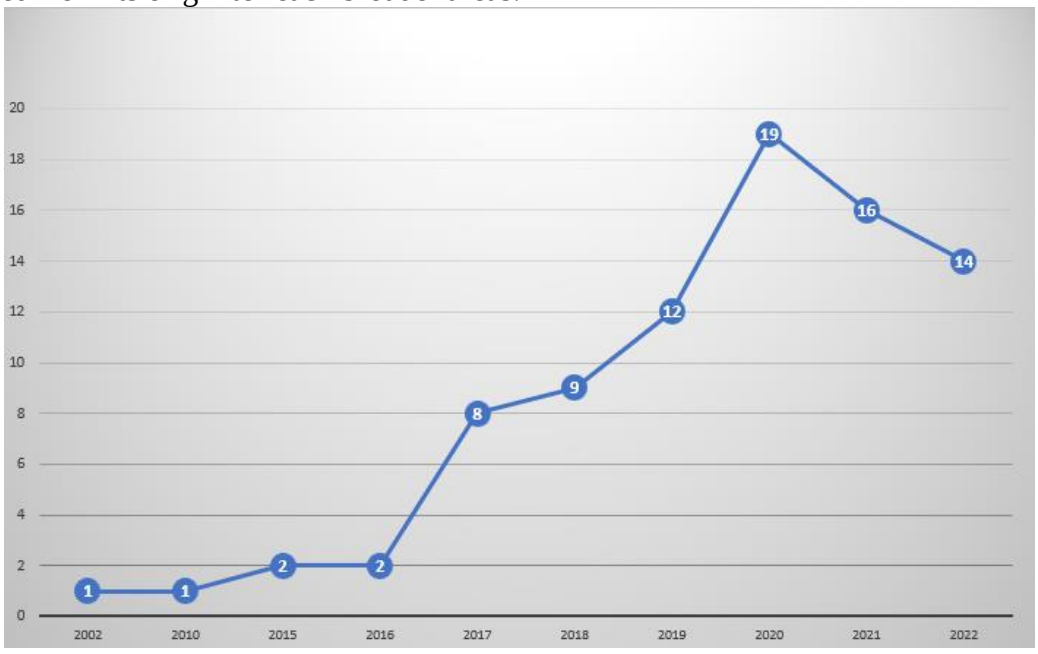

Figure 6 Evolution of publications on Circular Economy and Entrepreneurship
Source: Prepared by the authors (2023)

4.1 Methodological analysis of articles

In the analysis of the 84 articles, it was identified that 71 studies (84.5%) used empirical research methods, while the remaining 13 studies in the sample (15.5%) used theoretical approaches. According to Figure 7, of the 84 studies, 71 used qualitative methods (84.5%), 10 used quantitative methods (11.9%) and three used mixed methods (3.6%), respectively.

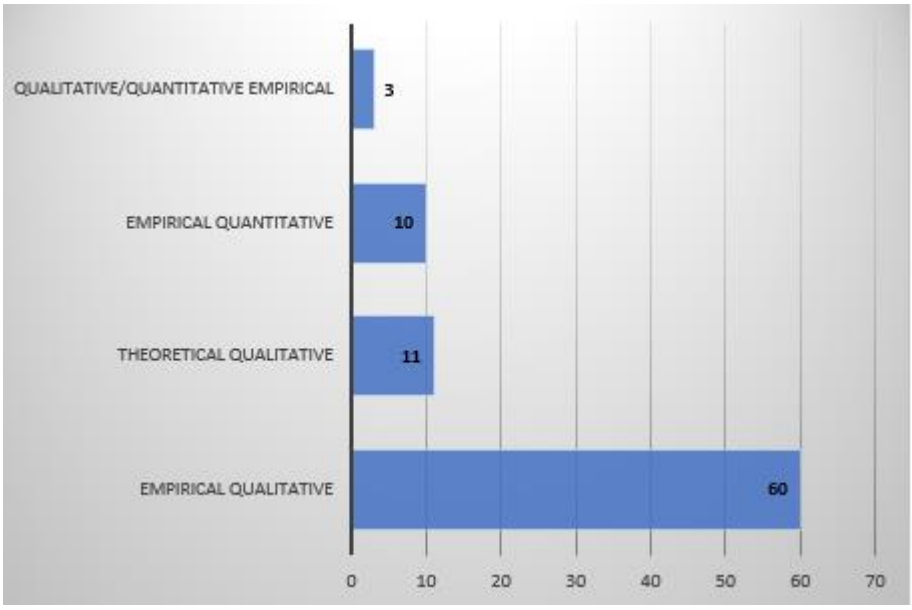

Figure 7 Methods applied in the articles analyzed
Source: Prepared by the authors (2023)

Empirical studies with a qualitative approach (n=60) predominantly used case study methods or multiple case studies, in companies that employ CE in entrepreneurial businesses. Interpretive interviews and documentary research were the main data collection techniques used by the authors in their studies and the content analysis of the collected data was achieved through inferential means. In quantitative studies (n=10), the predominant method was multivariate analysis using the statistical technique of correlation analysis and numerical analysis.

4.2 Thematic analyzes of articles

Carrying out the content analysis of the 84 selected articles, it was possible to characterize the CE phenomenon and Entrepreneurial Business Model as an emerging theme in seven different aspects. These categories are: Industrial Symbiosis, Supply Chain, Product Lifecycle, Circular Business Models, Sharing Platform, Producer-Consumer and Product-Service Systems, which are shown in Figure 8.

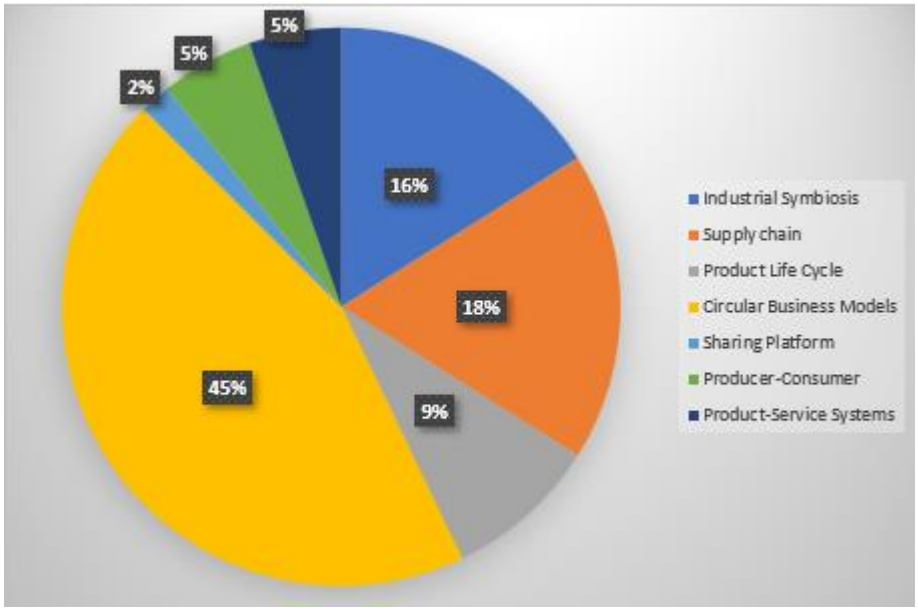

Figure 8 Categories of Circular Economy and Entrepreneurship
Source: Prepared by the authors (2023)

4.2.1 Industrial symbiosis

Industrial symbiosis aims at environmental, economic and social integration and the search for solutions through the exchange of raw materials, energy, water and industrial waste, to minimize or reduce costs in the production processes of industrial plants close to each other. Iacondini et al. (2015) stated that one possibility to reduce the amount of waste and reuse materials from industrial processes is by using Industrial Symbiosis. Zeng et al. (2021) discussed China's rapid industrialization and detailed the significant negative effects on the environment and public health as a result of the country's industrial parks. According to Iacondini et al. (2015) and Zeng et al. (2021) the need to connect various production lines allows private companies to start using industrial synergy, which has positive economic, environmental and social effects. The authors also claim that Industrial Symbiosis is the best starting point to promote innovative technologies for a path towards sustainable economic growth.

Sudusinghe and Seurin (2022) conducted an analysis of the collaborative practices needed to broadly understand the various forms of collaboration, improving sustainability performance in interactions between supply chain partners. For Rejeb et al. (2022) the use of IoT in CE leads to new connections and industrial relationships that act as a driving force for successful collaborations, resource conservation and mitigation of environmental impact. According to Gennari (2022) companies can make the transition from a linear approach to a circular approach more easily if they move from punctual relationships to networks, where all stakeholders in the network contribute and gain from these relationships.

Millette et al. (2020) suggest a framework for incubators to develop skills and resources for developing circular economy networks. Ferreira et al. (2022) evaluate collective strategies for competitive advantage in different sectors. Suchek et al. (2022) review opportunities and internal/external factors influencing circular business model adoption. And dos Santos et al. (2022) tracked CE's potential contribution to sustainability, measuring indicators that combine economic, social and environmental aspects into a single indicator.

4.2.2 Supply chain

It promotes the recycling of materials in industrial processes and seeks to ensure the added value of these materials by using them in raw materials and inputs. Linder et al. (2017) studied circular business models based on remanufacturing and reuse. According to the

authors, increasing the use of components and products already produced can increase net value creation in the value chain. Nunes et al. (2022) critically analyzed the benefits of sustainability in *startups* in the stages of value proposition, value creation and delivery, and value capture with *stakeholders*.

Despeisse et al. (2017) verified the emergence of advanced manufacturing technologies to identify opportunities to change the way manufacturing activities are organized. The authors exemplified how industrial 3D printing processes are enabling circular production systems, allowing the use of recycled and recovered materials as inputs in manufacturing processes. As for advanced technologies, Chaudhuri et al. (2022) and Rejeb et al. (2022) stated that the authenticity of the recycled material and the auditability of the end-to-end supply chain are guaranteed by recorded data from the material's provenance collected and recorded on the blockchain.

Sudusinghe and Seurin (2022) state that changes in the direction of the supply chain of a supply chain made by the businesses involved in a collaborative effort can have an impact on sustainability performance. The authors state that a factor in the adoption of CE practices is the use of external collaboration practices, including the sharing of responsibility for product recovery.

Suchek et al. (2022) confirmed that the influence of both environmental commitment and green economic incentives suggests supply chain management. Foroozanfar et al. (2022) stated that, for companies to develop and implement business models that optimize the benefits of a CE approach, they should focus on combining several strategies. How to derive value from production waste and byproducts, find platform-based solutions that improve an organization's supply chain visibility, and create new product designs and market prospects for companies.

4.2.3 Product life cycle

Despeisse et al. (2017) emphasize the importance of CE practices in the product lifecycle, including development, remanufacturing and repair, to extend the useful life of the product. Kahupi et al. (2021) and Rejeb et al. (2022) highlight customer support for sustainable innovations and the potential of IoT for recycling management. Nunes et al. (2022) highlight the role of innovative technologies in startups, improving product design, market growth and exclusive offers. Dantas et al. (2022) emphasize the need for innovation in consumer behavior patterns, manufacturing, distribution and product life cycle systems to accelerate the change to CE.

4.2.4 Circular Business Models

Circular business models are considered to represent a potential method for industry to profitably increase resource productivity. Some works conceptually contributed to the definition of business models from the perspective of resource productivity and innovation (Bansal et al., 2020; Chaudhuri et al., 2022; Konietzko et al., 2020; Linder et al., 2017; Rok & Kulik, 2021). The authors investigated how companies work through proposals, creation, distribution and capture of value. They examined how companies create propositions, how they develop products and services that provide value to their customers, and how they capture those values through revenue and profits.

Some business models, such as the textile industry and the electronics industry, rely heavily on natural resources and have an adverse effect on the environment as a result of their operation. However, there are opportunities for improvement, including the rational use of resources and the development of new business models. Todeschini et al. (2017) proposed a framework with trends and drivers for the fashion industry. Royal et al. (2020) explored the challenges faced by social entrepreneurs in designing local business models at the

technological, political, and social levels. Riisgaard et al. (2016) investigated the electronics repair sector.

Donner et al. (2020) typified the business models in agribusiness (Environmental Biorefinery, Biogas Plants, Agricultural Cooperatives, Agroparques), while Viaggi (2015) analyzed the environmental performance of the agricultural sector. Nosratabadi et al. (2020) carried out a comprehensive review of applications in the Fashion, Health, Energy, Construction, Hospitality and Food sectors and in the areas of Management and marketing, Entrepreneurship, Supply chain, etc. Palmie et al. (2021) analyzed the scenario of change in the electricity sector in regulatory, political and economic contexts.

Some research has focused on conducting thematic analyzes and research trends in the area of business models (Ferreira et al., 2022; Foroozanfar et al., 2022; Suchek et al., 2022). Staicu and Pop (2018) investigated stakeholders to understand the challenges in transitioning to CE. Using grounded theory, Kahupi et al. (2021) explored how to create a competitive advantage around sustainable products. Rejeb et al. (2022) investigated the role of modern technologies in facilitating the transition to CE employing IoT support. Al-Awlaqi & Aamer (2022) explore in a quantitative approach how entrepreneurial intentions determine the adoption of business models in CE.

Ceptureanu et al. (2018) proposed a conceptual framework to investigate the woodworking sector. Gennari (2022), Millette et al. (2020) and Nunes et al. (2022) analyzed startups and SMEs with a focus on CE using a conceptual framework. According to the perspective of care and gender in CE, Plá-Julian and Guevara (2019) looked at the opportunities and challenges faced by entrepreneurs.

4.2.5 Sharing platforms

Sharing platforms promote sustainable use of human and physical resources, offering economic opportunities, changing consumer behavior, resource reduction, economic growth, and social sustainability through academic definitions (Curtis et al., 2019).

4.2.6 Producer-consumer

Consumers play a crucial role in the development of goods and services, as highlighted by Despeisse et al. (2017) and Reckinger (2018). They contribute to the concepts of circularity by commenting on production methods, comparing prices and offering praise or criticism. Reckinger's (2018) research on local initiatives in Luxembourg, Belgium, emphasizes the need for collaborative efforts to create a resilient food system. Sudusinghe and Seuring (2022) argue that the shift from product ownership to service-based systems requires companies to focus on quality customer service, building trust and agility in responding to customer needs and expectations.

4.2.7 Product-service systems

The system enables the transformation of products into goods and services but lacks widespread adoption in industry. Linder et al. (2017) studied product-service systems, while Spring et al. (2017) explored servitization and IoT technologies offer opportunities for improved data collection, proactive maintenance, and product life control (Rejeb et al., 2022).

4.3 Suggestions for future research

Figure 9 presents some recommendations for future research based on the analysis of studies retrieved from the databases. The terms CE and Entrepreneurship were used as parameters for this study and a research agenda is presented based on the limitations that appeared in the analyzed articles.

Author-Data	Future research recommendations
Linder et al. (2017); Despeisse et al. (2017); Spring & Araujo (2017);	Investigate product design concepts in circular business models.

Bundgaard et al. (2017); Demirel & Danisman (2019)	
Todeschini et al. (2017); Real et al. (2020)	Check the challenges and opportunities for evolution in business models in the textile sector in circular startups.
Curtis & Lehner (2019); Desrochers (2002); Donner et al. (2020)	Investigate the typologies of circular business models.
Veleva & Bodkin (2018)	Examine Circular Economy practices in business models addressing consumer behavior, aiming to change them towards a sustainable economy.
Henry et al. (2020)	Understand the role of Circular startup in the transition to a Circular Economy by performing a comparative analysis of geographic areas, new business models and innovation of companies oriented towards Circular Economy. Define and assess the barriers and facilitators that affect business models for the Circular Economy.
Tremblay et al. (2010)	Investigate recycling plants, socio-environmental public policies suitable to facilitate partnerships between the various stakeholders.
Plá-Julian & Guevara (2019)	Research the participation of women in productive processes in circular business models.
Riisgaard et al. (2016)	Research practices and production processes to extend the life of products and reduce replacement rates for new products.
Angrisano et al. (2016); Dantas et al. (2022)	Investigate innovation in circular business models.
Iacondini et al. (2015); Sudusinghe & Seuring (2022)	Investigate Industrial Symbiosis in industrial production.
Narayan & Tidstrom (2020); Viaggi (2015); Chaudhuri et al. (2022); Ariztia & Araneda (2022)	Examine value creation in circular business models.
Del Vecchio et al. (2021)	Check the challenges and opportunities for evolution in the business models of digital entrepreneurship in circular startups.
Flygansvaer et al. (2019)	Investigate reverse logistics concepts for products in circular business models.
Murthy & Ramakrishna (2022)	Investigate the concepts of urban mining, that is, the search for precious metals and the recovery and proper treatment of products in circular business models.
Palmie et al. (2021)	Investigate circular business models with energy profiles for the improvement of industrial production.

Figure 9 Recommendations for future research
Source: Prepared by the authors (2023)

5 Final considerations

CE aims at sustainable economic development, minimizing problems in relation to environmental issues through the improvement of production processes. CE contributes to reducing the use of resources and the environmental pollution that industries emit, preventing environmental degradation.

In this sense there are numerous business opportunities that arise for entrepreneurs to explore. In the transition to new business models, entrepreneurship plays a significant role in promoting sustainability, as it brings new ideas, innovation and solutions to help improve the economy while preserving the environment. Furthermore, it opens the door to job creation and helps to create new markets.

This study identified the production of knowledge about CE in companies focused on entrepreneurship that has been recently addressed in the academic literature. The available academic literature retrieved on this topic was classified into seven categories. The categories are: Circular Business Models (25 articles); Supply chain (10 articles); Industrial Symbiosis (9 articles); Product life cycle (5 articles); Producer-consumer (3 articles); Service Systems (3

articles) and Sharing Platform (1 article). These categories can stimulate the development of entrepreneurial businesses with a focus on CE by pointing out possible options for business models that organizations can take into account when making efforts to be sustainable. These models comprise energy transformation, resource value maximization, product sharing platforms, product lifecycle duration, urban raw material mining, circular supply chain, indicators and metrics for sustainability, repair and remanufacture of products, product design, waste management and recovery, among others.

It is understood that in the studies analyzed, the adoption of CE practices is being applied in various business models, generating opportunities for society, institutions, organizations and entrepreneurs in general. There is an interest in academic research being conducted to advance the theory that the adoption of CE practices in entrepreneurial businesses provides.

Some limitations in this systematic literature review should be addressed in future research. First, the publication identification process was centered on two academic databases, *Web of Science* and *Scopus*, in order to recognize articles in this area of study. Because of this, articles not indexed in these data sources may have escaped this analysis. Furthermore, despite the extensive search query, the use of specific search terms and synonyms may have resulted in the omission of pertinent publications when searching for publications of interest in the thematic area.

For future research, it is suggested to examine the role of circular *startups* in the adoption of CE practices by comparing different geographic areas, carrying out qualitative studies with the objective of understanding the factors that facilitate and impede the creation of new sustainable CE-oriented businesses. Additionally, one can explore in empirical studies the integration between industries addressing the integration of logistics chains and production processes to reduce waste and waste reduction, addressing how production cycles can be reduced and industrial waste can be better reused and recycled.

This research contributes to the practice of CE with a focus on entrepreneurship, helping to understand this thematic area. This categorization can serve as a resource for entrepreneurs to identify initiatives that are being adopted for a more sustainable economy. The results of this categorization can be used as a guide when searching for data to help managers recognize the best opportunities. In this way, entrepreneurial businesses in the circular economy can generate new opportunities with economic, social and environmental benefits.

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